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Interest Rate Volatility and Asymmetric Interest Rate Pass-through in Selected SAARC Countries

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Interest Rate Volatility and Asymmetric Interest Rate Pass-through in Selected SAARC Countries

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The outbreak of the Global Financial Crisis in 2008 witnessed the success of monetary policy in stabilising the economy. Central banks have been actively using different monetary policy strategies to achieve and maintain desirable economic goals, such as low unemployment levels, stable general price levels etc. Central banks usually convey monetary policy decisions by firstly adjusting policy rates that subsequently passed-through to bank retail rates, in which the latter process is known as interest rate pass-through, before the monetary policy decisions are finally channelled to the economy through various monetary policy transmission channels. Previous literature has also discovered that interest rate volatility influences bank retail rate adjustment behaviour, while changes in the monetary stance also affect the bank retail rate volatility. Therefore, this study intends to examine the pass-through mechanism in four major SAARC countries, namely; Pakistan, India, Bangladesh and Sri Lanka. This study used the Threshold Autoregressive and Momentum Threshold Autoregressive models of Enders and Siklos (2001) and the Error Correction Exponential Generalised Autoregressive Conditional Heteroscedasticity in Mean (EC-EGARCH-M) model proposed by Wang and Lee (2009). Based on the empirical results, the first stage of the interest rate pass-through mechanism is complete in Pakistan, India and Sri Lanka only. While, the second stage of the interest rate pass-through mechanism is incomplete for both the deposit rate and lending rate models of all of the sample countries, except for the lending rate model of Sri Lanka. The money market rates and bank retail rates of all of the sample countries are found to have asymmetric long-run relationships, except for the lending rate of India. It has also been discovered that the asymmetric short-run adjustment between the money market rates and bank retail rates of Pakistan and Sri Lanka and between the money market rates and deposit rate of India supported the adverse customer reaction hypothesis,

while Bangladesh supported the collusive pricing behaviour hypothesis. In terms of the effect of interest rate volatility on the adjustment behaviour of bank retail rates, it is significantly positive for both bank retail rate models of Pakistan and the lending rate model of Bangladesh, while significantly negative for the deposit rate model of Bangladesh. Its effect is insignificant on both retail rate models of India and Sri Lanka. As for the presence of asymmetry in the conditional volatility of both bank retail models, the asymmetry effect is found for the lending rate model of all of the sample countries, while the leverage effect is found on the deposit rate model of Pakistan and Sri Lanka. Generally, this study has managed to achieve its objectives. Various relevant policy recommendations are proposed to the central banks of the sample countries to improve the performance of interest rate pass-through in their countries.

Keywords: Interest rate pass-through, asymmetric adjustments, asymmetric cointegration, bank retail rates, interest rate volatility, leverage effect

Ketidaktentuan Kadar Faedah dan Kesan Pindahan Asimetri Kadar Faedah di Negara-negara SAARC yang Terpilih

ABSTRAK

Krisis Kewangan pada tahun 2008 telah menyaksikan kejayaan dasar kewangan dalam penstabilan ekonomi. Bank-bank pusat telah menggunakan strategi dasar kewangan yang berbeza secara aktif dalam pencapaian dan pengekalan matlamat ekonomi yang diinginkan, contohnya seperti tahap pengangguran yang rendah, paras harga umum yang stabil dan lain-lain. Bank-bank pusat biasanya menyampaikan keputusan dasar kewangan dengan penyesuaian kadar-kadar faedah dasar terlebih dahulu dan kemudiannya dipindahkan kepada kadar-kadar runcit bank, yang mana proses tersebut dikenali sebagai kesan pindahan kadar faedah, sebelum keputusan dasar kewangan tersebut akhirnya disalurkan kepada ekonomi melalui saluran-saluran transmisi dasar kewangan. Hasil kajian terdahulu juga mendapati ketidaktentuan kadar faedah mempengaruhi gelagat penyelarasan kadar-kadar runcit bank, sementara perubahan pendirian kewangan juga mempengaruhi ketidaktentuan kadar-kadar runcit bank. Oleh itu, kajian ini bertujuan untuk mengkaji kesan pindahan kadar faedah di 4 negara SAARC yang utama iaitu Pakistan, India, Bangladesh dan Sri Lanka. Kajian ini menggunakan model-model autoregresif ambang (TAR) dan autoregresif momentum ambang (MTAR) oleh Enders dan Siklos (2001) dan Pembetulan Ralat Heteroskedastisiti Autoregresif Bersyarat Umum Bereksponansi dalam Min oleh Wang dan Lee (2009). Berdasarkan hasil kajian empirikal, mekanisme pindahan kadar faedah pada tahap pertama didapati lengkap untuk Pakistan, India dan Sri Lanka sahaja. Manakala, mekanisme pindahan kadar faedah pada tahap kedua didapati tidak lengkap untuk kedua-dua model, iaitu kadar deposit dan kadar pinjaman untuk semua negara sampel, kecuali model kadar pinjaman Sri Lanka. Kadar pasaran wang dan kadar-kadar

runcit bank untuk semua negara sampel didapati mempunyai hubungan jangka panjang yang asimetri, kecuali kadar pinjaman India. Ia juga telah didapati bahawa penyalarasan jangka pendek yang berasimetri antara kadar pasaran wang dan kadar-kadar runcit bank di Pakistan dan Sri Lanka dan antara kadar pasaran wang dan kadar deposit India menyokong hipotesis gelagat pengguna, manakala Bangladesh menyokong hipotesis gelagat kolusi. Dari segi kesan ketidaktentuan kadar faedah pada pelarasan kadar-kadar runcit bank, ia adalah positif bagi kedua-dua model kadar runcit bank Pakistan dan model kadar pinjaman Bangladesh, manakala negatif bagi model kadar deposit Bangladesh. Kesannya tidak signifikan pada kedua-dua model kadar runcit India dan Sri Lanka. Dari segi kewujudan kesan asimetri dalam ketidaktentuan bersyarat kedua-dua model runcit bank, kesan asimetri didapati wujud dalam model kadar pinjaman untuk semua negara sampel, manakala kesan leveraj pula didapati wujud pada model kadar deposit Pakistan dan Sri Lanka. Secara umumnya, kajian ini telah berjaya mencapai matlamatnya. Cadangan dasar-dasar yang relevan telah diutarakan kepada bank-bank pusat negara-negara tersebut bagi tujuan penambahbaikan mekanisme pindahan kadar faedah di negara mereka.

Kata kunci: *Pengalihan kadar faedah, penyesuaian asimetik, kointegrasi asimetri, kadar runcit bank, volatiliti kadar faedah, kesan leveraj*

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LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BB	Bangladesh Bank
CBSL	Central Bank of Sri Lanka
CRR	Cash reserve ratio
DR	Deposit rate
EC-EGARCH-M	Error correction exponential generalized autoregressive conditional heteroscedasticity in mean
ECM	Error correction model
EMU	European Monetary Union
EU	European Union
FRSP	Financial Sector Reform Program
GDP	Gross domestic product
IMF	International Monetary Fund
LAF	Liquidity adjustment facility
LR	Lending rate
MFI	Ministry of Finance of India
MFP	Ministry of Finance of Pakistan
MTAR	Momentum threshold autoregressive
NSS	National Savings Schemes
OMO	Open market operation
RBI	Reserve Bank of India
SAARC	South Asian Association for Regional Cooperation

SBP	State Bank of Pakistan
SLR	Statutory liquidity ratio
SSS	Small Savings Schemes
TAR	Threshold autoregressive
UK	United Kingdom
VAR	Vector autoregressive

CHAPTER 1

INTRODUCTION

1.1 Introduction

The success of monetary policy as an economic stabilising tool since the outbreak of the global financial crisis has led policymakers to realise its importance in maintaining the well-being of an economy. Since then, monetary policy has been widely accepted as a fundamental tool in macroeconomic management. Monetary policy plays a significant part in an economy in coping with cyclical downturns while spurring economic growth and enhancing price stability (Deger, 2012). Accordingly, central banks have been using monetary policies as viable tools in controlling output, investments, aggregate prices and unemployment levels (Karagiannis, Panagopoulos & Vlamis, 2010). As monetary policy plays a significant role in stabilising the economy, the recent downturns in economies worldwide have put it under a new spotlight (Matemilola, Noordin & Kamarudin, 2018).

Although monetary policy is well-recognised as a powerful tool in today's modern world, with an ever-increasing usage of interest rates as the key instruments of monetary policy, its conduct necessitates a detailed examination on the way in which it is conveyed to the economy in order to prevent any unwanted and unanticipated consequences (Rocha, 2012). The way in which monetary policy decisions are conveyed to the economy is known as the monetary policy transmission mechanism (hereafter "transmission mechanism"). A well-functioning transmission mechanism, represented by the smooth and fast conveyance of monetary policy decisions to the economy, is critical for the effective conduct of monetary policy (Fadiran & Edun, 2013). In fact, this subject has drawn many studies, and they have

mainly concentrated on examining the significance of the transmission mechanism, especially, after the global financial crisis (Yuksel & Ozcan, 2013).

Monetary policy can transmit policy effects into the economy through several, but interconnected, transmission channels, such as the interest rate, the exchange rate, the asset price, the credit and the expectation channels (Mishkin, 2000). Nevertheless, its performance is largely depending on the process whereby banks adjust their retail rates, i.e. deposit and lending rates, following the adjustments in the short-term interest rates (i.e. money market rates and the treasury bill rate) which are controlled by the central bank. This is identified as the interest rate pass-through (hereafter "pass-through"). As the pass-through is the first and foremost building block of the whole transmission mechanism, the ability of monetary policies to achieve their objectives critically hinges on the magnitude of the pass-through, whereby, adjustments in short-term interest rates are conveyed to bank retail rates (Aziakpono, Wilson & Manuel, 2007).

However, studies on the abovementioned subject have generally discovered that the pass-through is usually incomplete in the long-run, while sluggish in the short-run (see, for example, Cottarelli & Kourelis, 1994; Mojon, 2000; Hussain & Nahar, 2016; Liu, Liu & Peng, 2018). Under such circumstances, monetary policy decisions are ineffective because their effects do not perfectly and instantaneously affect the economy, which ultimately renders the desired objectives of such monetary policy decisions unachievable. Furthermore, recent studies have discovered that bank retail rates may adjust asymmetrically to adjustments in short-term interest rates, this may be due to several factors, particularly; banking system structures and competition (see, for example, Payne, 2006; Zulkhibri, 2012; Tang, Liew & Puah, 2015; Matemilola, Bany-Ariffin & Muhtar, 2015).

The presence of these factors greatly impedes the efficiency of the banking system which acts as the key fund's provider in an economy, thus leading to the ineffectiveness of monetary policy decisions made by the central bank. The main reason to study the pass-through is to scrutinise whether monetary policy decisions made by the central bank are effective in achieving the desired economic goals. This is achievable through examining the magnitude of the adjustments in the short-term interest rates that are passed-through to bank's retail rates, as well as to discover factors that cause possible asymmetric adjustments in bank's retail rates toward adjustments in short-term interest rates. Subsequently, this allows for appropriate policy decisions to be made by the central banks based on these identified factors to improve the pass-through.

Despite the significance of the process of pass-through in the transmission mechanism of an economy, empirical studies that have focused on this subject are scant in the South Asian Association for Regional Cooperation (SAARC) countries[1]. This is despite the importance of the process of pass-through on this region, especially for Pakistan, India, Bangladesh and Sri Lanka. These countries have been adopting, or are in a gradual transition[2] from using a monetary targeting framework to using the increasingly popular inflation targeting framework, whereby short-term interest rates are the key instrument in the conduct of monetary policy decisions. In addition, the banking system is the main fund's provider especially in developing countries, such as in the four countries studied, which requires an

[1] Other SAARC countries which are; Afghanistan, Nepal, Bhutan and the Maldives are not included in this study due to a lack of appropriate data.

[2] India transited to the framework in June 2016 (Ministry of Finance of India (MFI), 2015; Mishra, Montiel & Sengupta, 2016), while Pakistan is currently under an inflation targeting lite regime and is transitioning to a full-fledged inflation targeting framework (Arif, 2011). Although Sri Lanka and Bangladesh are still currently under a monetary aggregate targeting framework, there are numerous studies that have proposed the full transition to an inflation targeting framework for Sri Lanka (see, for example, Perera, 2010; Anand, Ding & Peiris, 2011; Perera, 2016) and Bangladesh (Islam & Uddin, 2011; Hossain, 2015).

efficient banking system to allocate funds in the economy with the least distortion (Arora & Ratnasiri, 2014; Gul, Khan & Hassan, 2018). Therefore, all of these reasons justify the importance of a thorough examination of the pass-through process in the aforementioned countries.

Although there are a few relevant studies that have focused on these countries, they do however, have a few noticeable limitations (Andries & Billon, 2016). First, most of them do not account for asymmetric adjustment. Without taking asymmetric adjustments into account, these studies cannot sufficiently address and highlight the main reasons behind the workings of the pass-through process, which relates to, for instance, the banking system structures, information asymmetries, and the behaviour of consumers and firms. This information is vital as it provides clearer policy implications for the central banks of these countries. While some of the studies did account for asymmetric adjustments, the methods that used, however, are rather outdated. Furthermore, and the most important point, these studies do not allow for the effect of interest rate volatility on the bank retail rates adjustment behaviours, while, in fact, its effect has been well-document by previous studies on the pass-through process. As these countries underwent significant reforms and liberalisations over the past decades, interest rate volatility must be examined when scrutinising their pass-through processes. Hence, this study will address the gaps of the aforementioned studies by adopting more advanced methods which incorporate the element of interest rate volatility in examining the studies country's pass-through processes.

1.2 Monetary Policy Transmission Channels

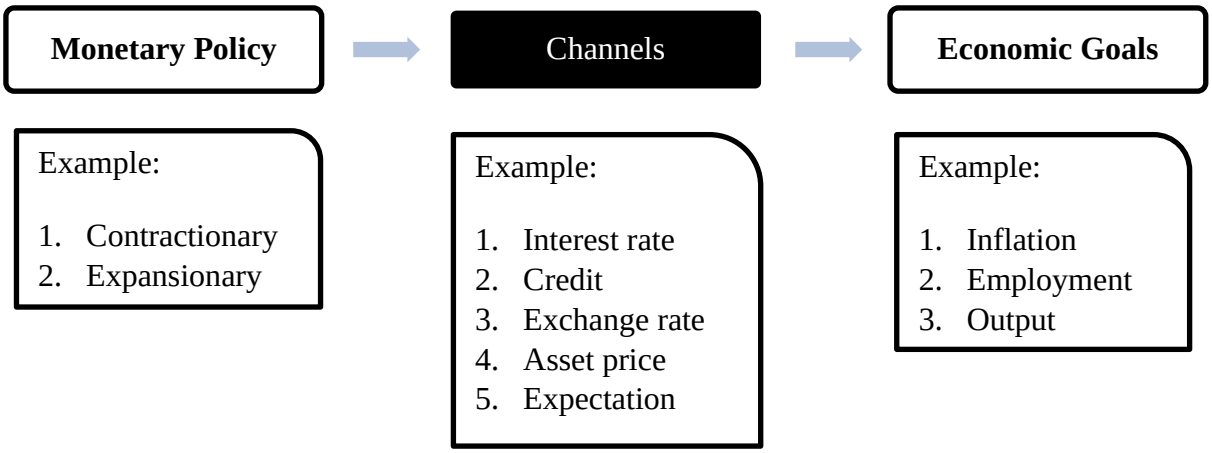


Figure 1.1: The Black Box of Transmission Mechanism
(Source: Song, 2003)

The transmission mechanism is defined as the process whereby monetary policy decisions influences macroeconomic variables through the five transmission channels, as discussed in the previous section. However, the whole mechanism is very complicated and sophisticated in itself, which led Bernanke and Gertler (1995) to coin it as the famous "black box" (see, Figure 1.1), since the precise workings, and the relative importance of these channels in achieving the objectives of monetary policy are rather ambiguous and conflicting.

In general, there is no "best channel" that suits a particular economy. In fact, the channels can work simultaneously to achieve the final economic goals of a country (Khundrakpam & Jain, 2012). The ideal transmission channel of a country may differ across economies due to a number of relevant factors, such as the structural properties of the economy, the stages of banking system development, the availability of monetary policy

instruments, the fiscal stance of the authorities and also the degree of economic openness (Mohan, 2006a).

Although monetary policies are increasingly popular among the economic stabilisation policies used by central banks, however, they sometimes may cause unwanted or unexpected consequences which may ultimately causes adverse effects on the real economy. Thus, the central banks must have a proper evaluation of the timings and consequences of their monetary policy decisions in order to achieve the successful conduct of monetary policies (Mishkin, 1995). Since the effect of monetary policy decisions may be passed-through to the economy in a number of channels, the central banks are required to have a thorough understanding of the workings of monetary policy through each channel and their possible effect on the economy (see, Figure 1.2).

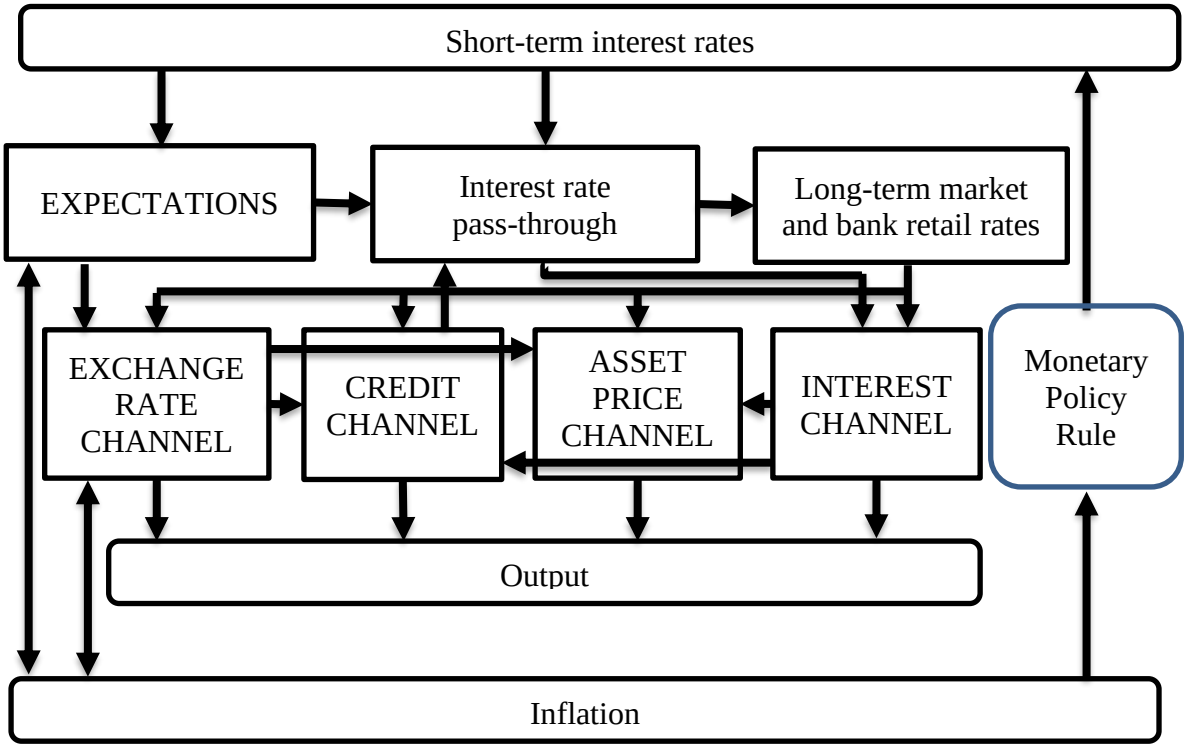


Figure 1.2: The Channels of Transmission Mechanism
(Source: Egert & MacDonald, 2009)

The transmission mechanism provides an explanation on how adjustments in the nominal money supply and nominal interest rate affect macroeconomic variables, i.e. the levels of inflation, output and unemployment (Cambazoglu & Gunes, 2011). As shown in Figure 1.2, the process of the transmission mechanism commences with the conveyance of policy decisions by central banks through adjustments in the short-term interest rates (i.e. money market rates and the treasury bill rate (T-bill)) which are then passed-through to longer-term market rates and bank retail rates. In turn, such decisions will be conveyed to the economy through the aforementioned transmission channels to accomplish monetary policy goals, i.e. price stability, high output levels and full employment.

The dominant transmission channel, which is the most traditional channel among the aforementioned transmission channels, is the interest rate channel. It posits that contractionary monetary policy usually increases real interest rates, and hence decreases the cost of capital or borrowing by economic agents, i.e. households and firms, which then promotes greater investment and consumption demand, and ultimately affects the aggregate output, prices and employment levels (Mohan, 2006a). As consumer spending decisions on housing and consumer durable goods are identical to decisions on investments, this channel is also applicable to consumer spending on residential and consumer durable goods (Song, 2003).

However, Bernanke and Gertler (1995) contended that the traditional interest rate channel only partially explains the whole transmission mechanism which is complex. Due to the this, they proposed the credit channel which serves as an enhancement that intensifies and proliferates the effects of the abovementioned traditional channel. In contrast, this channel transmits the monetary policy decisions by influencing the supply of credit instead

of interest rates (Gigineishvili, 2011). Under this channel, monetary policy decisions influence the economy through two subchannels, i.e. bank lending and balance sheet which complement each other. The balance sheet subchannel postulates that an increase in the net worth of firms following a rise in the firm's stock price followed by an expansionary monetary policy will reduce the problem of information asymmetries, i.e. moral hazard and adverse selection. This reduction will lead to higher lending from banks, resulting in higher investment and ultimately in a rise in aggregate output (Mishkin, 2001). Alternatively, the bank lending subchannel hypothesises that an increase in bank reserves and deposits, due to expansionary monetary policy, will increase the availability of bank loans. Consequently, an increase in bank loans translates to higher investment and consumption. However, the efficacy of this channel has been questionable, since banks have gradually shifted to traditional banking activities and, thus, diminished their overall role in financial intermediation (Khundrakpam & Jain, 2012).

The third transmission channel is the exchange rate channel which postulates that economic goals can be achieved through proper changes in relative prices (Jamilov & Egert, 2014). At first, monetary policy influences the exchange rate in both nominal and real terms. Then, the exchange rate influences import volumes and relative price levels which ultimately affects the net exports and investments of an economy (Egert & MacDonald, 2009). Although this channel focuses on the exchange rate, however, it also involves the effects of the interest rate. As noted by Mishkin (1995), deposits denominated in the local currency will be more attractive relative to deposits denominated in foreign currencies once the domestic real interest rate increases. This, in turn, leads to an appreciation of the local currency. A higher value of the local currency relative to foreign currencies causes an

upsurge in the relative price of domestic products and services as compared to those from abroad, and thus, it ultimately lowers aggregate domestic output due to a fall in net exports.

The asset prices channel is considered as the fourth transmission channel. Unlike other channels, this channel transmits monetary policy decisions through its influence on asset markets, such as those for bonds and stocks (Cambazoglu & Gunes, 2011). There are two sub-channels within this mechanism, namely; the wealth effect and the Tobin-Q ratio, which are often related to consumption and investment decisions in an economy, respectively. As explained by Modigliani (1986) life cycle theory, the former subchannel postulates that an increase in the interest rate after an expansionary monetary policy will permanently increase property or stock prices and ultimately improve the wealth of homeowners and shareholders. Following this, current and future household consumption will rise by assuming that these households smooth consumption over time (Nastansky & Strohe, 2010). On the other hand, the Tobin-Q ratio (Tobin, 1969) suggests that an expansionary monetary policy will induce the demand for shares, and thus, increase share prices. The increase in share prices will induce a higher Tobin-Q value, hence increasing investments in firms since a higher Tobin-Q value reflects the ability of firms to purchase a greater amount of new investment goods with a minimal amount of equity (Horatiu, 2013).

The last channel is the expectations channel which is linked to the Lucas (1972) and Sargent and Wallace (1975) rational expectation hypothesis (Ireland, 2005). This channel postulates that the forward-looking component of the expected inflation and expected monetary policy stance is the main driver behind the influence of monetary policy decisions on economic goals. This forward-looking behaviour on prices and wage setting by firms is due to the fact that there are costs associated with changes in prices and renegotiating

contracts (Sidaoui & Ramos-Francia, 2008). Firms and consumers shape their opinions on expected inflation by basing their belief in the central bank's ability and commitment in anchoring an announced inflation rate (Khundrakpam & Jain, 2012). If the credibility of the central bank to reduce inflation is strong under a high inflationary period, economic agents will anticipate a prompt monetary policy response from the central bank that suppresses inflationary pressure, particularly through increases in short-term interest rates. This anticipation anchors inflation expectations and, therefore, has no effect on wage negotiations and price setting decisions (Sidaoui & Ramos-Francia, 2008). Based on this notion, the credibility and transparency of the central bank play a significant part in the workings of this channel (Mohan, 2006a). However, firms and consumer expectations on future macroeconomic conditions are hard, if not impossible, to correctly quantify and estimate due to human nature (Kasperaviciute, 2014). Thus, this channel is argued to only partly capture the workings of the whole transmission mechanism.

Among the transmission channels discussed above, an effective pass-through, in which adjustments in short-term interest rates are passed through to bank retail rates without distortions, is the most critical determinant of successful monetary policy decisions. As depicted in Figure 1.2, despite the availability of other transmission channels, the pass-through will always be the foremost building block of the whole transmission mechanism (Mariscal & Howells, 2002; Khundrakpam & Jain, 2012). Similarly, Jamilov and Egert (2014) also posit that the ability of monetary policy in conveying its influence through the aforementioned transmission channels critically depends on the ability of short-term interest rates to be fully passed-through to longer-term market as well as bank retail rates. As noted by Egert, Crespo-Cuaresma and Reininger (2007), the effect of monetary policy decisions through the aforementioned transmission channels will diminish considerably if the interest

rate is unable to be fully and quickly passed-through to long term market and bank retail rates. Hence, it is imperative to examine the fundamental workings of the pass-through.

1.3 Interest Rate Pass-through: Concept and Functions

Pass-through is recognised as the most straightforward link to the whole transmission mechanism (De Bondt, 2002; Baugnet, Collin & Dhyne, 2007; Rajan, 2015). It is a process in which adjustments in short-term interest rates by central banks ultimately affect the investment and consumption decision of economic agents through its effect on bank retail rates. Therefore, adjustments in short-term interest rates have become a significant process of the transmission of monetary policy decisions (Manna, Phil & Quiros, 2001; Beyer et al., 2017). As noted by Raunig and Scharler (2009), the pass-through has two processes, which are; the first moment properties, i.e. the magnitude and speed of pass-through from short-term interest rates to bank retail rates, which governs on the ability of banks in passing-through changes in short-term interest rates to their bank retail rates and whether the pass-through is complete and symmetric, and the second-moment relationship between short-term interest rates and bank retail rates, i.e. to what extent interest rate volatility or uncertainty affects bank retail rates adjustment behaviours, which is related to whether banks incorporates risk premium into the pricing behaviour of their retail rates due to the significant impact interest rate uncertainty caused by interest rate volatility.

Whenever a central bank intends to boost economic growth, it undertakes an expansionary (contractionary) monetary policy. Such action increases (reduces) the liquidity level in the economy by lowering (increasing) the short-term interest rates that ultimately pass through to lower (higher) interest rates in which economic agents obtain loans from the banks, thus encouraging (discouraging) them to increase their borrowings. On the other

hand, this also lowers (increases) interest rates in which economic agents deposit their money in the banks, thus discourages (encourages) them to increase their deposits. Subsequently, it will result in increased (decreased) investment and consumption demand and ultimately increases (decreases) the aggregate demand and output. Finally, the central bank achieves its economic goals, i.e. expansionary monetary policy increases aggregate demand and increases employment while contractionary monetary policy decreases inflation, and this ultimately leads to price stability in an economy (Nwoko, Ihemeje & Anumadu, 2016).

1.3.1 Theories on Incomplete and Asymmetrical Pass-Through Behaviour

The effective implementation of monetary policy is when the magnitude of the long-run pass-through is equal to unity, i.e. a 1% increase in short-term interest rates should induce a 1% increase in bank retail rates. Furthermore, the adjustment pattern of bank retail rates following an adjustment in short-term interest rates must be symmetric. Though, empirical studies on various countries, i.e. developing and developed countries, usually imply that the long-run pass-through is incomplete and that the short-run adjustment pattern is asymmetric (see, for example, Payne, 2007; Payne & Waters, 2008; Wang & Lee, 2009; Yuksel & Ozcan, 2013; Hussain & Nahar, 2016). Many studies believe that the interest rate adjustment process exhibits asymmetries which are caused by rigidities that occur during the adjustment process (see for example, Wang & Lee, 2009; Wang & Thi, 2010). These rigidities can be largely associated with interest rate adjustment costs and to the presence of information asymmetries (Stiglitz & Weiss, 1981). As for the magnitude of long-run pass-through, there are essentially three conditions – i) incomplete, ii) over complete and iii) complete. While, for the asymmetric short-run adjustments, there are essentially two conditions – i) upward adjustment rigidity and ii) downward adjustment rigidity.

1.3.1.1 Theories on the Incompleteness of Pass-through

When the magnitude of long-run pass-through is less than 1, this implies an incomplete pass-through. The incompleteness of pass-through means that the influence of an adjustment in the interest rates is only able to be partially felt by an economy, implying an ineffective monetary policy. This could also violate the Taylor (1993) rule which posits that the central bank should increase the interest rate more than one-to-one to fight inflation (Woodford, 2003), and ultimately leads to the failure of monetary policies due to the incomplete pass-through (Marotta, 2009).

Imperfect substitutions between bank deposit and loan products and other money market instruments, i.e. T-bills and call money, and between bank loan products and non-bank financial sources, i.e. equities and bonds are usually found to contribute to the incomplete pass-through mechanism (Egert et al., 2007). High customer switching costs also lead to incomplete pass-through (Lowe & Rohling, 1992; Egert et al., 2007; Zulkhibri, 2012; Yuksel & Ozcan, 2013). These costs include the costs of obtaining information, search and managerial costs as well as the switching costs between banks faced by economic agents. In addition, an inelastic demand function and weak competition in the banking system also contribute to the latter issue (Zulkhibri, 2012), as well as the depth and development of the financial market (Yuksel & Ozcan, 2013; Andries & Billon, 2016).

An over pass-through implies that the magnitude of the long-run pass-through is greater than 1. Zulkhibri (2012) and Andries and Billon (2016) posit that higher pass-through is likely to happen when close substitutes for bank deposits exist. For the case of lending rates, Sander and Kleimeier (2004), De Bondt (2005), Yuksel and Ozcan (2013) and Andries and Billon (2016) imply than over pass-through happens when banks choose to not limit

their credit granting, and instead choose to raise lending rates to recompense for the higher risk under the presence of information asymmetries. However, banks may ration credit when increments in lending rates are no longer able to compensate for the increasing borrowing risks (Stiglitz & Weiss, 1981; Lowe & Rohling, 1992). Smaller banks may also require higher risk premiums charged on their lending rates to compensate for their non-access to external funding sources (Jamilov & Egert, 2014).

Furthermore, the level of economic growth also causes pass-through to be different from unity. As noted by Sznajderska (2013), banks may limit the demand for loans by greatly increasing their lending rates since the demand for loans is higher under a high level of economic growth. Banks expectations on macroeconomic conditions may also pose a significant factor, especially under the menu cost constraint, in which they take into account future changes in price (either expansionary or contractionary monetary policy) before setting their retail rates (Jamilov & Egert, 2014).

1.3.1.2 Theories on the Asymmetrical Behaviour of Pass-through

The pass-through is said to be symmetric if the adjustment behaviour of retail rates towards changes in short-term interest rates is the same between expansionary and contractionary monetary policy. A symmetric pass-through is particularly important as the adjustment behaviour of retail rates by banks following any changes in monetary policy stance will be the same regardless it is an expansionary or contractionary monetary policy, thus allowing central banks to better predict and control the impacts of monetary policy has on the real economy through retail rates.

Nevertheless, asymmetrical behaviour in interest rate pass-through is a common finding in the pass-through literature. It happens when the bank retail rates adjusted

differently towards the direction of monetary policy, i.e. expansionary and contractionary monetary policy, whereby the speed of adjustment of retail rates following changes in the short-term interest rates are more rigid on one direction of change than the other. Under this situation, the impact of monetary policy will be transmitted unevenly to bank retail rates at a single time. Therefore, the presence of asymmetrical behaviour in the interest rate pass-through may cause central bank to be unable to properly predict and effectively control the direction of the real economy with its monetary policy through bank retail rates, and thus ultimately causing monetary policy to be unable to achieve its intended impact on the real economy.

As noted by the seminal work of Cottarelli and Kourelis (1994), adjustment rigidity in interest rate pass-through process are largely associated to the structural characteristics of the banking system. For instance, a weak degree of banking competition is typically associated with downward adjustment rigidity in lending rate and upward adjustment rigidity in deposit rate because banks with higher monopoly power will tend to increase lending rate at a faster speed than deposit rate, while decrease deposit rate more rapidly than lending rate, in order to increase profit. On the other hand, if the banking customers has a higher bargaining power in a highly competitive banking system, bank will be more inclined to reduce lending rate than deposit rate and to increase deposit rate than lending rate in fear of losing customers to other banks that offers better rates, thus leading to asymmetric adjustment in the bank retail rates, with lending rate adjusting rigidly upward and deposit rate adjusting rigidly downward. Taken together, these phenomena indicate non-optimal banking system structures, which will lead to rigidities in the changes on retail rate following changes in monetary policy stance, and subsequently causing asymmetries in the adjustment behaviour of retail rates in response to contractionary and expansionary monetary policy.

Three popular hypotheses have been used to explain the asymmetric rigidities in the adjustment of bank retail rates, namely the collusive pricing behaviour and adverse customer reaction hypotheses of Hannan and Berger (1991) and Neumark and Sharpe (1992), as well as the condition of information asymmetries as coined by Stiglitz and Weiss (1981) which relates to the adverse selection and moral hazard hypotheses.

In line with the structure-conduct-performance hypothesis, the collusive pricing behaviour hypothesis is associated with the degree of banking system concentration and competition (Mangwengwende, Chinzara & Nel, 2011; Sznajderska, 2013; Matemilola et al., 2015). This hypothesis postulates that any other pricing arrangements than the mutually-agreed collusive arrangement generate additional unnecessary costs to the banks (Wang & Lee, 2009), causing them to be unlikely to reduce the lending rates or increase deposit rates as they do not want to disrupt their collusive arrangement (Payne, 2007; Payne & Waters, 2008; Fadiran, 2014; Matemilola et al., 2015). In other words, collusive pricing arrangements suggest an upward adjustment rigidity in the deposit rate during a contractionary monetary policy, while suggesting a downward adjustment rigidity in the lending rate during expansionary monetary policy (Aziakpono & Wilson, 2010).

Also known as the consumer behaviour hypothesis, the adverse customer reaction hypothesis implies that banks operate in an extremely competitive setting and may not increase their lending rate during contractionary monetary policy, and will not decrease their deposit rate during expansionary monetary policy because they fear losing customers due to negative reactions from customers (Holmes, Iregui & Otero, 2015; Matemilola et al., 2015). This posits a downward adjustment rigidity in the deposit rate and an upward adjustment rigidity in the lending rate (Toolsema, Sturn & De Haan, 2002; De Bondt, 2005; Payne,

2007; Payne & Waters, 2008; Wang & Lee, 2009; Aziakpono & Wilson, 2010; Hussain & Nahar, 2016).

In another context, Stiglitz and Weiss (1981) argued that information asymmetry is the main cause behind the rigidities in the adjustment of the lending rate in response to adjustments in short-term interest rates. Essentially, this hypothesis posits an upward adjustment rigidity in the bank retail rates during a contractionary monetary policy. As explained by Lowe and Rohling (1992), borrowers are expected to have information on all of the risks associated to their projects, while banks, on the other hand, cannot even differentiate or distinguish between all of the risks associated with their investments. These information disparities amongst banks, borrowers and the associated investment risks are the main reason behind the existence of information asymmetries which leads to issues of adverse selection and moral hazard by the borrowers.

As postulated by the adverse selection hypothesis, such rigidities occur because higher lending rates will attract riskier borrowers (Stiglitz & Weiss, 1981; Payne, 2007). This is because borrowers perceive that higher project default risks are usually related to higher expected returns (Agenor & Montiel, 2008). Similarly, the moral hazard or the adverse incentive hypothesis implies that the lending rate is upward rigid because higher lending rates provide adverse incentives for borrowers to select riskier projects (De Bondt, 2002). Although the receipts by the banks are expected to increase in conjunction with increases in the lending rate, however, in fact, they might actually decrease since the probability of default loans rises substantially. Thus, instead of increasing the lending rate, banks choose to limit credits to evade the costs related to loan defaults by riskier borrowers

(Payne & Waters, 2008), while setting lending rates below market equilibrium rates (De Bondt, 2002).

Other than the aforementioned popular hypotheses, several other factors have been identified to contribute to the adjustment rigidities in the bank retail rates following adjustments in short-term interest rates. Customer switching costs are also a major factor that contributes to the interest rate adjustment stickiness (Lowe & Rohling, 1992; Egert et al., 2007). Higher switching costs arise when a customer considers switching from one bank to another (De Bondt, 2002). These includes the costs of obtaining information, search and managerial costs and switching costs between banks faced by consumers (Zulkhibri, 2012). Taking this into account, banks may be reluctant to reduce the lending rate (or increase the deposit rate) because lowering the lending rate (or increasing the deposit rate) under a high switching cost situation may not attract more potential consumers anyway (Lowe & Rohling, 1992).

Related to the latter context, risk-sharing agreements set forth by Fried and Howitt (1980) are also considered as a foundation that explains lending rate stickiness, and might be further favoured under high switching costs (Lowe & Rohling, 1982). These agreements are anticipated to prevail in a banking system whereby long-term relationships and recurrent transactions between banks and consumers are prevalent (Sharpe, 1997). To sustain a feasible long-term relationship between banks and customers, banks may share risks by shielding customers from volatile market rate developments by keeping bank retail rates relatively stable over time. On the other hand, banks may also provide guarantees for consumers with a less volatile lending rate in return for a higher-than-average lending rate through risk-sharing agreements (Andries & Billon, 2016). As a result, these agreements

may tend to smooth out changes in the bank retail rates especially lending rates when short-term interest rates change, causing adjustment rigidities in bank retail rates.

Another cost factor that contributes to the stickiness of bank retail rates is the menu cost as postulated by Barro (1972). This cost can be related to bank expectation, whereby they will be reluctant to requote their retail rates if the changes of short-term interest rates are considered to be negligible or are regarded as temporary (Yu, Chun & Kim, 2013). Instead of instantaneously changing their prices, the banks may wait until these sequences of small changes accumulate or until there is a large change of short-term interest rates before adjusting their prices. When they expect higher rates due to higher short-term interest rates in near future, they might wait by increasing the deposit rate, while waiting to decrease lending rates if they expect lower short-term interest rates (Sznajderska, 2013).

1.3.2 The Effect of Interest Rate Volatility on Bank Retail Rates

Interest rate volatility can be defined as the variability of interest rates, or, how wildly an interest rate decrease or increase on average, over a specific time period. If an interest rate fluctuates rapidly in a given time frame, it is termed to have high volatility, while, if it fluctuates slowly, it is said to exhibit low volatility. As interest rate volatility is synonymous to unexpected movement in interest rate, it typically proxies for uncertainty in the future path of interest rates, and can therefore be considered a measurement of uncertainty in future economic condition and monetary policies (Martinez-Serna & Navarro, 2015).

In banking finance, the value of an asset or liability of a bank is critically depending on the movement of interest rate. As banks earn net interest income through maturity transformation by taking in deposits (liabilities) and providing loans (assets), they are

extremely susceptible to movements in the retail rates, i.e. deposit and lending rates, especially when there is a mismatch in the maturity period between their assets and liabilities (Oracle Financial Services, 2011). If the movement of the retail rates is volatile, it creates an uncertainty for the value of an asset or liability of banks to fluctuate unexpectedly. Accordingly, there is a possibility that the value of an asset or liability may change as a result of exposure to unexpected movement of the retail rates, a condition known as interest rate risk (Zhou & Zheng, 2017). Ultimately, unexpected changes in the retail rates will induce interest rate risk, and may affect the earnings of a bank by changing their net interest income (Kasman, Vardar & Tunc, 2011). Therefore, excessive interest rate risk can pose a significant threat to a bank's income and equity position because the present value of future cash flow of banks will change when the retail rates changes (Banks for International Settlement, 2001; Clarke, Logan & Alexander-Smith, 2005). In short, interest rate volatility creates financial management problems for banks, because it may adversely alter their net interest margins, which is the difference between lending and deposit rates offered by banks (Liu & Sathye, 2019; Khan & Jalil, 2020).

Nevertheless, banks often deliberately mismatch the durations of their asset and liability portfolios to profit either from the term premiums or from their own expectations about the future direction of the interest rates, which may impact their retail rates volatility, and are therefore susceptible to exposure to interest rate risk (Greenbaum, Thakor & Boot, 2016). Consequently, especially for risk-adverse banks, in order to manage their exposure to increased interest rate risk due to higher uncertainty in future interest rates, they often tend to increase their net interest margin (Chaudron, De Haan & Hoeberichts, 2020), by including risk premium through discretionary pricing decisions of deposit and lending rates in order to shift the risk to bank borrowers and depositors (Wright & Houpt, 1996; Brousseau & Durre,

2013; Beutler, Bischel, Bruhin & Danton, 2017). Therefore, as evidenced by Bikker and Gerritsen (2018), interest rate volatility affects the retail rate adjustment behaviour of banks, whereby the higher the interest rate risk exposure of banks, the lower the deposit rate it will offer to depositors, and the higher the lending rate it will charge to borrowers.

Furthermore, the examination for the presence of asymmetries in the volatility for bank retail rates allows the examination of the effect of changes in the monetary policy stance on bank retail rates volatility. This could provide an indication of the presence of the leverage effect or bank risk-taking behaviour, which indicates that negative shocks of monetary policy generate greater bank retail rates volatility than positive shocks of the same magnitude. The leverage effect posits that a decline in bank retail rates following a reduction in the short-term interest rates would lead to greater fluctuation in bank retail rates. When short-term interest rates decline, banks increase leverage to generate more bank profits as both the cost of deposits paid to depositors and the profit from loans obtained from borrowers are low. However, an increment of leverage exposes banks to more risks. Subsequently, as highly leveraged banks are more vulnerable to shocks and uncertainties, they are more sensitive to negative short-term interest rate shocks. As a result, the bank retail rates are more volatile because banks often readjust their retail rate pricing to compensate/reflect the higher risks due to higher leverage (Fadiran & Ezeoha, 2012). In short, the presence of the leverage effect posits that banks are more sensitive to negative short-term interest rate shocks than positive shocks, which in turn leads to highly volatile bank retail rates.

Thus, this implies that interest rate volatility has a substantial role in the pass-through and thus must be considered. The aspects of volatility provide an explanation on how interest rate fluctuations affect the adjustment behaviour of bank retail rates, while the leverage effect

elucidates whether interest rate adjustments caused by negative shocks are greater than those of positive shocks of the same magnitude. These two phenomena have been discovered to influence the pass-through and its adjustment process (Fadiran & Ezeoha, 2012). This issue is particularly important for developing countries that have been actively undergoing significant financial reforms and liberalisations because such reforms and liberalisations often lead to increases in interest rate volatility caused by the deregulation of interest rate that enables the interest rates to be market-determined (Moyo & Le Roux, 2020). As noted by Chen (2019), a relatively volatile interest rate caused by uncertainties in future economic outlook and monetary policies will induce adverse shocks to the banking sector leading to uncertainties in bank profitability. Therefore, banks will tend to hesitate in making changes, at least in the short-run, to their retail rates in order to avoid bank losses. Consequently, this weakens the linkages between short-term interest rates and retail rates, and will likely to impede the pass-through and causes rigidities in the interest rate adjustment process (Deger, 2012; Di, 2014). Thus, the inclusion of interest rate volatility (second-moment relationship) is able to produce further valuable information on the pass-through and its adjustment process that the study on the magnitude of the pass-through (first-moment relationship) itself cannot produce.

1.3.3 The Function of Interest Rate Pass-Through Under Inflation Targeting Framework as Monetary Policy Strategy

Since firstly introduced by the Reserve Bank of New Zealand in 1990, the effectiveness of the inflation targeting (IT) framework in achieving price stability in an economy has become widely acknowledged. Accordingly, the IT framework as a viable monetary policy strategy for achieving and maintaining price stability, has led to its increasingly wide adoption among central banks around the world, especially among

emerging and developing countries (Asab & Cuestas, 2015). The move towards the adoption of the IT framework is largely attributable to the difficulties faced by central banks that traditionally conducts monetary policy strategy using monetary aggregate as the main operating target of monetary policy strategy, which has led to the view that short-term interest rate is a more reliable monetary policy instrument (Taylor, 2019).

Under the IT framework, central banks commit to maintain price stability as the main objective of their monetary policy strategy. In order to achieve price stability, central banks try to keep their inflation close to the announced target range by using short-term interest rates as the main operating target (Rossini & Vega, 2008; Ascarya, 2012). For instance, if the inflation rate falls below the inflation target, central banks will decrease the short-term interest rate which will then be reflected in lower bank retail rates and ultimately increases aggregate demand and inflation rate to meet the inflation target, and vice versa (Karahan, 2014). In other words, the success of the IT framework is critically reliant on the ability of central banks to achieve its inflation target by using short-term interest rates as the main monetary policy instrument. Therefore, it is vital for central banks to understand all the aspects of monetary policy transmission channel of short-term interest rate since the effectiveness of the IT framework is critically reliant on a strong transmission mechanism of short-term interest rate, particularly to the bank retail rates, which the process known as the interest rate pass-through.

Accordingly, it is essential for IT central banks to examine whether the interest rate pass-through is complete and symmetric as it reflects the ability and behaviour of banks in conveying monetary policy stances to meet the inflation target through changes in retail rates (Gigineishvili, 2011). A higher and more symmetric interest rate pass-through implies a

more effective IT framework, since short-term interest rate is able to control bank retail rates in the way it is intended by central banks to achieve the inflation target (Karahan, 2014). Accordingly, this will enable central banks to accurately model the inflation dynamics and to properly forecast inflation rates under the IT framework.

In addition, the performance of the interest rate pass-through mechanism can also provide an indication of the development level of the financial markets of a country. A weak and asymmetric interest rate pass-through indicates an under-developed and inefficient financial system (Asab & Cuestas, 2015). Since the IT framework is critically reliant on a strong interest rate pass-through driven by well-developed and efficient financial systems, this will provide a signal to central banks to first develop its financial markets first to strengthen the ability of short-term interest rate in passing-through its effect to bank retail rates before transiting to a monetary policy strategy based on IT framework (Gigineishvili, 2011). Therefore, the interest rate pass-through mechanism will determine whether the adoption of IT framework by central banks as the monetary policy strategy is whether feasible given their current state of financial systems.

1.4 Motivation of the Study

The monetary policy frameworks of the SAARC member countries, especially those of Pakistan, India, Bangladesh and Sri Lanka, have increasingly gravitated towards interest rates as the main monetary policy tool used by their central banks in conveying monetary policy stances. This is in line with their efforts in deregulating interest rates and financial systems in order to enhance the efficiency of their financial systems, and subsequently the ability of their banking systems in conveying their monetary policy stances, and hence improving their monetary policy effectiveness. Moreover, they have been in the process of

migrating to an inflation-targeting monetary policy framework, which also critically reliant on the ability of their banking systems in passing through the monetary policy stances of their central banks. However, this is can only be made possible with a sound and efficient banking system.

This is especially important since as in most developing countries where non-banks play a minor role, the banking system of these SAARC member countries dominates their financial sectors, whereby they are considered as the main players in both core intermediation and non-core financial services in these SAARC member countries. Therefore, since the substitutes for bank loans and deposits are extremely low, the banking system is considered as the main determinant of economic growth and development of the sample countries because they are the main source of fund for domestic consumption and investments.

Given this situation, the central banks of these SAARC member countries can use their banking systems as the main monetary policy vessel to achieve their economic goals. However, this can only be made possible by having a sound and efficient banking structure, as only by having sound and efficient structures enhances the relationship between short-term interest rates and bank retail rates as a result of significantly fewer interest rate distortions in the economy, which ultimately contributes to the success of monetary policy decisions.

Furthermore, as mentioned above, these SAARC member countries have been actively undergoing massive financial liberalisation and reforms over the past two decades. However, whether these reforms have sufficiently improved the functioning of their banking systems remains ambiguous. As the information on bank retail rates rigidity has important

implications for financial liberalisation programs, it is critical to conduct a proper examination of the pass-through in these countries as it reflects whether the structure and development of their banking systems have become more effective after such financial liberalisation and reform programmes.

Therefore, the above situations motivate the present study to critically examine the interest rate pass-through mechanism, since such a study can reveal the prevailing banking structures of these SAARC member countries. This information will indicate whether the current banking system provides an encouraging environment for the process of migrating to an inflation targeting framework, or whether substantial banking system reforms are needed first to strengthen the pass-through mechanism.

1.5 Problem Statement

Following the global financial crisis, SAARC member countries especially Pakistan, India, Bangladesh and Sri Lanka have begun to increasingly reliant on monetary policy as an alternative economic policy to regulate inflation and unemployment in their economies other than fiscal policy (State Bank of Pakistan (SBP), 2014). Since then, a number of policy changes have been made by them to better accommodate the use of monetary policy as the main economic policy tool in aggregate demand management. The most significant change in their monetary policy framework, thus far, is the transition of operating target of monetary policy from monetary aggregates to interest rates. This transition is in line with their long-term monetary policy objective, which is to transit to an inflation-targeting monetary policy framework to achieve a common objective of price stability. Under this new framework, the central banks in these countries will solely focuses on the use of interest rates as the main monetary policy tool in conveying all monetary policy decisions. Accordingly, the question

on whether interest rates in these countries will be able to effectively influence their real economy in both short-run and long-run is becoming more prominent.

Nevertheless, despite the recent changes that prioritise interest rates, arguments have arisen which had casted doubt on the effectiveness of the current monetary policy framework in achieving the desired economic goal of these SAARC countries. For instance, Munir and Qayyum (2014) and Mukthtar and Younas (2019) discovered that monetary policy had only short-term minimal impact on the inflation rate of Pakistan. In India, Bhirud (2014) and Reserve Bank of India (RBI) (2018a; 2020) raised concerns over the absence of a smooth monetary policy transmission that have been hampering economic growth and investments. As for Bangladesh, Alam (2015), Hossain (2020) and Hossain and Ibon (2020) contended that monetary policy is ineffective in controlling short-run economic fluctuations due to the prevailing structural weaknesses of the Bangladeshi banking system. Although Ghazanchyan (2014) and Perera (2016) found evidences that monetary policy is able to affect the macroeconomic variables in Sri Lanka to a certain extent, however, the recent report by Central Bank of Sri Lanka (CBSL) (2017) have warned that the recent upward trend of excess liquidity in the Sri Lankan banking system may have negative impact on its overall monetary policy transmission mechanism.

Generally, the above evidences have pointed to the occurrence of ineffective monetary policy transmission mechanism in Pakistan, India, Bangladesh and Sri Lanka. As pointed out by Borio and Hofmann (2017), ineffective monetary policy could be possibly attributable to the incompleteness of interest rate pass-through mechanism especially for countries that mainly reliant on interest rates to convey monetary policy stances. This notion fits well to these SAARC countries due to their ever-increasing reliant over the use of interest

rates in their monetary policy transmission. As argued by Chileshe and Akanbi (2016), incompleteness of interest rate pass-through mechanism could be driven by the presence of rigidities in the adjustment of interest rates, especially the bank retail rates, which would then lead to asymmetries in the adjustment of interest rates between expansionary and contractionary monetary policy. This is especially prevalent for a bank-dominated financial system, because the effectiveness of interest rate pass-through mechanism is typically attributable to the banking system structure of a country (Binning, Bjornland & Maih, 2019), as in these SAARC countries (SBP, 2014a). If the incompleteness and asymmetries in the interest rate pass-through mechanism of these SAARC countries is not thoroughly investigated, the continual use of wrong monetary policy tool and lack of policy direction will lead to the collapse of their monetary policy, and ultimately wreak havocs in their economic and financial institutions starting from the banking system.

Furthermore, the global recession that followed the financial crisis in 2008 and the recent Covid-19 pandemic have opted central bankers around the world, including Pakistan, India, Bangladesh and Sri Lanka, to actively pursuing accommodative monetary policy in order to revive their economies. However, such prolonged low interest rate environment may tend to reduce banking profitability, which may subsequently lead to higher probability of bank-risk taking behaviour to resuscitate profitability (Ratanavararak & Ananchotikul, 2018). This is especially critical to these countries, because evidences have pointed to the tendency of the banking system of these SAARC countries to undertake excessive banking risk, such as the recent studies of Tahir (2019) for Pakistan, Sarkar and Sensarma (2019) for India, Majumder and Li (2018) for Bangladesh, and Gunawardhana and Damayanthi (2019) for Sri Lanka. This is particularly an important issue because other than fuelling the instability and potential collapse of a financial system (Jabra, Mighri & Mansouri, 2017),

excessive bank risk taking may also have caused interest rate volatility due to the risk-adverse nature of the banking system (Dell' Ariccia, Laeven & Suarez, 2017).

The above situation is extremely important because interest rate volatility has also been found to have direct effects on the performance of monetary policy (Gigineishvili, 2011; Pathberiya, 2017). At the same time, studies have found the recent surge of interest rate volatility following financial deregulation due to the substitution of non-market based monetary policy tools in favour of market-based ones, such as interest rates (Moyo & Le Roux, 2020). This same phenomenon has also been observed in the SAARC countries. For instance, the increasingly active usage of open market operation (OMO) has led to an increase in interest rate volatility in Bangladesh and Sri Lanka (Shahiduzzaman & Nazer, 2007; CBSL, 2015). In contrast, although Pakistan and India implemented interest rate corridor to manage the interest rate volatility to strengthen the operational aspect of their monetary policy, but instead, their interest rate volatility has been significantly increased (Mahmood, 2014; Ghate & Kletzer, 2016), which in this case, also brought upon arguments on the effectiveness and validity of their interest rate volatility countermeasures. As argued by Leroy and Lucotte (2015) and Gregor (2019), interest rate volatility will impede the effectiveness of monetary policy as it may bring about mixed signals of monetary policy stance, and subsequently raises interest rate risks to the banking system, which ultimately impedes the effectiveness of interest rate pass-through of a country.

Therefore, given the above scenarios, there is a need for a detailed study that empirically measures the magnitude of the interest rate pass-through mechanism for these SAARC countries, and also to determine the presence of asymmetric adjustments in their interest rates. At the same time, it is also important to examine impact of bank-risk taking

behaviour on interest rate volatility for these SAARC countries. By understanding these factors and their closely related dynamics, it is possible to design appropriate monetary strategies and policies to promote the effectiveness of interest rate pass-through, and then subsequently improve the effectiveness of their monetary policies and the stability of their banking systems.

1.6 Objectives of the Study

1.6.1 General Objective

The main objective of this study is to examine the interest rate pass-through mechanism in the selected major SAARC countries, namely Bangladesh, Pakistan, India and Sri Lanka.

1.6.2 Specific Objectives

Specifically, the objectives of this study are:

i. To measure the magnitude of interest rate pass-through in Bangladesh, Pakistan, India and Sri Lanka.

ii. To discover if asymmetries are present in the short-run adjustment of bank retails rates in response to changes in short-term interest rates in Bangladesh, Pakistan, India and Sri Lanka.

iii. To empirically evaluate the effect of interest rate volatility on bank retail rates adjustment process in Bangladesh, Pakistan, India and Sri Lanka.

iv. To investigate whether asymmetry or leverage effects are present in conditional variance of bank retails rates in Bangladesh, Pakistan, India and Sri Lanka.

1.7 Significance of the Study

A detailed examination of the magnitude of the pass-through is imperative as it is the first stage of the whole transmission mechanism, which through its effect on several transmission channels, has significant influences on the economic growth and development of a country. Therefore, a correct assessment of the ability of adjustments in short-term interest rates by central banks to be passed through to bank retail rates is imperative so as to understand and foresee the effects of monetary conditions on the economy. The main foundation of examining the pass-through is that it reveals information regarding the magnitude and any potential asymmetries in the adjustment of the bank retail rates following adjustments in short-term interest rates. With this information, central banks will be able to predict the correct intensity and timing of monetary policy decisions, as well as reflecting on the current banking system structure of a country, i.e. banking system soundness, efficiency and stability, which allows appropriate remedial policies to be drawn up to enhance the efficiency of the banking system.

Since the banking system makes up a significant portion of the financial sector in the sample countries, namely; Pakistan, India, Bangladesh and Sri Lanka[3], it can be said that this sector may play a substantial role in shaping their current and future economic growth and

[3] The size of the banking system relative to the financial sector can be represented by deposit money bank assets as a share of GDP statistic, with Pakistan (44.6%), India (68.4%), Bangladesh (57.4%) and Sri Lanka (66.1%) in 2017 (see Figure 2.1).

development through its ability in gathering deposits from savers and providing loans to encourage investment and production in these countries. The empirical findings of this study are expected to highlight any structural weaknesses that prevail in the banking systems in these countries, and, thus, allows subsequent policy decisions to be administered by their central banks. By eliminating these weaknesses, the switch from a monetary aggregate targeting framework to an inflation targeting framework by these countries would be more feasible due to more efficient and effective banking systems. This is because a well-functioning banking system means less pass-through distortions from the short-term nominal rate to the bank retail rates and then to the economy, thus allowing the central bank to achieve the inflation target. When the central banks are able to achieve the inflation target, which is the core determinants of a successful implementation of inflation targeting framework, this enhances their credibility in the view of economic agents. Subsequently, this makes it easier for the central banks to control the expectations of both consumers and investors in these countries, thus allowing them to achieve the announced inflation targets more efficiently and at a lower cost.

In addition, this study scrutinises the second-moment properties of the pass-through by incorporating the element of interest rate volatility into the empirical model. Although its effect on pass-through has been discovered by a few previous studies (see, for example, Egert et al., 2007; Jamilov & Egert, 2014; Andries & Billon, 2016), studies that have explicitly tested for the effect of interest rate volatility on the adjustment behaviour of bank retail rates are surprisingly rare in the existing literature. Considering that the sample countries underwent episodes of financial reforms and deregulation which were likely to generate a substantial amount interest rate volatility in the banking system, this study further contributes to the literature by examining the effect of interest rate volatility on the adjustment behaviour

of bank retail rates. At the same time, the possible presence of bank leverage effect would indicate that the banking systems in these countries are taking excessive risks, thus providing an early warning indicator to the central banks that they should act cautiously in changing their monetary policy stances to prevent unnecessary effects on the volatility of interest rates. In fact, to the best of our knowledge, this study is among the first to explicitly scrutinise the effect that interest rate volatility has on bank retail rates adjustment behaviour and the risk-taking tendency of banks in these countries.

Furthermore, most of the previous literature on the sample countries used linear models to examine the pass-through. The use of linear models, i.e. the Engle-Granger cointegration test, the Johansen-Juselius cointegration test, the error correction model, the vector autoregressive model and the autoregressive distributed lag model, to examine the pass-through is not sufficient as interest rates typically exhibit asymmetric patterns. Thus, a non-linear model, that captures the asymmetric adjustments of the interest rate, is gravely needed. To overcome this problem, this study will employ asymmetric models, which are the TAR and MTAR models proposed by Enders and Siklos (2001), that are able to capture sign and size asymmetries as well as threshold adjustments. By using the aforementioned asymmetric-type methods, the empirical findings of this study will be more robust and allow for a more accurate picture of the current banking system structure in the sample countries, and, thus, allowing for appropriate remedial monetary policy decisions to be undertaken.

Moreover, this study utilises the EC-EGARCH-M model by Wang and Lee (2009) to test for the relationship between short-term interest rates and bank retail rates, as well as to inspect the effect that interest rate volatility has on the pass-through in these sample countries. Compared to the available methodologies used by past literature, this method has

several important and unique features. This method accounts for asymmetric adjustments in bank retail rates in response to changes in short-term interest rates while allowing for the examination of the effect that interest rate volatility has on the adjustment behaviour of the bank retail rates. This method also deals with the problem of heteroscedasticity which is a common characteristic of financial series data, such as interest rates. Since the presence of heteroscedasticity is detrimental to the robustness of empirical results, this study sufficiently addresses this problem, thus, making the empirical findings of this study more robust compared to previous literature and then exploits this heteroscedastic element to inspect the effect that interest rate volatility has on the adjustment behaviour of the bank retail rates in these sample countries.

Finally, due to the huge share of the world's population and the ever-increasing international bilateral trade ties between these selected SAARC countries and ASEAN countries, an effective interest rate pass-through mechanism will definitely be followed by the steady economic growth and development in these selected SAARC countries. Accordingly, this will benefit the ASEAN countries in general, and Malaysia specifically, especially in terms of net exports and foreign direct investments. This is particularly important since international trade activities between the SAARC countries and the ASEAN countries have nearly doubled over the past few years, which has also lent support to the SAARC countries economic significance towards the ASEAN countries. At the same time, ASEAN in general, and Malaysia specifically have also formed several trade agreements between the sample countries, i.e. Malaysia-India Comprehensive Economic Cooperation Agreement (MICECA), Malaysia-Pakistan Closer Economic Partnership Agreement (MPCEPA) and the ASEAN-India Free Trade Area (AIFTA). Recently, Malaysia has also called for the formation of a free trade area with Sri Lanka.

Generally, the empirical findings from this study provides not only valuable information on the conduct of effective monetary policy, but also important indicators of the structural properties of the banking system, i.e. competition intensity and interest rate volatility, which provide a significant indication on the soundness and efficiency of the banking systems in Pakistan, India, Bangladesh and Sri Lanka. The identification of the efficiency of the pass-through mechanism could guides the central banks in these countries in formulating and conducting monetary policies in their respective countries.

1.8 Organisation of the Study

This study investigates the pass-through in Bangladesh, Pakistan, India and Sri Lanka. The motivation of this study, problem statement and the significance of this study are discussed in this chapter. In addition, this chapter also provides theoretical explanations and the importance of pass-through for the aforementioned countries. The other chapters are organised as follows: Chapter 2 discusses the backgrounds of the countries studied in terms of their monetary policy frameworks and the development of their banking systems. Chapter 3 provides a review of past literature related to this subject for advanced and emerging countries. Chapter 4 provides the theoretical and conceptual framework as well as the methodologies used for estimation. Chapter 5 discusses the empirical results and findings of this study. Lastly, Chapter 6 concludes the overall findings and provides thorough policy implications based on the findings of this study.

CHAPTER 2

BACKGROUND OF THE SAARC REGION, MONETARY POLICY FRAMEWORKS AND BANKING SYSTEMS OF THE SAMPLE COUNTRIES

2.1 Introduction

This chapter starts with a discussion regarding the SAARC region and its member countries. Section 2.3 provides a summary of the banking systems of the countries sampled in this study, namely; Pakistan, Bangladesh, India and Sri Lanka. The following section, Section 2.4 covers the development of the monetary policy framework in the sampled countries, whilst Section 2.5 presents the development of the banking systems of the sampled countries.

2.2 Background of the SAARC Region and Its Member Countries

As the first formal region-building initiative in South Asia, SAARC was inaugurated in December 1985 as a platform to promote regional economic integration with the vision of enhancing opportunities and welfare to realise the full potential of the South Asian region (Chakma, 2018). The key objectives of its formation are to build cooperative efforts in enhancing the economic growth, eliminate widespread poverty, and to improve the deprived health and education sectors among the member countries (Manzoor, Wei, Nurunnabi & Subhan, 2019).

The region was comprised of seven countries at the time of its establishment; Bangladesh, Pakistan, India, Sri Lanka, Nepal, Bhutan and the Maldives, while Afghanistan joined the region in 2007 (Bishesh & Banga, 2016). The SAARC region encompasses almost 5.13 million square kilometres which comprise almost 4% of the world's total surface area (Forhad, 2014). The region has a population of approximately 1.74 billion people, which

represents almost 24% of the world's total population (Daly & Khan, 2016). In fact, India, Bangladesh and Pakistan are among the world's top ten most populous countries. When taken as a whole, this region constitutes more than 40% of the developing world (Waskay, Khatri & Kaul, 2014).

Table 2.1: Selected Macroeconomic Indicators of the SAARC Countries, 2018

	GDP (%)	**Export of Goods and Services (%)**	**Population (%)**
India	78.72	84.65	74.55
Pakistan	9.13	4.44	11.70
Bangladesh	7.95	6.37	8.89
Sri Lanka	2.57	3.18	1.19
Nepal	0.85	0.41	1.55
Afghanistan	0.57	0.25	2.05
Maldives	0.15	0.58	0.03
Bhutan	0.07	0.12	0.04
Total (%, 4 major SAARC countries)	**98.36**	**98.64**	**96.33**

Source: World Development Indicator, World Bank, 2020.

The SAARC member countries have extremely diverse characteristics which include, among others; natural resources, country size, economic structures and population. India occupies more than 70% of the total landmass of the region, and its territorial and maritime boundaries touch all of the other member countries except for Afghanistan (Sawhney, 2010). Nepal and Bhutan are landlocked, whereas the Maldives and Sri Lanka are island states (Chowdury, 2004). As the countries of the SAARC region comprise more

than one-third of the developing world, they suffer from economic problems, such as widespread poverty, high unemployment and income inequality and all of the countries are still dependent on external assistance (Sawhney, 2010).

India is the largest economy in the region in terms of its gross domestic product (GDP), the export of goods and services and its total population, while Pakistan and Bangladesh are the second and the third largest. Sri Lanka ranks fourth and is considered as an important emerging economy. When taken together, these four major SAARC countries constitute more than 98% of the total gross domestic product, 99% of the total exports of goods and services in the region, and more than 96% of the region's population inhabit these four countries (see Table 2.1). In fact, these four major SAARC countries are of crucial significance for any sub-regional integration and cooperation plans to function effectively in the region, with Pakistan and India as the main constituents of any formal regional integration agreements in the region (Zaheer, 2013).

Another reason for considering only the four major SAARC countries in this study is that the data of these countries is well organised, reliable and is readily available when compared to the other less significant SAARC countries, which are Afghanistan, Nepal, Bhutan and the Maldives. Thus, these four less significant SAARC countries are not considered in this study. The main reason for their exclusion is because of the absence of appropriate data, and, thus, they do not offer a reasonable comparative database (Zaman, Khan & Ahmad, 2013). The justification of their exclusion is as follows - Bhutan and the Maldives are two tiny economies in the region (Das, 2007), and they suffer from a lack of data availability. Afghanistan also shares the same justification. In the case of Nepal, the aggregate data for deposit rates and lending was discontinued in 2010 according to the World

Bank statistics database. These four minor SAARC countries are frequently excluded in empirical studies due to the lack of data availability (see, for example, Chowdhury, 2005; Basnet, 2013; World Bank, 2017). Thus, this study will focus on the four main SAARC countries, namely; Bangladesh, Pakistan, India and Sri Lanka.

2.3 Overview of the Banking Systems in the Sample Countries

Banks dominate the financial sectors of the four major SAARC countries. They play a major role in mobilising and distributing the savings of depositors to borrowers who intend to borrow for consumption and investment. Due to this role, the banks in the four major SAARC countries are in the powerful position of conveying monetary policy decisions to the economy. Though the effectiveness of the monetary policy is hence dependant on the way in which the banks adjust their retail rates following adjustments in the short-term interest rates controlled by the central bank, that is termed as the pass-through.

The pass-throughs of the four major SAARC countries largely depend on the structural properties of their respective banking systems. The pass-throughs are expected to be higher and symmetric under sounder and more stable banking systems. This section discusses the banking system characteristics of the four major SAARC countries, following the definitions of Beck, Demirguc-Kunt and Levine (2009) which reflect the size, depth and efficiency of the banking systems. These characteristics offer an indication of the condition of the current banking systems and their role in the economic growth and development in the sample countries.

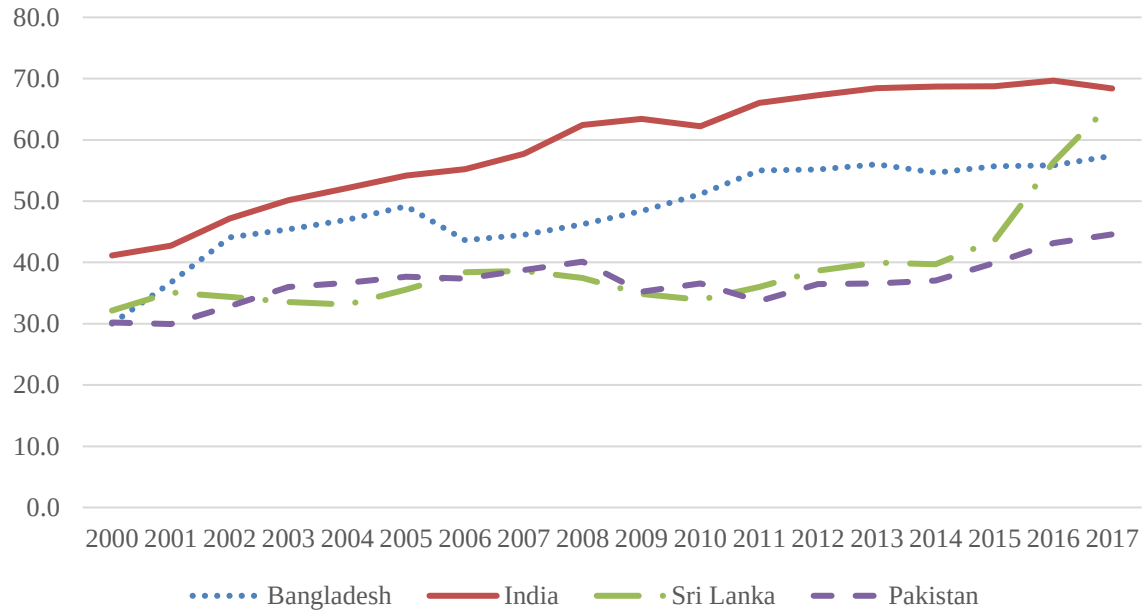


Figure 2.1: Deposit Money Bank Assets (% GDP), Selected 4 Major SAARC Countries, 2000-2017
(Source: Global Financial Development, World Bank, 2020)

Figure 2.1 depicts the deposit money bank assets to GDP ratio which provides an indication of the size of the banking system with respect to the economy of the four major SAARC countries. Based on Figure 2.1, it can be inferred that the size of the banking systems in the four major SAARC countries has been increasing over the past decades. Among the sample countries, India has experienced the most rapid banking system size expansion which increased from 41.1% in 2000 to 69.7% in 2016, before falling to 68.4% in 2017. This fall in 2017 was caused by persistent deterioration in asset quality that necessitated sharp increase in provisions that ultimately causes balance sheet stress in the Indian banking sector (RBI, 2018b). This is followed by Bangladesh and Sri Lanka, which both increased, by 27.4% and 34% respectively, in the same period. Although Pakistan is the second most

significant country of the SAARC region, it is, however, ranked fourth in terms of the size of its banking system among the four major SAARC countries.

In general, the steady growth of the size of the banking systems in the four major SAARC countries indicates that the banking systems have been increasingly captured a larger share of the financial intermediary processes. Consequently, this also posits that the monetary policy decisions made by their central banks are expected to be channelled mainly through the banking system to the economy. This notion has highlighted the increasing importance of the role of banks in the four major SAARC countries in conveying monetary policy decisions to the economy, as their ever-increasing size means that they now have a farther reach of monetary policy. In this context, the banks are playing a greater role in engaging in deposit-accepting activities and loan-providing activities, which may ultimately affect the aggregate demand in the four major SAARC countries. Furthermore, as the assets of the banking system have been growing over time, which can then be channelled into private sector credit, sound and efficient banking systems are required to prevent distortions in fund allocations in the four major SAARC countries.

The domestic credit to private sector to GDP ratio is used to evaluate the value of credit provided by banks to the private sector with respect to the economies of the four major SAARC countries. In other words, it examines the extent to which banks provide the necessary finance to the economy in terms of consumption and investment. Based on Figure 2.2, this ratio has been on an increasing trend for Bangladesh, India and Sri Lanka, but not for Pakistan.

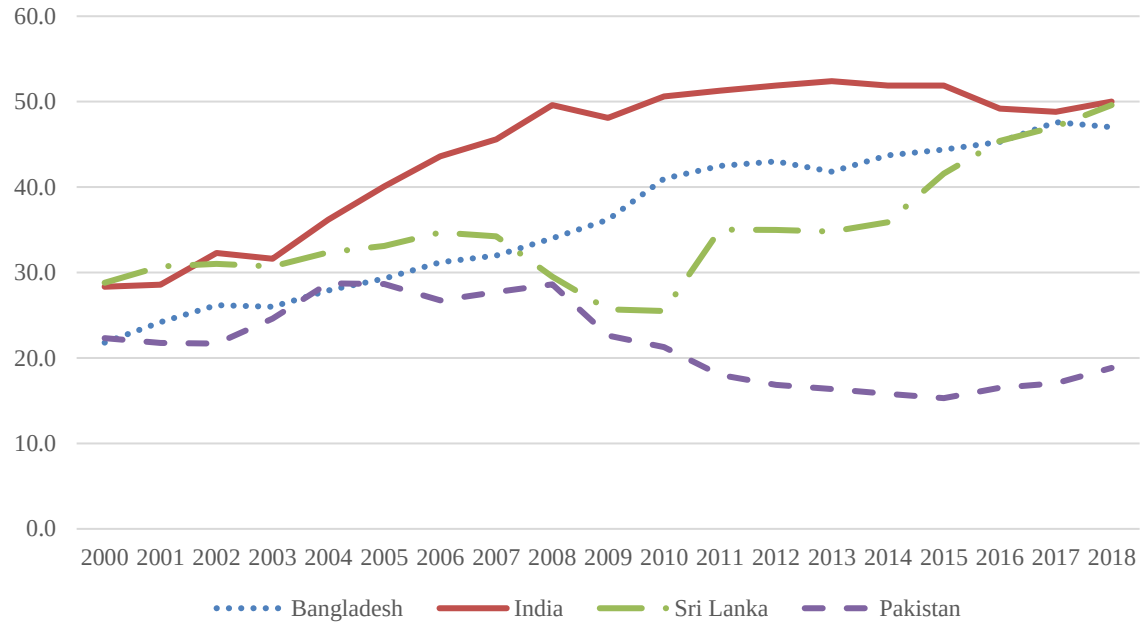


Figure 2.2: Domestic Credit to Private Sector (% GDP), Selected 4 Major SAARC Countries, 2000-2018
(Source: Global Financial Development, World Bank, 2020)

The banks in India contributed the most domestic credit to the private sector, where the ratio has almost doubled from 28.3% in 2000 to 50.0% in 2018. A similar trend has also been observed in Bangladesh, where the ratio has increased by more than double from 21.8% in 2000 to 47.6% in 2017. However, Bangladesh experienced slight decrease to 47.0% in 2018 due to investor's uncertainties towards the Bangladeshi national election (International Monetary Fund (IMF), 2019). Sri Lanka is ranked third, where its ratio increased from 28.8% to 49.6% over the same period, a total increment of 20.8%. The ratios among these three countries imply that the contribution of the banks in these countries in financing the domestic economy is increasing, and thus their economies are relying more on the banks for credit. This enhances the role of banks in conveying monetary policy decisions to the economy.

In the case of Pakistan, the ratio increased from 22.3% in 2000 to 28.6% in 2008, before it fell drastically back to only 15.3% in 2015 and then started to increase again in 2016. This phenomenon was mainly caused by low borrowings from the private sector due to exceptionally low demand for working capital from the private sector which had consequently caused excessive liquidity in the banking system (Ministry of Finance of Pakistan (MFP), 2009). At the same time, reduced government revenue, due to falling international oil prices and commodity prices and the reduced availability of external financing, resulted in excessive governmental borrowing from the banking system using T-bills to finance the rising fiscal spending (MFP, 2010). Under this situation, the ratio was expected to decline in the aforementioned period. Although the private sector did not rely greatly on bank borrowing between 2008 to 2015, however, the lower cost of borrowing together with lower government budgetary borrowing since 2016 have expanded the domestic credit channelled to the private sector in financing their working capital and also for fixed investment (MFP, 2016). This implies that the role of banks in financing the domestic economy has again gained importance in Pakistan after 2016.

Bank concentration, as depicted in Figure 2.3, measures the level of competition in the banking system and is calculated as the assets of the three largest banks in a country as a share of the assets of all of the banks in the country. A higher percentage shows that a country has a high banking concentration, and, hence, the competition level in the banking system is deemed to be weak, and vice-versa.



Figure 2.3: Bank Concentration (%), Selected 4 Major SAARC Countries, 2000-2017 (Source: Global Financial Development, World Bank, 2020)

From Figure 2.3, it can be inferred that banking system concentration has been decreasing in the four major SAARC countries over the past decade. This phenomenon is largely attributed to the success of the financial reform initiatives which have been undertaken by the central banks over the past few decades. Overall, Bangladesh experienced the largest decline in bank concentration between 2000 to 2015, where it declined from 93.9% in 2000 to 26.4% in 2017. Among the four major SAARC countries, Sri Lanka had the highest bank concentration in 2017 where it amounted to 53.4%. The level of bank concentration in India remained largely unchanged over the same period, where the percentage slightly decreased from 34.6% in 2000 to 37.3% in 2017.

The bank concentration level in Pakistan decreased from 74.9% in 2000 to 41.6% in 2015, although it peaked at 95% in 2011. The level of bank concentration in Pakistan has

been declining since 2003 because new private banks started to operate in the country. However, it increased again from 2005 and peaked in 2011 as a result of mergers and acquisitions in the banking system, as a result of the banks being required to conform with the SBP's instruction to increase their capital to RS. 6 billion by December 2009. In fact, two huge mergers took place in 2007 (Khan, Kayani & Javid, 2011).

2.4 Development of the Monetary Policy Framework in the Sample Countries

2.4.1 Pakistan

The central bank of Pakistan, the SBP, was established on 1st July 1948, under the SBP Order 1948, this was a year after Pakistan gained independence in 1947 (Hanif, 2014). The Act was then substituted by the SBP Act 1956 which delegated the board of the SBP to design and monitor monetary policies in line with the economic growth and inflation rates set by the government (Shaheen, 2012). Under the new Act, the SBP was given the twin objectives of stabilising the price level and sustaining high levels of economic growth (Choudhri, Jan & Malik, 2015).

During the 1970s through to the 1990s, except for the exchange rate policy, the SBP did not have any authority or suitable monetary policy instruments to pursue the goals as stated in the Act. At that time, the monetary policy decisions made by the SBP only had a limited significance and the SBP was mainly involved in administering directed credit to priority sectors at subsidised interest rates (Choudhri et al., 2015). Monetary policies during this period mainly operated through direct quantitative restrictions (Shaheen, 2012). Simultaneously, all of the local banks were nationalised and merged into 6 major national banks in 1974, which mainly focused on providing loans to pre-determined economic sectors and supplying funds to the government (Shaheen, 2012). As a result, the inefficiency of the

financial sector caused by nationalisation, high loan defaults, excessive government borrowing and budgetary deficits and a defective interest rate policy were among the main reasons behind the SBP's unsuccessful monetary policy which failed to bring economic stability to the economy, particularly prior to the mid-1990s (Raoof & Hassan, 1999). Until 1990, the SBP continued to use non-market-based monetary policy instruments such as the cash reserve ratio (CRR), the statutory liquidity ratio (SLR), selective credit controls, government-directed and subsidised credit, and administered interest rates (Hanif, 2014).

Based on the aforementioned issues, both the monetary policy framework and the financial sector of Pakistan undertook a significant transformation in the late 1980s, with the primary focus on liberalisation. During this period, the SBP began planning extensive financial sector reforms with assistance from the IMF and the World Bank (Ahmed & Islam, 2006; Khan & Qayyum, 2007). Accordingly, numerous measures were taken to improve the financial sector (Qayyum, 2008a), which included a move towards indirect and market-based monetary management (Ahmad, 2012). After the financial market was liberalised, the SBP finally ended the use of the credit-deposit ratio in 1995, which was a type of direct credit control instrument, which was subsequently replaced by OMO (Shaheen, 2012). In 1992, with its OMO, the SBP announced the auction of 6-month government T-bills and a 3-days repo facility, which allowed banks to obtain liquidity (overnight or up to 3-days in lieu of T-bills as collateral) at the SBP reverse repo rate (Choudhri et al., 2015). Accordingly, the SBP began to use the reverse repo rate as the policy rate, and commercial banks were permitted to extend credit in accordant to indicative annual targets of monetary aggregates set by the SBP (Shaheen, 2020). Moreover, the SBP replaced the credit ceiling system with a new system which allowed banks to freely extend credit, provided that it was within the limits set in relation to the credit-deposit ratio (Choudhri et al., 2015).

In 1994, the SBP was given full autonomy over the operations of monetary policy instead of the administered monetary policy regime. Although given full autonomy, the SBP was tasked by the government to manage the monetary system according to the goals of its policies, and this indicated that the SBP had no goal independence (Malik, 2013). The monetary aggregate (M2) was the operating target of the SBP in achieving its monetary policy objectives, which were set within the Annual Credit Plan framework (Choudhri et al., 2015). In this framework, the federal government fixed the targeted economic growth rate and the inflation rate, the SBP then merged the targeted rates to obtain the targeted M2 growth rate. In order to achieve this, the SBP used monetary policy instruments such as OMO, CRR, and the discount rate (Munir & Qayyum, 2014). Following the financial sector reforms, OMO had become a major monetary policy instrument which was mainly conducted using market-related T-bills, which subsequently granted the SBP the ability to govern liquidity in the interbank market (Shaheen, 2012).

In 1997, the SBP Act 1956 was revised to enhance the role of the SBP. The board of the SBP was granted autonomous accountability to formulate, conduct and implement monetary policy while determining and enforcing the limits on credit that the SBP had to provide to the federal and provincial governments (Ahmad, 2012). In addition, the issuance of any directives by the government to banks or other financial institutions that were non-compliant with the policies of the SBP were also barred (Malik, 2013). Subsequently, a coordination board was formed to ensure good coordination between the fiscal and monetary policies. Subsequently, the SBP transitioned to a more market-based monetary policy, whereby the interest rate was recognised as the main monetary policy instrument. At the same time, the SBP also developed its capacity to effectively manage the financial sector itself and its associated activities (Ahmad, 2012). Since that time, the SBP has mostly been

independent of the influence of government, mainly due to the statutory provisions that were enacted (Malik, 2013).

During the Global Financial Crisis, Pakistan was confronted with a poor economic scenario with the economic growth rate persistently decreasing while the inflation rate was rising. This condition pushed Pakistan's economy into stagflation. Serious condemnation was directed at the effectiveness of the SBP's monetary policy. Although the SBP had dual objectives during that period, it remained unsuccessful in achieving these objectives. From 2006 to 2007, the SBP undertook a contractionary monetary policy to control the rising inflation rate, however, the measures were ineffective in reducing the inflation rate (Munir & Qayyum, 2014). Consequently, to further rationalise monetary policy, the SBP explicitly announced an interest rate corridor in 2009 with the reverse repo rate as the ceiling and the repo rates as the floor of the corridor (Shaheen, 2020). This corridor was established in an attempt, by the SBP, to steer the money market rate within the publicised interest rate corridor. In addition, the SBP also introduced standing facilities to manage liquidity in the money market and to ensure better alignment between the short-term market interest rate and the monetary policy stance (Choudhri et al., 2015).

Before the financial sector reforms, the SBP adopted monetary aggregate targeting as its main monetary policy framework in which broad money M2 was used as the main instrument to achieve price stability (Janjua, 2005). However, the failure of M2 to achieve price stability, as stated above, was due to structural changes in both the economy and the financial sector, while financial innovations and technological advancements had greatly deteriorated the strong relationship between the money supply and inflation (Hanif, Malik & Iqbal, 2012). As a result, the SBP abandoned M2 as its monetary policy instrument. To

date, the SBP has made the T-bill rate the key benchmark for other short-term interest rates in Pakistan's banking system (Omer, 2016). The T-bill rate also guides the SBP in setting appropriate levels of the discount rate, which is the key monetary policy anchor used by the SBP in carrying out its monetary policy decisions (Hassan, 2011).

In 2015, the monetary policy framework of Pakistan had achieved an important milestone by establishing an independent Monetary Policy Committee following the amendment of the SBP Act 1956. This has effectively removed the monetary policy decision making from the board of directors of the SBP under the advice of an advisory committee (Sohail, Sameen & Ahmed, 2019). This is a move towards enhancing the transparency and credibility of the SBP monetary policy by taking a committee-based decision and issuance of monetary policy statements, after being discretionary over the past decades (Tahiri, 2017).

At present, the SBP does not have an explicit intermediate target in attaining the goals of its monetary policies, i.e. price stability. Instead, the SBP has been controlling inflation through adjustments in the money market rate which are generally based on the evaluation of the general macroeconomic situations, and especially based on the relative position between spot inflation with respect to the inflation target as publicised by the SBP (Shah, Raza, Alazhari & Farooq, 2018). Therefore, inflation and its forecasting has been implicitly and practically serving as the nominal anchor of the SBP's current monetary policy framework. This approach to monetary policy decision makings is indistinguishable from a semi-inflation targeting framework[4].

[4] SBP's website.

2.4.2 India

The central bank of India, known as the RBI, was established on 1st April 1935 in accordance with the provisions of the RBI Act 1934. Originally, the RBI was established as a private bank but it was later nationalised on 1st January 1949 following the independence of India from British rule on 15th August 1947[5]. A core function of the RBI has been the formulation and implementation of monetary policy to maintain price stability and financial stability while warranting satisfactory credit flows to the productive economic sectors of India (RBI, 2011a).

After its establishment, between the years 1935 to 1950, the main emphasis of the RBI was to regulate the demand and supply of credit using market-based instruments, such as the bank rate, reserve requirements and OMO (RBI, 2011a). Due to the RBI adopting a passive interest rate policy, the bank rate was only adjusted once in November 1935, whereby it was reduced from 3.5% to 3%. During this period, the prevalence of price stability in the economy led the RBI to not use selective credit controls although it was entrusted with sufficient authority to implement them (RBI, 2011b).

Throughout the 1950s to 1980s, the monetary and credit policies were regarded as important instruments in maintaining price stability and also for regulating the investment climate and business activity. Until the late 1960s, the role of RBI was largely aligned with the planned development process of India in accordance with the national 5-year plans (Dua, 2020). This can be evidenced in the Second Five-Year Plan (1956-1961), whereby it necessitates monetary policy to support the funding of the plan and to promote savings for

[5] RBI's website.

its deployment to sectors in accordance with the priorities of the plan. This led the RBI to accommodate government deficit financing through the issuance of ad-hoc T-bills (Goyal, 2014). The use of ad-hoc T-bills led to less automatic monetisation. The net credit of the RBI to the government is the key reason behind the expansion in the money supply (Bhattacharya, 2006). Consequently, several quantitative control measures were announced to suppress inflationary pressures in the economy, while expanding credits to prioritised sectors (Goyal, 2014). These measures included the introduction of a quota-cum-slab interest rate system which stipulated the minimum lending rate in 1960, a credit authorisation scheme in 1965 which was used to limit the credit disbursed by banks, and the adjustment of the bank rate (RBI, 2011b).

Beginning in July 1969, the monetary policy started to prioritise primarily on credit planning with non-food credit taken as the policy indicator. This followed the nationalisation of the major banks in India. With the nationalisation of major banks, the main monetary policy objective between the 1980s until the mid-1980s was the regulation of credit in accordance with the developmental needs of India (Dua, 2020). The SLR and CRR were used as policy instruments, since the bank rate played an insignificant part in the monetary policy operations due to the prominent prescription of different rates for numerous sector-specific refinancing facilities and also due to the absence of an efficient bill market (RBI, 2011b). As a result, the Chakravarty Committee was established to extensively review the whole monetary system and to perform necessary modifications to the institutional set-up and monetary policy framework. Under the committee's recommendations, a flexible monetary targeting framework that took into account the real sector was introduced by the mid-1980s, with broad money (M3) explicitly recognised as the nominal anchor of the monetary policy, with reserve money as the operating target and the CRR as the key

monetary policy instrument (Mohan, 2005). Nevertheless, several other structural rigidities prevailed in the monetary system and continued to hamper the market from becoming efficient. In 1991, another recommendation was proposed by the Narasimham Committee I which was to improve the efficiency of the financial sector. Following the recommendation, financial liberalisations were carried out and subsequently caused a structural shift in the financing model for both the government and the private sector. In 1992, reverse repo transactions were introduced to absorb liquidity from the financial sector (RBI, 2011b).

In 1991, a balance of payments crisis had caused the demand for money to be unstable. This was due to the evolving interrelationships between money, prices and output, which ultimately made control of the monetary aggregates difficult. As a result, a series of structural reforms and financial liberalisations were carried out in the 1990s. Interest rates were deregulated in the mid-1990s (Dua, 2020). Accordingly, the RBI had abandoned the use of non-market-based to market-based monetary policy instruments, such as OMO (RBI, 2011a). Nevertheless, the structural reforms and financial liberalisations had brought upon innovative financial products and the exponential growth of non-banking financial institutions, which causes difficulties to the RBI in effectively monitoring and controlling money supply (Sethi, Baby & Dar, 2019). To overcome this issue, a "multiple indicator approach" was implemented in 1998 which looked on all the economic and financial variables that influence the major objectives outlined in the Preamble of the RBI Act in order to monitor their impacts on inflation and economic growth (Dua, 2020). This approach stressed the importance of rate channels, such as the rates of return in different markets, the inflation rate, and the exchange rate, relative to quantity instruments, such as money, credit, output, trade, capital flows, and the fiscal position, during monetary policy-making decisions (IMF, 2015).

In 1998, another recommendation was made by Narasimham Committee II which led to the establishment of the interim liquidity adjustment facility (ILAF) in 1999. However, it only became fully operational from mid-2000, whereby liquidity was injected through the bank rate while liquidity was withdrawn through the fixed reverse repo rate. The ILAF then progressively transitioned into the fully-fledged liquidity adjustment facility (LAF) in 2004, and since then it has been functioning through the overnight fixed repo and reverse repo rates (Chacko & Balagopal. 2013). Nonetheless, two major drawbacks were identified in the LAF, i.e. the lack of a single policy rate and a formal corridor. Consequently, a new operating practice was set up, with the call money rate being explicitly acknowledged as the operating target (Chacko & Balagopal, 2013). Under this new iteration of the LAF, the signals of monetary policy stance were conveyed through the call money rate and also an interest rate corridor. In the corridor, the repo rate was recognised as the single policy rate, while the bank rate and the reverse repo rate are recognised as the ceiling and the floor, respectively (Cristadoro & Veronese, 2011). In general, the introduction of the LAF since mid-2000 has helped the RBI to develop the call money rate as its key monetary policy instrument (Das, 2015).

The RBI officially implemented an inflation targeting framework in June 2016 which required it to achieve the publicly publicised inflation target (Mishra et al., 2016). A six-member Monetary Policy Committee was also constituted for setting the policy repo rate (Dua, 2020). Under the new framework, an effective transmission mechanism that largely depends on the pass-through performance is vital because it augments the effectiveness and reliability of the link between the monetary policy instruments. Consequently, this may promote public confidence in the view that the RBI has the ability to achieve its publicised

inflation target, thus allowing it to achieve the targeted inflation rate in much easier and less costly ways.

2.4.3 Bangladesh

The central bank of Bangladesh, namely; Bangladesh Bank (BB), was established on 16th December 1971 after Bangladesh gained independence from Pakistan. Under the BB Order of 1972, the BB is entrusted to maintain price stability, promote sustainable economic growth with a large amount of output and real income, maintain a stable exchange rate and also oversee the overall wellbeing of the financial sector of Bangladesh (Younus, 2005).

After its establishment, the BB functioned under a wide array of pegged exchange rate frameworks under capital controls. Under these frameworks, the exchange rate was recognised as the nominal anchor, while sustaining price stability was the ultimate goal. During this period, monetary policies were conducted based on non-market-based instruments, such as administered interest rates and the volume of credit. Bank rate policy was also often used to support the administered interest rate policy of the BB (Nguyen, Islam & Ali, 2012).

At the same time, administrative import allocations were implemented to limit the excessive demand for foreign exchange. After the introduction of the inflation-adjusted real effective exchange rate index during 1985, the external competitiveness of the local currency of Bangladesh, namely; the Taka, against international currencies began to come under scrutiny (Bangladesh Policy Analysis Unit, 2005). During that period, the BB utilised non-market-based monetary instruments to achieve the explicit goal of saving the limit of monetary expansion on an annual basis after entering into an arrangement with the IMF (Rahman, Nower, Tushar, Abbas & Musa, 2019). Such non-market-based monetary

instruments includes directed credit, administered interest rates, the CRR and SLR, and indirect monetary instruments, such as the outright sale or purchase of government securities, repo and reverse repos to regulate the money supply and credit in the financial sector (Younus & Akhtar, 2009). In addition, moral suasion was also used as an instrument to control the money supply (Nguyen et al., 2012).

Between the 1970s and 1980s, numerous selective and quantitative control measures were extensively used by the BB to supply sufficient credit to state-owned enterprises and also to other priority sectors in order to realise the economic reconstruction and other development objectives set by the government. Banks were offered concessionary loans under a refinancing facility to lend to priority economic sectors. A National Commission on Money, Banking, and Credit was established by the government to detect issues related to the banking system and to suggest remedial measures to improve the efficiency of the banking system. Based on the report of the commission, the World Bank conducted an extensive study on the Bangladeshi financial sector and consequently suggested the need for reforms to enhance the safety, soundness and efficiency of the banking system. Consequently, the government commenced the Financial Sector Reform Programme (FSRP) which consisted of various institutional reforms, policy reforms and liberalisation measures which followed the recommendations of the World Bank (Younus & Akhtar, 2009).

Under the FSRP in the 1990s, the monetary policy framework that is taken up by the BB has begun to shift towards mostly market-based and focuses on influencing the target variables through a supply and demand framework (Hossain & Ibon, 2020). The FSRP had brought substantial changes to the financial sector of Bangladesh, which included the deregulation of deposit and lending rates to allow for more flexibility to meet market needs

and to improve the allocation of economic resources, the replacement of direct credit controls with indirect monetary instruments, the autonomy of banks and financial institutions to regulate by themselves, the strengthening of bank supervision by the BB, the formation of appropriate accounting policies including loan classification and the improvement of capital, and also the strengthening of the debt recovery legal framework and regulations affecting financial institutions (Younus & Akhtar, 2009). Accordingly, such changes have enabled the BB to operate monetary policy decisions using market-based monetary instruments together with direct monetary instruments to achieve price stability and more efficient financial intermediation (Ahmed & Islam, 2004). Nevertheless, the use of direct monetary instruments such as directed credit and administered interest rates were gradually reduced in favour of more market-based monetary instruments like repo and reverse repo (Hossain & Ibon, 2020). With the introduction of the FSRP, the BB shut down the refinance and rediscount windows to develop an interbank market (Nguyen et al., 2012).

Under the FSRP, the BB introduced numerous liberalised interest rate and market-based monetary instruments (Nguyen & Islam, 2010), which subsequently allowed the BB to rely on them together with indirect monetary instruments to conduct monetary policy operations (Ahmed & Islam, 2004). Since 2013, interest rate liberalisation has been undergoing major changes, i.e. the lending and deposit rates have been progressively de-restricted, the development of money market instruments (e.g. the introduction of repo and reverse repo in 2003), OMO on various government T-bill auctions (e.g. 28-day, 91-day, 182-day, 264-day, 2-year and 5-year), and the implementation of a floating exchange rate (Ahmed & Islam, 2004). Starting in 2003, the non-market-based credit control policy was abolished, and the BB has since then relied on OMO as its market-based monetary policy

instrument, with interest rates as the main monetary policy tool for controlling the money supply and credit (Younus & Akhtar, 2009).

Within the FRSP[6], the broader monetary policy stance has gradually shifted from being exchange rate-based to the market-based control of inflation through monetary aggregate targeting (Rafiq, 2015). Under this new stance, the main aim was to regulate the growth of broad money (M2) at a rate in conjunction with the objectives of the BB in achieving output growth and price stability. The BB has been regulating M2 as it had been viewed to be mainly determined by reserve money through the money multiplier, and hence the BB set the reserve money as the operational target (Barkawi & Monnin, 2015). The main idea is that the BB had assumed that monetary aggregate growth, i.e. reserve money and M2, has an expectable relationship with the inflation rate. Based on this view, the BB aims to achieve price stability by controlling the growth of monetary aggregates (Nguyen & Islam, 2010).

The key monetary policy instrument available to the BB are; OMO, reserve requirements, interest rate policy, re-lending and rediscount windows and credit policy (Afroze, 2013). In particular, the BB has been using short-term interest rates as its market-based monetary policy instruments, i.e. repo to inject liquidity and reverse repo rates to withdraw excess liquidity from the financial sector, as a means to facilitate money market operations and to manage liquidity while stabilising reserve money targets (Younus & Akhtar, 2009). Presently, the BB influences real sector price levels through financial sector

[6] The FSRP has been considered as a success since it has promoted greater capital adequacy, governance, regulation and supervision, legal and payment systems (Nguyen et al., 2012). Though the FSRP ended in the mid-1990s, continuous reform measures were still being pursued (Bhattacharya & Chowdhury, 2003).

prices by intervening in the repo and reverse repo rates as the policy rates and also quantity theory-based money stock targeting (Bhattacharya & Khan, 2009).

However, control of money stock growth will be lost as the Bangladeshi economy continues to open up and its financial sector integrates more fully with the global markets (Paul, 2016). Consequently, the tightening efforts related to domestic money stock have been impeded by the liberalisation process. As the monetary policy operations of the BB continue to evolve post-reforms and the economy continues to engage in globalisation, the monetary policy operations of the BB will have to progress from monetary stocked based targeting towards a market interest rate targeting based framework, since the former policy works best only for underdeveloped economies with limited external openness. This view was further supported by the IMF (2013), which stated that interest rate based monetary policies will remain as a significant instrument in the overall monetary management in Bangladesh, whereby its interest rate structure will remain mainly market-determined and that numerous efforts will be undertaken to reduce the spread between lending and deposit rates by establishing a more competitive financial sector. Strong evidence has also been found for the existence of an interest rate channel in Bangladesh (Bashar, 2008). Since both the money and credit channels have been found to operate in Bangladesh, bank deposits and loans can be used by the BB if it wants to achieve price and economic growth stability (Younus, 2005).

At present, the BB has been increasingly focusing on monitoring the overnight call money markets day to day activities, as it is considered to be the main link of the transmission mechanism (Shahiduzzaman & Naser, 2007). This is because the call money market is the most significant and sensitive part of the Bangladeshi money market, whereby a large

number of banks actively participate in the market to remove temporary asset and liability mismatches on a regular basis (Choudhury, 2015).

2.4.4 Sri Lanka

The CBSL was established on the 28th August 1950 (Karunatilake, 2004), after the independence of Sri Lanka in 1948, under the Monetary Law Act (MLA) 1949 No.58 (Dharmadasa, 2015). Since its establishment, the CBSL has been responsible for achieving multiple objectives, i.e. stabilising domestic monetary values, ensuring exchange rate stability, encouraging high output levels, promoting low employment as well as promoting the development of productive economic sectors (Perera & Ichihashi, 2016). The MLA 1949 No.58 was later amended in 2002 in accordance with the prevailing international trends in central banking which is to maintaining economic and price stability and financial system stability (Weerasinghe, 2018). This reduced the main objectives of the CBSL to only two objectives by focusing more on stabilisation rather than development objectives (Perera & Jayawickrema, 2014), i.e. maintaining economic, price and financial sector stability (Amarasekara, 2008).

Since its establishment, until the early 1980s, the focus of the CBSL policy was on economic development although the cost of inflation was high. During this period, the CBSL adopted a more non-market-based approach in handling the economy through the use of direct credit and interest rate controls to boost the identified sectors and also by imposing stringent exchange controls (Perera & Jayawickrema, 2014). However, as a result of the liberalisation[7] of Sri Lanka's economic policies, beginning since 1977, the CBSL has

[7] The reform included numerous measures and strategies, i.e. liberalisation of trade, realignment of the exchange rate, reforms in the financial sector (Cuthbertson & Athukorala, 1990).

gradually transited towards the use of more market-based[8] monetary policy tools after it moved from dual exchange rate regime to a managed float with a crawling band exchange rate regime as a part of trade liberalisation and financial sector reform process (Vinayagathasan, 2013; Paranavithana, Magnusson & Tyers, 2018). The use of non-market-based control measures, i.e. credit control and an administered bank rate, were progressively abandoned by the CBSL which has instead been gradually relying on OMOs for monetary policy operations (Amarasekara, 2008). Following the liberalisation, the regulation of interest rates was made for the first time in 1977, further revisions were made in 1980 and consequently became market-determined after 1988. Discount and rediscount windows in the money market were opened by the CBSL in 1981 (Patabendige & Senarath, 2014).

During the 1980s, the CBSL officially transitioned to a monetary aggregate targeting framework with reserve money (M0) as the operating target and the anticipated growth of broad money (M2) as the intermediate target (Perera & Jayawickrema, 2014). Accordingly, the CBSL has gradually abandoned the use of non-market-based monetary policy instruments in favour of market-based ones, i.e. interest rates. Consequently, the interest rate has become the most vital monetary policy instrument used by the CBSL in its monetary policy operations as evidenced by the establishment of the repo and reserve repo facilies by the CBSL in October 1993 and November 1998, respectively (Amarasekara, 2008).

In 2001, the CBSL made a significant move by transitioning towards a floating exchange rate framework. Accordingly, this caused modifications to the monetary policy framework by placing greater reliance on market-based monetary policy instruments (CBSL,

[8] Sri Lanka moved to a managed float in 1997 (Lane, 2013).

2005; Perera, 2016). In 2002, the adjustments to the exchange rate system and the amendments of the MLA 1949 No.58 reduced the role of the exchange rate to that of an economic stabiliser[9]. Accordingly, reserve money had become the nominal anchor of monetary policy, since price stability is achieved through the influence of changes in the broad money supply under the monetary targeting framework (Perera, 2016).

Following the implementation of the floating exchange rate framework in 2001, the CBSL has been using interest rates as the key monetary policy instrument (Amarasekara, 2009). In 2003, the CBSL transitioned to a system of more active OMO with overnight, short-term and long-term operations to maintain market liquidity and market interest rates in an effort to facilitate monetary policy operations (Weerasinghe, 2018). Under this new system, monetary policy operations were focused on preserving the targeted level of reserve money, while sustaining the call money rate at the level that was in line with the targeted level of reserve money (Wijesinghe, 2006). In order to achieve the targeted level of reserve money, the CBSL conducted OMOs to steer the interbank call money rate within an interest rate corridor with repo as the ceiling and reverse repo as the floor of the corridor (Amarasekara, 2008). At the same time, participants in the money market were anticipated to be actively engaged in the setting of the interbank call money rate within the corridor (Amarasekara, 2009).

Hence, it can be inferred that the CBSL had focused on achieving its monetary policy goals in a given monetary target by relying on interest rate management and OMO as the key monetary policy instruments (Vinayagathasan, 2013). By relying on more active OMOs,

[9] The CBSL emphasised the role of exchange rate stability before the amendment of the MLA 1949 No. 58 in 2002.

the interest rate channel was deemed to play a significant part in the transmission of monetary policy decisions by the CBSL, with the overnight call money rate as its operating target. Through the repo and reverse repo facilities in the OMO, the interest rate corridor was considered to be the key instrument that signalled the monetary stance of the CBSL (Perera & Jayawickrema, 2014; Perera & Ichihashi, 2016). The SRR was also used as an important tool of injecting liquidity to the market on a permanent basis (CBSL, 2019).

At present, the monetary policy operations of the CBSL have transitioned towards the broader adoption of an inflation-targeting framework (Vinayagathasan, 2013). This can be evidenced by the amendment to the MLA 1949 No.58 to facilitate the transition to flexible inflation targeting framework with the view to establishing a strong CBSL mandate, building effective fiscal-monetary policies coordination and further improving technical and institutional capacity (CBSL, 2019). This transition was inevitable due to several factors, especially due to the weakening relationship between the money supply and inflation in the current monetary aggregate targeting framework. This caused the role of the monetary targets under the monetary aggregate targeting framework to become uncertain. Under this situation, the CBSL has been refining its monetary policy framework and has been progressively aligning it with a more flexible inflation targeting type of monetary policy framework. In fact, the CBSL has fulfilled a number of prerequisites for the adoption of an inflation targeting framework, which consequently has led the CBSL to aim to transition to a flexible inflation targeting framework by 2020 (CBSL, 2015; Kannangara & Perera, 2020). At present, the CBSL is adopting an enhanced monetary policy framework which consists features of both monetary aggregate targeting and inflation targeting, where the intermediate target is to maintain inflation rate at the mid-single digit levels through influencing short-term interest rates (Kannangara & Perera, 2020).

2.5 Development of the Monetary Policy Framework in the Sample Countries

2.5.1 Pakistan

Pakistan had an under-developed banking structure at the time of its independence in 1947. During that period, all of the banks in Pakistan had closed most of their branches and migrated to India leaving only a few foreign banks, which were merely attached to the financial business of international trade. There was no central bank in Pakistan at that time[10] (Ali & Afzal, 2011). As a result, the SBP was founded as the central bank of Pakistan in 1948 and was entrusted with the goal of strengthening the banking system by developing banks in the private sector (Qayyum, 2008b). During the first two years of its operation, the SBP successfully opened 51 new bank branches in East and West Pakistan. These banks comprised branches of, 28 Pakistani banks, 12 Indian banks, 4 foreign banks and 7 branches of newly the established National Bank of Pakistan. By the end of 1949, 35 scheduled banks had been formed, i.e. 4 Pakistani banks, 23 Indian banks and 8 exchange banks, with a total of 192 branches operating in both East and West Pakistan (Bilgrami-Jaffery & Fatima, 2013). However, between the 1950s and the 1960s, the active expansion of the banking sectors resulted in competition that was unsound and illegal bank practices were prevalent, due to bribery and corruption (Ahmad, Rehman, Saif & Safwan, 2010). In fact, only a minimal number of bank account holders had access to a quarter of the total credit, and most them were themselves directors of the banks (Ali & Afzal, 2011).

As a result, in 1974, under the nationalisation program, the SBP took all of the private banks into state-ownership in an effort to direct credit towards certain economic sectors as

[10] Pakistan achieved independence after its repartition with India. At that period, the RBI was the central bank for both Pakistan and India. However, a need to establish a central bank for Pakistan was felt as the RBI was not performing its functions fairly for Pakistani banking industry (Zafar & Aziz, 2013).

well as to provide funding to the government (Babar, Latief, Ashraf & Nawaz, 2019). At that time, all of the banks were merged into six major national banks, alongside the establishment of numerous specialised credit institutions and household savings schemes. Such nationalisation of banks met certain social objectives, i.e. the expansion of bank branches countrywide, obligatory credit distribution to the public and agricultural sectors and deposit mobilisation through National Savings Schemes (NSS) (Iimi, 2004). However, it eliminated the private sector from the banking system (Shaheen, 2012), which drastically altered the financial sector of the country (Ali & Afzal, 2011). Besides the SBP, the banks were also regulated by the Pakistan Banking Council (PBC), such dual supervision of banks weakened the supervisory capabilities of the SBP which ultimately worsened the quality of banking services offered by the nationalised banks (Abbas & Malik, 2010). Moreover, during this period, the financial sector was severely regulated by the SBP through administered interest rates that were negative in real terms. These restrictions and regulations had resulted in non-productive lending activities due to political interference rather than project viability (Shair, Sun, Shaorong, Atta & Hussain, 2019; Babar et al., 2019).

Extreme government controls on the banking system, credit distribution towards priority economic sectors and negligence regarding the profitability of firms taking loans were the major characteristics of the financial sector of Pakistan that impeded its efficiency (Ali & Afzal, 2011). The nationalised banks brought about various problems, such as political intervention in credit allocation, an excessive level of non-performing loans and burgeoning intermediation costs (Shaheen, 2012). At the same time, the money market was still in its infancy, while the bond and equity markets were practically unavailable (Qayyum, 2005). In short, the nationalised banks were not functioning based on commercial principles, which consequently caused the efficiency, market sensitivity and financial strength of the

banks to be severely affected (Ali & Afzal, 2011). In fact, at the beginning of the 1990s, the nationalised banks made up more than 90% of the total assets, advances and investments of the financial sector of Pakistan (Waheed, 2009).

To curb the aforementioned issues, the first stage of banking system reforms was carried out in the 1990s, following the recommendations of the IMF and the World Bank (Shaheen, 2012). In 1991, Pakistan amended the nationalisation policy and had privatised the majority of banks which marked the beginning of the banking system reform in Pakistan (Babar et al., 2019). The notable features of Pakistan's banking system reforms were the determination of interest rates as per market signals, the abolition of subsidised credit allocations, the restructuring and recapitalising of the nationalised banks through autonomy and the privatisation of nationalised banks, the removal of restrictions on opening new private banks, improvements in the regulation and management criteria of financial organisations and etc (Khan & Khan, 2007). Additionally, the SBP had introduced a market-based monetary and credit management system, and eliminated direct intervention in the banking system (Shaheen, 2020). Following these reforms, the banking system evolved into a more market-based system that was governed by a robust regulatory framework and overseen by an extensive legal and judicial system. Nevertheless, these financial reform measures were unsuccessful in improving the macroeconomic environment (Hanif, 2014). This was mainly due to the fact that the reforms were introduced during a period of macroeconomic instability in the country, i.e. a large fiscal budget deficit and high, yet volatile inflation (Shaheen, 2012).

In late 1996, the banking system of Pakistan almost collapsed, since around 30% of its total assets were non-performing loans which had continued to be unresolved, due to the

ineffective judicial system in the country. Simultaneously, liquidity issues had emerged due to the spread of disintermediation and banking losses. These issues were mainly caused by governance failures and weak financial regulation. Political intervention plagued the function of financial intermediation and borrowers were not expected to repay their loans (Khan & Khan, 2007). As a result, the banking system entered the second phase of reforms between the late 1990s and the early 2000s. These reforms were primarily designed to prepare for a more wide-ranging and competitive environment in the banking system and also to finalise the privatisation and liberalisation policies[11]. Following this second phase reforms, several improvements were seen in the banking system, i.e. the cost structures of banks were rationalised through capital maintenance and an increase in public funds, banks were partially privatised before were fully privatised, the expansion of bank branches was completely relaxed, loan collateral foreclosure was facilitated and reinforced to minimise the costs related to default, the NSS began to be restructured, integrating it into the financial market and reducing the NSS's distortionary effects on household savings due to its attractive interest rates, and the obligatory reserves of foreign currency deposits was also abolished (Iimi, 2004).

The banking system reforms were quite successful. The banking system, which was once entirely dominated by nationalised banks, was opened up to the private sector, leading to the number of banks, i.e. private, microfinance and investment, as well as other financial institutions to increase drastically. The number of private banks expanded from 12 banks during the reform period to 26 banks in the post-reform period at the end of June 2008.

[11] The World Bank continued to assist the structural adjustment of the banking system and approved the second phase program in October 2001 (Iimi, 2004).

Accordingly, the private sector has emerged as the main player in the financial sector, with its share of banking assets relative to all banks in the financial sector that has increased to 75%, while the share of the nationalised banks had declined from 92% in 1990 to only 19% at the end of March 2009 (Waheed, 2009). As of 2019, the banking system comprised of 34 banks, of which 5 banks were still nationalised, 5 banks were owned by foreigners and 20 local private banks. There were about 14,119 bank offices operating in the country in June 2019, of which 10,835 branches were owned by local private banks while 10 were owned by foreign banks (SBP, 2018). Following privatisation, 80% of banking assets were held by privately owned institutions (Burki, 2015). Taken together, the aforementioned developments in the financial sector indicate that the system underwent extensive change due to the extensive reform measures over the past decades.

2.5.2 India

After its independence in 1947, the Indian government took the view that banks were biasedly granting loans to trade and large firms as working capital (Joshi & Little 1996). The government perceived that the banks should be encouraged to mobilise their financial resources towards important economic sectors in conjunction with the planned national development strategy (Shirai, 2001). When rural development was granted the highest priority by the government during the introduction of the First Five Year Plan in 1951, the operations of India's banks were mostly confined to urban areas and they were not ready to engage with the plan (Gauba, 2012). Consequently, in 1955, the State Bank of India (SBI) was established and started to provide wide-ranging banking facilities, especially in rural and semi-rural areas (Khanna & Kaushal, 2013).

In 1968, a bank nationalisation plan was introduced after the realisation that the SBI itself was insufficient to support the development of the economy and that additional state-linked banks were required (Gauba, 2012). Consequently, during that period, all of the established private banks were nationalised in 2 stages, i.e. in 1969 and 1980. The newly formed nationalised banks were bound by quantitative loan targets to enlarge their coverage to rural areas while being forced to provide necessary credit to priority sectors. In addition, these nationalised banks were then progressively used by the government to finance its fiscal deficits. At that time, although both private and foreign banks were allowed to carry out their operations alongside the nationalised banks, their presence in the banking system remained negligible since their banking activities were extremely limited under stringent entry regulations and bank branch licensing policies (Shirai, 2001).

Until the 1980s, about 90% of all of the deposits in the banking system were controlled by 27 nationalised banks, while the remaining share of deposits was controlled by private banks (Shirai, 2001; Gauba, 2012). In the early 1990s, although the social agendas of the nationalised banks were quite successful, the banking system was in deep stress which was mainly due to the reserve requirements, administered interest rates, and the provision of financial resources to prioritised economic sectors (Bhaumik, Kutan & Majumdar, 2016). These factors ultimately amplified the degree of financial suppression and unfavourably affected the deployment and provision of financial resources in India (Shirai, 2001). Furthermore, the operational and allocational efficiency of the banking system was classified as unprofitable for several reasons, i.e. an excessive number of non-performing assets, a weak capital base, interest rate controls, cross-subsidisation of loans and non-performing loans (Joshi & Little, 1996). In 1991, the government introduced pro-market reforms, however, they were not effective against the financial repression that prevailed in the

banking system (Bhaumik et al., 2016). Consequently, these factors greatly reduced the incentive for banks to function appropriately.

By 1991, the banking system had deteriorated to the point that the banks no longer facilitated the consumption needs of the economy and directed savings into productive investments (Joshi & Little, 1996). Due to the aforementioned issues and compounded with the balance of payments issue during the same year, the financial sector was in grave need of an exhaustive reform program (Arun & Turner, 2002). As a result, in 1992, the Narasimham Committee I was set up and the RBI introduced banking system reforms based on their suggestions (Bhaumik et al., 2016). These reforms included changes in the banking systems, i.e. the abolition of directed credit, lower CRR and SLR, deregulation of interest rates, lower entry barriers for new banks, and the implementation of prudential standards (Shirai, 2001). In fact, the Narasimham Committee I report was considered to be the foundation for the early reforms in the Indian banking system (Roland, 2008).

In 1993, the RBI permitted the entry of private banks into the banking system, on condition that these new private banks were well-capitalised and possessed cutting-edge technology. At the same time, the RBI also forbade the cross-holding practices of banks with industrial entities. The RBI also implemented some limitations on the new banks in terms of opening bank branches to preserve the franchise value of the current banks (Shirai, 2001). Consequently, the level of competition in the banking system increased significantly following the lowering of entry barriers for private banks, whereby 7 new private banks and 20 foreign banks began to operate in India's banking system. Collectively, these banks owned more than a 20% share of the total assets of the banking system by March 2004 (Roland, 2008). Taken together, the deregulation of new bank entry requirements improved

the Indian banking system in terms of advanced technologies, specialised management skills, improved bank risk management policies and better bank portfolio diversification strategies (RBI, 2004).

By mid-1997, the reforms had started to yield positive results, as reported by the RBI. The report by the Narasimham Committee II disclosed that the improvements following the reforms had halted the deterioration of the banking system. However, its achievements were far from satisfactory, especially in terms of customer service quality, technological advancement, the developments in housekeeping practices, in terms of reconciliation of book entries and balancing (Uppal, 2011). As a result, in 1998, the RBI introduced the second wave of banking reforms, following the recommendations of the report by Narasimham Committee II (Bhaumik et al., 2016). In the report, the Committee recommended promoting healthy competition between nationalised banks and private banks. Consequently, the reform process of the RBI focused on enhancing the use of market-based measures while greatly reducing the use of non-market-based measures, i.e. reserve requirements, market-determined pricing strategy for government securities, abolition of administered interest rates, and improved transparency and disclosure standards to promote banking discipline (Kumar, 2014).

As of first quarter of 2020, the Indian banking sector consists of 20 state-owned banks, 22 private banks, and 44 foreign banks. In addition, there are also 44 regional rural banks, 1542 urban cooperative banks, and 94,384 rural cooperative banks and cooperative credit institutions (Indian Brand Equity Foundation, 2020). The total loans extended by the banking sector amounted to 93 trillion rupees and had accepted deposits amounted to 120 trillion rupees by the end of the first quarter of 2019 (Li, Liu, Meng & Sathye, 2019)

2.5.3 Bangladesh

After its independence in 1971, all of the banks operating in Bangladesh, including the commercial banks, performed their banking operations mainly to accomplish the goals of the government (Rahman, 2012). In the 1980s, the banking system expanded significantly following the entry of new private banks. At the same time, the banks adopted a policy of rapid expansion into rural areas and providing plentiful credit to public enterprises without considering the quality of the loans. This consideration of socio-economic welfare superseded sound credit analysis by the banks, and many of them opened branches in rural areas without taking viability into consideration. For instance, the lending rates for priority sectors were kept at artificially low levels without considering the costs arising from the risks involved, as well as the actual cost factors. Consequently, a massive number of asset portfolios at the banks became overdue. Debt recovery was also poor mainly due to weak debt recovery laws and unsuccessful debt recovery efforts by the banks (Islam, 2013).

To curb the aforementioned issues, the BB initiated the Ownership Reform Program (1982-1989) that permitted private banks to begin operations in the banking system as well as improving the efficiency of the existing banks (Ali, Uddin & Hossain, 2015). Simultaneously, the government denationalised two previously nationalised banks, namely; Utarra Bank and Pubali Bank (Bhattacharya & Chowdhury, 2003), with the aim of promoting efficiency in the banking system through healthy competition and a goal to gradually privatise the other four nationalised banks which held about 60% of the banking system's total bank deposits at that time. Consequently, this reform program improved the financial intermediation process in the economy. The growth rate of deposits held by the private banks exceeded that of the nationalised banks (Ali et al., 2015). However, the reform program was held back by two major setbacks, i.e. the excessive influence of the government

in the process of credit sanctioning and the absence of an obligation to lodge loan classifications and provisions (Rahman, 2012).

Consequently, in 1984, a national Commission on Money, Banking and Credit was established by the government to evaluate the whole monetary and credit situation in Bangladesh and to prepare suggestions for the country's financial sector (Islam, 2013). After a detailed evaluation of the various issues prevailing in the banking system, the Commission passed an extensive list of suggestions, which were mainly about the need for structural, institutional, policy and legal reforms in the financial sector, to the government (Raquib, 1999). Such issues included overdue loans from nationalised banks, the unfavourable development progress of financial institutions, the inadequate supply of loans to rural areas and the agricultural sector, supervisory problems faced by the BB, management issues in banks, and the excessive number of scams and forgeries that plagued the banking system. Subsequently, although various remedial measures were taken, including the fixing of recovery targets for the nationalised banks and financial institutions and barring defaulters from obtaining new loans, the banking system continued to deteriorate (Bhattacharya & Chowdhury, 2003).

In view of this, in 1990, the first FRSP (1990-1995) was introduced by the World Bank under its Financial Sector Adjustment Credit project to address the inefficiencies in the Bangladeshi financial sector. It was sponsored by the World Bank and the United States Agency for International Development, while the IMF provided technical support in terms of monetary policy operations and banking supervision (Hammelton, Gardner, Khan & Khalily, 1997). The main objective of the reform program was to gradually deregulate the interest rate structure in order to improve the bank's allocative efficiency, enhance the debt

recovery environment and also to reinforce the capital markets (Bhattacharya & Chowdhury, 2003). In 2000, an assessment of the outcomes of the project was carried out under the Structural Adjustment Participatory Review Initiative (SAPRI) which indicated that the reform measures had satisfactorily achieved its objectives. However, the results were deemed to be far from the desired outcomes of the reform program since the FSRP had been unable to reduce the volume of non-performing loans that had plagued the banking system. It had also been ineffective in promoting the efficiency of resource allocation, especially in terms of access to credit by productive sectors. The deregulation of the interest rate did not enhance the competitive pressures in the banking system as evidenced by the fragmented and oligopolistic banking system even after the reforms (Ali et al., 2015).

Although the FRSP had been undertaken, the weak performance and low capacity of the banks raised the concern of the government to recognise the key issues in the financial sector (Rahman, 2012). Consequently, the government introduced two initiatives that lasted from 1996 to 2002 just before the term of the FRSP expired. The Banking Reform Committee (BRC) was established in October 1996 which aimed to improve the debt recovery performance of banks and to improve the supervisory capacity of the BB (Ali et al., 2015). Afterwards, in 2003, the government launched another project, namely; the Commercial Bank Restructuring Project (CBRP) which focused mainly on identifying an immediate course of action that was required to strengthen the authority of the BB to effectively regulating and supervising the banking system particularly in monitoring loans and strengthening the legal frameworks linked to finance and banking (Barai, 2020). However, the project was still unable to reduce the volume of non-performing loans, as can be evidenced by the non-performing loan ratio that attained its highest level of 41% in 1999. Instead of improving the banking system, the BRC and CBRP actually worsened the

negative flow in the rural banking due to poor loan recovery and the removal of the refinance and interest rate band (Ali et al., 2015).

Starting from 2003 onwards, the government adopted various initiatives to promote the robustness and competitiveness of the banking system. In 2003, the BB was granted the BB Amendment Bill 2003 which bestowed upon it autonomy in formulating monetary policies and undertaking banking system reforms. In 2003, the World Bank and the Bangladeshi government jointly launched a reform project called the Central Bank Strengthening Project (CBSP). This was launched as an effort to create a robust and effective regulatory and supervisory system by strengthening the legal framework, reorganising and modernising the banking system as well as building the capacity of the BB. In 2007, another reform initiative was undertaken by the BB which involved the privatisation of 3 state-owned banks with support from the World Bank. At the same time, in the reform package, the BB set monitorable goals for the recovery of non-performing loans, imposing limits on new non-performing loans, operations, digitalisation, income and profitability, increasing bank net worth and disclosure (Khatun, 2016).

At present, banks dominate the Bangladeshi financial sector and have key roles in it (Rahman, 2012). As of November 2014, banks had provided at least 5.2 trillion Taka of credit to the private sector (BB, 2015). The market share of state-owned banks has been progressively decreasing, while private banks and foreign banks have been gaining market share mainly in terms of bank deposits, loans and advances (Bhattacharya & Chowdhury, 2003) which has effectively indicated an improved level of competition in the banking industry. As of 2019, there were 6 state-owned banks and 3 specialised banks that were

completely or largely owned by the government, 41 private banks, 9 foreign banks and 5 non-scheduled banks (BB, 2020).

2.5.4 Sri Lanka

Prior to 1948, Sri Lanka had a liberal banking system with minimal direct government intervention. The subsidiaries of foreign banks had the largest share in the banking system, where their main objectives were mainly to fulfil the financial requirements of international trade and the working capital of the plantation sector of Sri Lanka (Karunasena, 1996). However, in 1948, the government started to intervene directly in the banking system after the country achieved its independence. The government's interventions included, among others; the control of loan allocations, intervention in interest rate setting and the imposition of strict regulations on foreign exchange. All of these direct interventions were in line with the government's aim of achieving a self-sufficient economic system, this subsequently led the government to also set priority areas for economic development. The government used the banking system as the main vessel for the distribution of financial resources for economic development and also for providing the main financial intermediary and payment functions in the country (Seelanatha & Wickremasinghe, 2009).

In 1950, the government established the CBSL as the chief supervisory body of the financial sector. The government was able to control the banking system as it owned two of the largest banks, which were the Bank of Ceylon and the People's Bank (Fernando, 1991). Until 1977, the government gave these two state banks monopoly rights to protect and develop their businesses. The entry of foreign banks and their branches was not permitted (Karunatilake, 2004), and the operations of private banks were severely limited to prevent business disruptions at the two aforementioned state-owned banks (Karunasena, 1999). The

government facilitated the expansion of these two banks by providing them with legislative rights to venture into new areas, i.e. the establishment of specialised lending facilities, financing international trade and as the bankers of the government (Karunasena, 1999). Between the 1960s to the 1970s, the bank's major emphasis was on localising and expanding the financial sector into remote areas, with support and participations from the government. The government directly intervened in the financial sector through several measures, i.e. the establishment of new government-linked financial institutions, the introduction of new banking regulations and by limiting activities in the financial sector (Karunasena, 1996). Based on the aforementioned facts, it can be inferred that the government was strongly committed to a social welfare policy during this period, with strong government intervention in almost every aspect in the economy (Dunham & Kelagama, 1994).

In the early 1970s, excessive governmental intervention in the financial sector had led to the ineffective distribution of financial resources, which had caused the country to suffer from economic hardships. Consequently, the latter issues aroused the necessity for less direct governmental intervention in the financial sector. As a result, in 1977, the CBSL initiated the first wave of financial sector reforms which lasted until 1988. These reforms were primarily associated with abolishing the banking regulations that had permitted the government to have direct control over the economic capacity of the banks in the financial sector and they were expected to promote more effective financial intermediation through the formation and promotion of efficient financial infrastructures (Seelanatha & Wickremasinghe, 2009). Included among the reform measures were; the deregulation of the interest rate, the introduction of market-based credit policies, the loosening of entry regulations for foreign and local banks and the improvement of supervisory procedures (Edirisuriya, 2007). In particular, foreign banks were allowed to open branches, the credit

ceiling was removed and Foreign Currency Banking Units were permitted by 1979 (Patabendige & Senarath, 2014). Consequently, new foreign banks started business operations, thus giving additional opportunities for international exposure and room for competition within the banking system (Aluthge, 2001).

Unfortunately, by the early 1980s, the reform process had lost its momentum. This was due to the shift in governmental priorities towards politically-driven investment projects, and also, subsequently due to the beginning of the national conflict. During this period, government intervention in the banking system still persisted albeit in a declining manner (Athukorala & Jayasuriya, 2004). In view of this, between 1989 to 1994, the CBSL launched the second wave of financial sector reforms that were aimed at stabilising the economy and strengthening the role of the private sector as the main driver of economic growth (Seelanatha, 2007). However, the latter measure caused rent-seeking activities, and thus negatively affected the national revenue. Due to budget deficits, the government failed to gain the benefits of the financial sector reforms and liberalisations (Dunham & Kelagama, 1994). Also, during this period, the government made some failed efforts to privatise the two state banks, which then led to recurring work slowdowns in the banking system (Seelanatha, 2007).

In 1994, the third wave of financial sector reform was initiated due to major changes in the political landscape in the country. Although the newly-formed government disagreed with the process of reforms initiated by the previous government, they did pledge to rationalise them under public scrutiny. In 1996, the Public Enterprise Reform Commission (PERC) was created to improve the performance of government-linked business operations, as well as to overcome the rising public criticism against privatisation. Consequently, the

government announced that the two state banks would be converted into purely commercialised businesses in the private sector, instead of privatising them. Subsequently, the two state banks were transformed into public limited companies which thereby granted more autonomy to the bank's management in making fundamental decisions regarding bank operations (Seelanatha & Wickremasinghe, 2009).

Over the past few decades, financial sector reforms in Sri Lanka have been rather successful. In 1960, only 2 domestic and 6 foreign banks, with just 28 branches and 17 branches, respectively, were operating in the country (Hemachandra, 2013). However, by 2018, the number had increased to 2 state-owned banks, 11 domestic private banks and 13 foreign banks (CBSL, 2018). Therefore, it can be said that the entry of foreign banks and the following widespread expansion of bank branch networks has gradually improved the competitiveness and efficiency of the Sri Lankan banking system (Claessens, Demirgiiu-Kunt & Huizinga, 2001; Northcott, 2004).

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

This chapter presents a review of the existing literature related to pass-through. A brief description of the historical development of the concept of pass-through is covered in Section 3.2. Section 3.3 discusses the empirical evidences on pass-through, while Section 3.4 covers the empirical evidences on asymmetrical adjustments of the interest rates towards changes in short-term interest rates. Section 3.5 presents the empirical evidences on the impact of interest rate volatility on the adjustment behaviour of bank retail rates. Empirical evidences on the impact of expansionary on bank risk-taking behaviour and leverage and the impact of contractionary monetary policy on bank credit risk and lending rates will be presented in Section 3.6 and 3.7, respectively. Section 3.8 provides the empirical evidences on the subject matter for the sample countries in this study, namely; Pakistan, India, Bangladesh and Sri Lanka. A discussion regarding the perceived literature gap is included in the last section of this chapter, which is Section 3.9. Finally, Section 3.10 provides a comprehensive discussion on asymmetrical models that have been used by previous literature on this subject.

3.2 Brief Description on the Historical Development of the Concept of the Pass-through Mechanism

The concept of pass-through is relatively new in empirical studies and was incepted in the 1990s by the early studies which focused on examining bank retail pricing behaviours (see, for example, the empirical works of Hannan & Berger, 1991; Neumark & Sharpe, 1992; Lowe & Rohling, 1992). Following these seminal works, interest in the study of pass-

through began to emerge and these seminal studies have formed the basis for empirical studies on pass-through until the present day. Nevertheless, these earlier studies only focused on the asymmetries and price rigidities under the setting of an imperfectly competitive banking market structure (Holmes et al., 2015).

The earlier studies mentioned above have mainly attributed customers and bank-related factors as the main causes of interest rate rigidities in the financial sector. However, there has been dissatisfaction among economists and policymakers with this view, which, compounded with the increasing concern to explore possible alternative explanations of price rigidities in the financial market, has led to renewed interest in pass-through research (Fomum, 2011). Accordingly, the seminal study of Cottarelli & Kourelis (1994) delivered an alternative explanation of interest rate rigidity by linking the magnitude of pass-through to financial sector structures. Their study has since changed the whole outlook of pass-through studies.

The interest in pass-through studies began to gain pace following the introduction and successful launch of the single monetary policy and the introduction of the Euro in 1999 which subsequently shifted the overall focus on pass-through studies. Most empirical studies on the Euro Area focused on how the single monetary policy could be conducted under a situation of diverse financial structures across the European Union (EU) member countries (Fomum, 2011). Such studies on the EU includes; Mojon (2000), De Bondt (2002, 2005), Sander & Kleimeier (2004, 2006).

A decade later, the occurrence of the Global Financial Crisis in 2008-2009 caused a major occurrence of interest in examining the concept of pass-through. Advanced countries that were severely affected by the crisis, especially in the US and its close partners, attracted

the attention of researchers who were concerned about how bank retail rates responded, following adjustments in short-term interest rates (Deger, 2012). Consequently, the literature regarding the concept of pass-through has grown substantially ever since.

Currently, attention to the study of pass-through studies has begun to shift towards developing countries (Rajan & Yanamandra, 2015). Several studies have examined the extent and nature of the pass-through and its adjustment asymmetries on numerous countries and regions, be they either cross-country or single country studies. Irrespective of the differences in the methodologies or approaches, most of these studies have found that the pass-throughs have been incomplete in the short-run but almost complete in the long-run. However, there have also been empirical studies that have identified that the transmission process from short-term interest rates to bank retail rates is incomplete in both the short-run and long-run and may be asymmetric (Sznajderska, 2013). Furthermore, there have also been discoveries that have identified substantial differences in the magnitude of the pass-through across countries and banking products, and there is no clear-cut pattern to these differences between the countries.

3.3 Empirical Evidences on the Magnitude of Pass-through

Most of the empirical literatures has discovered substantial differences in the magnitude of pass-through across countries. Generally, it has been found to be sluggish and incomplete especially in the short-run. Although it is typically believed that the pass-throughs should be almost or fully complete in the long-run, there has been a substantial amount of literature that has discovered otherwise.

Numerous studies have found that pass-through has been complete in the long-run while incomplete and rigid in the short-run. For instance, under a cross-country setting of 31 countries over the period of 1980-1993 by using weighted ordinary least squares method, the seminal work of Cottarelli and Kourelis (1994) discovered significant differences in the short-run magnitude and speed of adjustment of pass-through to the lending rate even after 3 to 6 months across the sample countries. They found that some countries had almost immediate and complete adjustment while others had a slower adjustment speed. Nevertheless, they found that pass-through was almost complete for nearly all of the sample countries in the long-run. They explained that the structures of the financial sector, such as the degree of banking system competition, capital movement controls, the entry barriers for new banks, the ownership structure of the banking system and the degree of development of the banking system positively influenced the pass-through level, while interest rate volatility tended to negatively influence it.

Also, under a cross-country setting, Borio and Fritz (1995) investigated the pass-through levels of a group of developed countries between 1984 to 1994. They also discovered relatively substantial differences in both the short-run and long-run pass-through among the sample countries. Particularly, the United Kingdom (UK) and the Netherlands indicated full and immediate short-run pass-through, but the level was considerably lower in other countries. Nevertheless, these differences in the pass-through process declined after one year. They discovered that among all of the sample countries, only the UK, the Netherlands, Canada and Belgium exhibited comparatively higher responsiveness in the long-run. Similarly, to Cottarelli and Kourelis (1994), the authors contended that banking system competition and interest rate volatility significantly influenced the pass-through process.

The establishment of the EU's Monetary and Economic Union (EMU) in the 1990s renewed interest in pass-through studies and has resulted in the concept being taken to a higher level. Studies that focused on the EU mostly stemmed from concerns over the capability of the financial sectors of the EU member countries to adapt to the new unified monetary policy following the implementation of Stage Three of the EMU. Notably, Mojon (2000) was among the first researchers that studied pass-through in the EU. Under the basis of individual countries, he extended the previous work of Cottarelli and Kourelis (1994) and Borio and Fritz (1995) by examining the influences of the financial structures across the EU member countries on the heterogeneity of the pass-through mechanisms and whether these countries had the capability to adapt to a single monetary policy through the use of the error correction model (ECM). Similarly, to the previous works, Mojon (2000) discovered cross-country differences in the pass-through mechanisms in the EU. Furthermore, his empirical result also conformed with Cottarelli and Kourelis (1994) and Borio and Fritz (1995) as he discovered the potential influence that financial structures had on the pass-through mechanism, such as competition in the banking system and interest rate volatility. In particular, he found that increased banking system competition reduced the differences in the pass-through mechanisms, while higher interest rate volatility led to lower it.

Similarly, to the context of Mojon (2000), De Bondt (2002, 2005) also used ECM and discovered evidence of incomplete short-run pass-through whereby it reached at most 50% within the first month, but was almost complete in the long-run especially for the lending rate in the EU. The long-run pass-through to the deposit rate was only 40% while it was almost 100% for the lending rate. Both studies also found that shorter maturity bank retail rates tended to possess more complete and faster short-run pass-through levels in comparison to those with longer maturities. These findings were consistent with the findings

of De Bondt (2002, 2005) who also found that bank retail rates with shorter maturities tended to respond faster than longer maturity rates such as mortgage or deposit rates.

Furthermore, De Bondt (2002, 2005) discovered that lending rates had higher and speedier pass-through rates than deposit rates. These cases of the relatively higher speed of adjustment of the bank retail rates were attributed to increased banking system competition and the reduction of costs of switching and information asymmetries after the implementation of a single currency and monetary policy following the introduction of the EMU in 1999. Their findings were supported by Chionis and Leon (2006), Hofmann (2006), Egert et al. (2007) who found that the speed of pass-through had improved after the launch of the euro currency for all of the EU member countries, except for Germany, by analysing various types of bank retail rates using error correction models. Conversely, by using the TAR, MTAR and asymmetric ECM models, Kleimeier and Sander (2006) found an improvement in the pass-through levels in the EU even before the establishment of the EMU, and this was largely explained by banking system reforms.

By examining the pass-through mechanism in Turkey using structural extended Kalman filter, Yuksel and Ozcan (2013) discovered that the short-run pass-through from short-term interest rates to the lending rate was significant but incomplete, while it was complete in the long-run. Similarly, to the findings of De Bondt (2002, 2005), they discovered that banks adjusted the lending rate comparatively faster than the deposit rate following an adjustment in short-term interest rates. This was especially true for cash and vehicle credit rates since their short-term effects were discovered to be high. However, the pass-through level to the deposit rates was excluded from their studies because no evidence

of a cointegration relationship was found between the short-term interest rates and the deposit rates.

There have also been a number of studies that discovered that the pass-through process was incomplete in both the short and long-run. For example, Payne (2007) contended that the pass-through from the Federal Funds rate to adjustable mortgage rates in the US was an incomplete long-run pass-through. Specifically, the estimated pass-through coefficient to adjustable mortgage rates ranged between only 0.47 to 0.51. Their result was in contrast to Scholnick (1996), as the latter author found complete pass-through to the 30-year fixed mortgage rates in Singapore and Malaysia in the long-run.

In their later study, Payne and Waters (2008) also found incomplete pass-through from the Federal Funds rate to the prime rate in the long-run. They failed to discover cointegrating relationships between the interest rates, probably because of the structural breaks in the data over the sample period of 1987 to 2005. Consequently, they utilised the Gregory-Hansen (1996) cointegration test to allow for an endogenously determined break in the cointegrating relationships. Once structural breaks were allowed in April 1996, they found very significant cointegrating relationships between the interest rates, and also an over-complete pass-through in the long-run as the coefficient was 1.06. According to the authors, this over-complete pass-through could be attributed to the tendency of banks to increase the prime rate to reimburse for additional risks, as argued by De Bondt (2002).

In a more micro level pass-through study, Holmes et al. (2015) found heterogeneous and incomplete long-run pass-through across 15 Columbian banking institutions. The deposit rate had a pass-through coefficient which averaged 0.7 in the long-run. In the case of the lending rate, the coefficient averaged 0.81 which was higher than the average

coefficient of 0.5 between the Federal Funds rate and mortgage rates, as found by Payne (2007). Similarly, their findings were also comparable with the findings of Valadkhani and Worthington (2014) who found pass-through coefficients that ranged between 0.7 to 0.8 from the official cash rate to the mortgage rates of the Big-4 Australian banks.

Jamilov and Egert (2014) examined the pass-through process in the Caucasus region between various country-specific short-term interest rates, deposit rates and lending rates by using the autoregressive distributed lag (ARDL) model. Their findings also pointed towards incomplete long-run pass-throughs. Similarly, to the previous studies, they attributed the incompleteness to the presence of interest rate volatility and low banking system competition, as well as macroeconomic instability. Furthermore, they also provided evidence that both the short-run and long-run pass-throughs varied considerably across different maturities and currency denominations, even within the country itself, while the magnitude of the pass-throughs may remain largely constant over time.

In the context of a mixture of nine Asian countries and the US, Wang and Lee (2009) found complete long-run pass-through in the deposit rate of the US only, while other countries had incomplete pass-throughs. Surprisingly, Wang and Lee (2009) found the inexistence of the pass-through mechanism in Indonesia, Japan, Korea and Thailand, following the insignificant results of the cointegration test. According to the authors, this situation was attributable to the independence of the interest rate from the influence of market forces which led lenders to be insensitive to interest revenue and costs and the non-profit-maximising behaviour of banks. Thus, government policies played a major role in affecting bank loans, rather than the risk factors of debt faced by banks in these four Asian countries.

Compared to the findings of Wang and Lee (2009), Wang and Nguyen-Thi (2010) also discovered incomplete long-run pass-throughs in Hong Kong and Taiwan by using sample data spanning from February 1988 to December 2004. They related their findings to the financial structures of the two Asian countries, such as imperfect competition and near monopoly banking systems. The study of Hussain and Nahar (2016) closely followed the study of Wang and Lee (2009) but in the context of Malaysia. They found incomplete but relatively higher long-run pass-through for both the deposit and lending rates than Wang and Lee (2009), with pass-through coefficients of 0.93 and 0.87 for the deposit and lending rates, respectively.

Tai, Sek and Har (2012) also found slow and incomplete pass-throughs in six Asian countries. Additionally, they also discovered that most of the sample countries had slower adjustments in the pass-through mechanism following the Asian financial crisis in 1997, except for Malaysia, which may be attributable to the improvement in the monetary policy framework and the efficiency of the banking system post-crisis. Additionally, the authors discovered the same empirical evidence as Hussain and Nahar (2014), where the deposit rate had a relatively higher pass-through tendency than the lending rate in the long-run across the six sample Asian countries. When compared to the findings of Wang and Lee (2009), who found no evidence of cointegration between the interest rates in Thailand and Korea, Tai et al. (2012) discovered the existence of the pass-through mechanism in these two countries, albeit at a very low level.

In the context of Taiwan, Zhang, Tsai and Chang (2017) found incomplete short-run pass-throughs in both the deposit and lending rates, similarly to Wang and Lee (2009), Wang and Nguyen-Thi (2010), but with the tendency to achieve a more complete long-run pass-

through for the lending rate only. Similar to Tai et al. (2012) and Hussain and Nahar (2016), Zhang et al. (2017) found that the long-run pass-through to the deposit rate is slightly higher than that of the lending rate. The latter author also provided support to the findings of Tai et al. (2012), whereby the Asian financial crisis in 1997 weakened the lending rate pass-through level in Taiwan.

In a more recent study, Chiumia and Palamuleni (2019) examined the pass-through from money market rate to the lending rate and savings rate of Malawi over the sample period of 1995 to 2017. Using the ARDL and ECM models, they discovered a near complete pass-through to the lending rate of Malawi, but not the savings rate. In addition, they found bigger banks maintain relatively higher lending rates as compared to smaller banks, while having lower savings rate compared to smaller banks. Therefore, they concluded that the magnitude of pass-throughs for Malawian banks are higher under smaller banks than bigger banks.

Investigating whether the effectiveness of monetary policy rate transmission differs before and after the interest rate liberalisation in China by using the ARDL and ECM models, Li and Liu (2019) contended that the mark-up is found to be lower after the liberalisation, and both the long-run and short-run interest rate pass-through has become faster and more complete. They attributed the improvement of the interest rate pass-through to the ongoing reforms of China banking system, which has improved the competitiveness of Chinese banks.

3.4 Empirical Evidences on the Asymmetric Adjustments of Interest Rates Toward Changes in Short-term Interest Rates

Though the literature on the pass-through mechanism has been mainly focused on examining the magnitude of the pass-throughs across different interest rates and maturities in the short-run and long-run, there has been another strand of pass-through study that further explores the presence of asymmetric interest rate adjustments. The investigation of the presence of asymmetric adjustments is particularly useful as it allows researchers to look into the root of the main causes behind the incomplete and sluggishness of the short-run and long-run pass-through, which usually reflects the structure of the banking system and the behaviour of borrowers and depositors. Subsequently, researchers will be able to formulate precise and well-formulated policies to improve the pass-through mechanisms.

Empirical studies on asymmetries in the pass-through can be traced back to the seminal works of Hannan and Berger (1991) and Neumark and Sharpe (1992) which examined the effect of banking market concentration on the adjustment of retail prices in the deposit market in the US. By employing a multinomial logit model and using data from 1983 to 1986, Hannan and Berger (1991) discovered evidence of upward adjustment rigidity in the deposit rate as the average probability of banks reducing the deposit rate was 62% but there was only a 39% average probability in increasing the deposit rate when the 3-month T-bill rate decreased by 29 basis points. A similar result was found by Neumark and Sharpe (1992) although they used different methodologies compared to Hannan and Berger (1991). These two studies posited that banks in a more concentrated market tended to be slower in raising their deposit rate in response to rising market rates, but were faster in decreasing the rate when the market rate decline. Subsequently, they established the customer reaction and

collusive pricing behaviour hypotheses to explain the observed asymmetries presented in the deposit rates of the financial markets.

Payne (2006, 2007) and Payne and Waters (2008) utilised Enders and Siklos (2001)'s TAR and MTAR models and asymmetric ECM to examine interest rate pass-through in the UK. Specifically, Payne (2006; 2007) examined the presence of asymmetric adjustments in the mortgage rates in response to changes in the Federal Funds rate in the UK, while Payne and Waters (2008) examined it in the context of the prime rate in the UK. Payne (2006) found a symmetric long-run adjustment process but incomplete pass-through in the 30-year fixed mortgage rate. On the other hand, Payne (2007) and Payne and Waters (2008) found upward adjustment rigidity in the mortgage rates for both newly built and previously owned homes, and the prime rate, respectively, indicating asymmetric long-run adjustments. Taken together, Payne (2007) and Payne and Waters (2008) generally implied that mortgage rates tended to respond faster to a falling rather than to a rising Federal Funds rate, which provided support for the customer reaction hypothesis and the adverse selection hypothesis.

By using the TAR, MTAR and EC-EGARCH (1,1)-M models to examine the presence of asymmetric adjustments of interest rates in 10 selected countries, Wang and Lee (2009) discovered diverse evidence on the aspects of asymmetric adjustments in interest rates. They found symmetric adjustment existed only in the deposit rate of the US and the lending rate of Singapore. Conversely, they found asymmetric adjustments in the deposit rates of Hong Kong, Malaysia, the Philippines, Singapore and Taiwan with upward adjustment rigidity, while, downward adjustment rigidity was found in the lending rates of Hong Kong, the Philippines and Taiwan. This finding was in line with Scholnick (1996) who found deposit rate adjustment in Malaysia and Singapore was upwardly rigid. Based on this

evidence, Wang and Lee (2009) concluded that the pattern of asymmetric deposit and lending rate adjustments in Hong Kong, the Philippines and Taiwan supported the collusive pricing hypothesis. They further argued that the lending rates of Hong Kong, the Philippines and Taiwan, which exhibited downward adjustment rigidity, was particularly due to the bank's reluctance to reduce the lending rate following the reduction in money market rates due to the greater risks related to information asymmetries. Furthermore, they also found that seven of the ten countries studied exhibited asymmetric volatility in their interest rates, but only Thailand and Korea indicated the leverage effect. However, this was in contrast to the findings of Hussain and Nahar (2016) who found the presence of leverage effect in the adjustment of interest rates in Malaysia by using the same methods used by Wang and Lee (2009) which were the TAR, MTAR and EC-EGARCH (1,1)-M models.

Similarly, to Wang and Lee (2009), Wang and Thi (2010) also discovered asymmetric adjustments of both the deposit and lending rates in Taiwan and Hong Kong by utilising the TAR, MTAR and EC-EGARCH (1,1)-M models. In particular, the latter authors discovered upward adjustment rigidity in the deposit rate and downward adjustment rigidity in the lending rate which provided support for the presence of the collusive pricing behaviour hypothesis, which was again consistent with the conclusions of Wang and Lee (2009). Furthermore, Wang and Thi (2010) also discovered that interest rate volatility negatively influenced the deposit and lending rates of Taiwan, which supported the findings of Cottarelli and Kourelis (1994) and De Bondt (2002, 2005). However, in contrast to Wang and Lee (2009), who found no evidence of the leverage effect in both bank retail rates, Wang and Thi (2010) found significant evidence of the leverage effect in the lending rate of Taiwan.

Extending the framework of Hannan and Berger (1991) to include lending rate adjustments in an asymmetric error correction model, Scholnick (1996) found upward adjustment rigidity in the deposit rates of Malaysia and Singapore, but upward adjustment rigidity in Malaysia and downward adjustment rigidity in the lending rate of Singapore. Similarly, to Hannan and Berger (1991) and Neumark and Sharpe (1992), Scholnick (1996) found support for the collusive pricing hypothesis. Similarly, Zulkhibri (2012) and Hussain and Nahar (2016) also discovered upward adjustment rigidity in both the deposit and lending rates in Malaysia over the sample periods of 1983 to 2005 and 1990 to 2013, respectively. They attributed the upward adjustment rigidity in the deposit rate to switching costs and imperfect competition in the deposit market, while to the credit rationing hypothesis for the lending rate as banks were reluctant to reduce loan rates because of the problem of adverse selection and moral hazard. However, by using the TAR, MTAR and asymmetric ECM models, Tang et al. (2015) found evidence in sharp contrast to Zulkhibri (2012), as they found downward adjustment rigidity in both the deposit and lending rates in Malaysia, which could possibly be due to information asymmetries.

Examining the effect of the pass-through mechanism in the context of South Africa by using both symmetric and asymmetric ECM as well as EC-EGARCH (1,1)-M model, Fadiran and Ezeoha (2012) supported the collusive pricing behaviour hypothesis after they discovered upward adjustment rigidity in the deposit rate and downward adjustment rigidity in the lending rate. In addition, they found that the deposit rate had a quicker downward adjustment than the upward adjustment for lending rate. Accordingly, this provided evidence that banks were discouraging savings, as well as the weak level of competition in the banking system. This finding differed from Fadiran (2014) who used both symmetric and asymmetric ECM models and had discovered that the adjustment behaviour of the deposit rate supported

the customer reaction theory in South Africa. Furthermore, Fadiran and Ezeoha (2012) also revealed that interest rate volatility negatively affected the deposit rate in South Africa and that it also had a leverage effect. Taken together, they suggested that all of these negative factors may render bank retail rates to be irresponsive to changes in the interbank rate and subsequently lead to weak a pass-through mechanism.

In sharp contrast to Fadiran and Ezeoha (2012) and Fadiran (2014), Matemilola et al. (2015) utilised the TAR, MTAR and asymmetric ECM models to examine the presence of asymmetric cointegration and adjustment of lending rate in South Africa. They found support for the customer reaction hypothesis in the lending rate adjustment of South Africa after they discovered that the lending rate adjusted downwards comparatively faster than upwards following changes in the money market rate. Consequently, they contended that banks in South Africa operated in a highly competitive environment and may not increase lending rates due to the fear of negative reactions from borrowers. Furthermore, they attributed the upward adjustment rigidity in the lending rate to the adverse selection hypothesis, in which banks avoid increasing the lending rate to prevent risky borrowings and consequently may instead ration credit.

In the context of six CARICOM Single Market and Economy (CSME) countries, Haughton and Iglesias (2012) found mixed evidence of the presence of asymmetrical cointegration by using the TAR, MTAR and EC-EGARCH (1,1)-M models. In particular, in the deposit and lending rates, they found symmetric cointegration for Barbados, Haiti and Trinidad and Tobago, while asymmetric cointegration for Guyana, Jamaica and St. Lucia. In the case of Jamaica, the adjustment of both bank retail rates exhibited upward adjustment rigidity. On the other hand, both bank retail rates were found to exhibit downward adjustment

rigidity for Guyana and St. Lucia which indicated the presence of collusive pricing behaviour in both countries as well as for the tendency of banks to increase the lending rate to compensate for the defaults caused by information asymmetries. Similarly, to Fadiran and Ezeoha (2012) who found that interest rate volatility negatively affected the deposit rate in South Africa, Haughton and Iglesias (2012) found the same effect on the deposit rates of Barbados, Guyana, Haiti and Trinidad and Tobago. The authors concluded that the deposit rate in Guyana, Trinidad and Tobago, as well as the lending rate in Haiti, Jamaica and Trinidad and Tobago exhibited the leverage effect.

By using the TAR, MTAR and asymmetric ECM models, Holmes et al. (2015) found evidence of asymmetric adjustment in various types of deposit and lending rates in Columbia. In particular, they discovered upward adjustment rigidity in both the deposit rate and the lending rate. The behaviour of deposit rate adjustment was in line with the collusive pricing behaviour hypothesis, as banks quickly reduce the deposit rate in response to monetary loosening due to the zero lower bounds policy of the Columbian central bank. Conversely, the behaviour of the lending rates was in line with the consumer reaction hypothesis. This phenomenon suggests the success of financial liberalisation in promoting competition in the loan market instead of in the deposit market as well as being attributable to the usury laws that protect borrowers from borrowing at excessively high lending rates. Hence, they implied that depositors rarely benefited from an attractive interest rate, however, borrowers may have benefit from a low interest rate. They concluded that such asymmetrical adjustments provided evidence that expansionary policy is more effective than contractionary policy in Columbia.

Apergis and Cooray (2015) utilised non-linear ARDL model to examine the presence of asymmetries in the adjustment of retail rates following changes in the money market rate in selected largest commercial banks in the UK, US and Australia over the sample period of 2001 to 2013. They found substantial positive asymmetry in the adjustment of lending rates, while strong negative asymmetry in the adjustment of deposit rate in all the banks in the sample countries. Furthermore, they contended that monetary policy regime changes and financial structure is not an important factor that explain the presence of asymmetries in the pass-through mechanism. They suggested that policies aimed at offsetting the disruptive effects of financial crisis had deactivated the asymmetries and the interest rate channel itself.

In the context of Mongolia, Doojav and Kalirajan (2016) examined the presence of asymmetries in the interest rate pass-through by using both linear and non-linear ARDL models. They discovered that the long-run pass-through from money market rate to retail rates in Mongolia is asymmetric in the long-run. In particular, in the long run, they found negative asymmetric pass-through with respect to lending rate, while positive asymmetric pass-through is found with respect to deposit rate in Mongolia.

By using the TAR, MTAR and asymmetric ECM models, Aliyu and Ismail (2016) found evidence of asymmetric cointegration between the money market rate and lending rate in Nigeria for both the pre-consolidation and post-consolidation periods. Specifically, the lending rate is found to exhibit downward rigidity during the pre-consolidation, but exhibit upward rigidity during the post consolidation period. Consequently, they suggested the need for a strict supervision of the ongoing banking consolidation exercise in Nigeria, and more measures from the central bank that can improve the competitiveness in the banking sector and strengthen the monetary policy transmission mechanisms.

Muhtaseb (2017) employed the TAR and the asymmetric ECM models to examine interest rate adjustments in the Lebanese lending rates over the period of 1998 to 2016. They found support for the collusive pricing behaviour hypothesis after they discovered a significant asymmetric adjustment in the Lebanese lending rate that exhibited rigidity in its downward adjustment following a decline in the central bank deposit certificate rate. They argued that their findings were as expected, due to the banking system in Lebanon having been increasingly concentrated according to the official statistics from Lebanon.

Utilising non-linear ARDL model, Zhang et al. (2017) found the deposit rate of Taiwan exhibits asymmetric and positive adjustment in the short-run. The deposit rate is found rigid downward, which supports the customer reaction hypothesis. In the long run, the adjustment of deposit rate towards changes in the money market rate is symmetric. As for the lending rate, symmetric adjustment is found in both short and long-run. Similar to Egert et al. (2007), Cihak et al. (2010), Gropp et al. (2014) and Yu et al. (2013), Zhang et al. (2017) found macroeconomic conditions usually influence the degree of pass-through in Asian countries, in which banks adjusts retail rates faster during high economic growth, but slower due to macroeconomic instability and interest rate volatility.

In the context of Malaysia and South Africa, Matemilola et al. (2018) investigated the effectiveness of policy rate pass-through to lending rates and whether the pass-through is symmetric and asymmetric in both countries. The authors discovered that Malaysian and South African banks adjust their lending rates rigidly downward, which support the customer reaction theory. They suggested that the speed of monetary transmission is unequal across the banking sectors, and that that a contractionary monetary policy takes a longer time to impact the economy than an expansionary monetary policy.

Sahin and Cicek (2018) used the non-linear ARDL model to examine the interest rate pass-through from money market rate to commercial loan, consumer loan and deposit rates in Turkey over the sample period of 2011 to 2017. The authors found greater pass-through to the commercial loan rate than consumer loan and deposit rates. Nevertheless, they discovered all the retail rates respond faster to money market rate cuts than hikes, indicating that the Turkish banks were reluctant to raise their retail rates than to decrease them. In addition, the average funding rate and interbank repo rate is found to play an important role than official policy rates, such as the weekly repo rate, overnight lending rate, overnight borrowing rate and late liquidity rate.

In a more recent study, Asab (2020) used the TAR, MTAR and EC-EGARCH (1,1)-M models to examine the presence of asymmetric adjustment in the deposit rate of Qatar following changes in the money market rate. The author discovered incomplete pass-through and asymmetric response of deposit rate in response to monetary shocks, whereby the deposit rate is found to be downward rigid, suggesting a high degree of customer sophistication and an elastic supply of deposits. Additionally, the impact of monetary shocks has a significant positive impact on deposit rate, and that negative monetary policy shocks generates more conditional interest rate volatility in the next period than positive monetary shocks.

3.5 Empirical Evidences on The Effect of Interest Rate Volatility on the Adjustment Behaviour of Bank Retail Rates

By utilising the ECM model, Gambacorta (2008) have discovered the significant impact of interest rate volatility on both bank deposit and lending rates in Italy over the sample period of 1993 to 2001. In particular, the author discovered that the adjustment of both bank retail rates is positively correlated with interest rate volatility, whereby higher

volatility increases both deposit and lending rates. In addition, the impact is higher for the lending rate than the deposit rate.

Wang and Lee (2009) found evidence of significantly positive impact of interest rate volatility on the deposit rate of Philippines and US, but significantly negative impact in Korea, Malaysia, Thailand and Taiwan. As for its impact on the lending rate, it is found to significantly positive in Hong Kong, Japan and Malaysia, but significantly negative in the Philippines, Singapore and Thailand. Similarly, Wang and Nguyen Thi (2010) have also discovered significantly positive impact of interest rate volatility on the lending rate of Hong Kong, while significantly negative on the deposit rate of Taiwan. Wang and Nguyen Thi (2010) contended such discovery could point out the inconsistencies of effect of interest rate volatility on the adjustment of bank retail rates. This is supported by Wang and Lee (2009), whereby the author attributed such inconsistencies to the differences of interest rate risk evaluation and pricing by the banks.

For the case of Brazil, Alencar (2011) have found significant impact of interest rate volatility with lending rate and time deposit rate. By utilising difference generalised method of moments to examine 63 Brazilian banks over the sample period of 2002 to 2009, the author discovered a significantly positive impact of interest rate volatility with the lending rate, but significantly negative impact on time deposit rate. The author attributed such discovery to the profit maximisation behaviour of Brazilian banks whereby profit-seeking banks are usually risk adverse to fluctuation in interest rates. Given the risk-adverse nature, Brazilian banks tend to reduce time deposit rate and increase lending rate when faced with higher interest rate uncertainty.

By examining the impact of interest rate volatility on the adjustment of bank retail rates in six CMSE countries, Haughton and Iglesias (2012) discovered significantly negative impact of interest rate volatility on the lending and deposit rates of Haiti. In contrast, the author found no significant impact on the adjustment of both bank retail rates in Saint Lucia. As for Barbados and Guyana, the impact is found to be significantly negative for the deposit rate of Barbados and Haiti, while insignificant on their lending rates. The latter discovery is also in line with the study of Fadiran and Ezeoha (2012) in the context of South Africa, whereby it is found that interest rate volatility negatively impacted the adjustment of South African deposit rate while no significant impact was found on the lending rate. The latter authors suggested that such findings indicate South African banks is discouraging savings while enjoying higher margins due to higher lending rate. Under such context, the same argument can also be applied to the Barbadian and Guyanese banks in the study of Haughton and Iglesias (2012).

By using fixed effect two-stage least square instrumental variable techniques to examine the pricing behaviour of interest rate volatility on loans and deposits by the German banks over the sample period of 2000 to 2009, Entrop, Memmel, Ruprecht and Wilkens (2015) found evidence that German banks price their loans and deposits according to their exposure to the risk caused by interest rate volatility. In particular, German banks increase both lending and deposit rates when faced with higher uncertainty of future interest rates. Nevertheless, the effect was reversed when the German banks expect to enjoy positive holding period returns following the exposure of interest rate volatility in the long term. Such finding can be justified as German banks are already partly compensated for taking the risk by these expected positive returns, which would in turn allow them to charge lower deposit and lending rates.

Hussain and Nahar (2016) examined the impact of interest rate volatility on the pricing behaviour of Malaysian banks over the sample period of 1990 to 2013. The authors found that interest rate volatility significantly and negatively impacted the adjustment of deposit rate, while no significant effect was found for the lending rate. The authors attributed the insignificant impact of interest rate volatility on lending rate of Malaysia is due to the new interest rate framework implemented on April 2004 which had enhanced the efficiency of Malaysian banking system by encouraging more efficient pricing of interest rate risk.

In the context of Switzerland, Beutler et al. (2017) have investigated the impact of interest rate volatility on the adjustment of lending rates of Swiss banks. By utilising the autoregressive distributed model over the sample period of 2001 to 2013, the authors discovered that the interest rate risk exposure of Swiss banks is the most important factor in the pricing of lending rate in the presence of interest rate volatility. It is found that the impact of interest rate volatility on lending rate of Swiss banks is positively correlated with their level of exposure to interest rate risk.

Hijazeen (2017) found evidence of insignificant relation between adjustments in deposit and lending rates with interest rate volatility in the context of Jordan by using pooled ordinary least square, fixed effect and random effect models over the period of 1995 to 2015. The author attributed such insignificant relationship to the conservative nature of Jordanian commercial banks, whereby they tend to encourage depositor through increasing deposit rates and reduce their lending appetite, which in turn exposed the Jordanian banks to less interest rate risks.

By using fixed effect and error correction models, Bikker and Gerritsen (2018) examined the impact of interest rate volatility on the rates offered to time deposits and

savings account by 58 Dutch banks over the sample period of 2003 to 2014. Similar to the findings of Gambacorta (2008) in the context of deposit rate of Italy and Wang and Lee (2009) on Philippines and US, Bikker and Gerritsen (2018) discovered that interest rate volatility has significantly positive impact on the adjustment of time deposit and savings rate. The latter authors also contended that its impact has increased following the onset of the global financial crisis as the interest rates started to respond more to the economic reality in the Netherlands.

3.6 Empirical Evidences on the Impact of Expansionary Monetary Policy on Bank Risk-taking Behaviour and Leverage

By examining the risk-taking behaviour of 643 European Union and US banks under a low short-term interest rate environment over the sample period of 1999 to 2008 by using dynamic GMM model, Altunbas, Gambacorta and Marques-Ibanez (2014) discovered that low short-term interest rates for an extended period of time may affect the bank's perception and attitude towards risk in at least two ways – i) through their impact on the valuations, incomes and cash flows, which in turn affect the way banks measure risk, and ii) through a more intensive search-for-yield process. Similarly, in the context of 126 European banks, Brana, Campmas and Lapteacru (2019) also contended that loosening of monetary policy has harmful effect on bank-risk-taking behaviour, thus confirming the risk-taking channel in European banks. Therefore, Althunbas et al. (2014) recommended that banking authorities should strengthen their cautiousness during period of prolonged low interest rates, especially if it is accompanied by other signs of risk-taking such as rapid credit and asset-price increase.

By using the pooled OLS model, Dell'Ariccia et al. (2017) examined the risk-taking behaviour of US banks according to the types of loan and degree of bank capitalisation over the sample period of 1997 to 2011. The authors found that the ex-ante risk-taking, which is

measured by the risk rating of new loans, is negatively associated with the increase in short-term interest rates. This lend strong evidence that a low short-term interest rate environment following contractionary monetary policy increases bank-risk taking, at least on the new loan issuance. In addition, they also discovered that the effect of short-term interest rates on bank risk-taking is less pronounced for banks with relatively low capital. The latter finding is also in line with Dell'Ariccia, Marquez and Laeven (2010), whereby well-capitalised banks tends to increase risk-taking following monetary easing, while highly levered banks tends to decrease risk-taking.

In the context of US banking sector also, Drechsler, Savoy and Schnabl (2018) found that lower short-term interest rates lead to greater leverage, lower risk premia and overall cost of capital and thus higher interest rate volatility. Under a low interest rate environment, banks will borrow from depositors to fund levered investments, which exposes banks to funding risk. Therefore, by changing the short-term interest rate, the central bank influences the cost of leverage through changes in the liquidity premium. Lower short-term interest rate makes liquidity cheaper for banks and thus raises their leverage, which resulted in lower risk premia and higher interest rate volatility.

Chen, Katagiri and Surti (2018) examined that impact of low interest rate environment on the bank earnings and the pressure for reach-for-yield incentives of Japanese banks. They discovered that the profitability of Japanese banks has been severely affected following loosening monetary policy, due to lower returns to maturity transformation in the face of flatter yield curves and the inability to offer significantly lower deposit rates. Smaller, less diversified and deposit funded banks are being affected the most, which leads to an

increase in pressures for reach-for-yield incentives which leads to new financial stability challenges.

By using fixed effect model, Bubeck, Maddaloni and Peydro (2020) investigated the impact of negative policy rates on the risk-taking behaviour of 26 largest European banks. The authors discovered that the portfolio of these banks that are more reliant on deposit funding are sensitive to changes in the yield of securities after the introduction of negative policy rates. Nevertheless, these banks are more likely to retain their investments in riskier securities as compared to other banks in the European Union. They concluded that the introduction of negative monetary policy rate induces the risk-taking behaviour on security portfolios by the large and systemic banks in the Euro area.

Sarkar and Sensarma (2019) investigated the impact of loose monetary policy on the reach-for-yield behaviour of banks and their share of risky assets in their portfolios. By using fixed effect and random effect models to examine such impact on 86 Indian banks by using the data from 1999 to 2016, they contended that loose monetary policy can encourage Indian banks to reach-for-yield, which subsequently increases their share of risky assets by using more short-term funding such as deposits from bank depositors. Consequently, they argued that expansionary monetary policy may increase default risk especially for foreign banks and new private sector banks.

Kawamoto, Matsuda, Takahashi and Tamanyu (2020) used system GMM and fixed effect model to investigate the risk-taking behaviour of Japanese banks on lending to small and medium-sized Japanese enterprises under a prolonged period of low interest rate environment in Japan. By using an aggregated dataset comprised of millions of small and medium-sized enterprises in Japan over the sample period of 1999 to 2016, the authors found

evidence of such risk-taking behaviour which have been primarily driven by low interest rate environment and also by increased competition among the Japanese banks. The evidence is apparent especially on bank loans to low-return borrowers. In line with the findings of Dell'Ariccia et al. (2010; 2017), Kawamoto et al. (2020) also contended that such risk-taking behaviour is very apparent especially in highly capitalised banks with low profitability than lowly capitalised banks.

3.7 Empirical Evidences on the Impact of Contractionary Monetary Policy on Bank Credit Risk and Lending Rates

By using the fixed effect, random effect and difference GMM models with the data of 75 countries over the period of 2000 to 2010, Beck, Jakubick and Piloiu (2013) found evidence on the tendency of non-performing loan to rise following an increase in lending rate after a contractionary monetary policy. They contended that such phenomenon occurs because rising lending rate translates to a rise of debt service costs, especially for borrowers with variable rate lending contracts.

Curak, Pepur and Poposki (2013) examined the relationship between the movement of short-term interest rate and the level of non-performing loans of 69 banks in 10 South-Eastern European countries between 2003 to 2010. The authors contended that there is a positive correlation between the levels of short-term interest rate and non-performing loans. Similar to the findings of Beck, Jakubick and Piloiu (2013), Curak et al. (2013) imply that higher short-term interest rate will increase the number of non-performing loans, because an increase in short-term interest rate creates additional debt servicing burden for borrowers with variable rate loan contract. Therefore, they suggested that adaptation of monetary policies should be considered by the monetary authorities in these South-Eastern European

countries as it has substantial impact on non-performing loans and thus credit risk on the banks.

In the context of Spain, Jimenez, Ongena, Peydro and Saurina (2014) discovered that credit risk is at the highest when short-term interest rate that was very low for an extended period suddenly increase steeply which causes a sudden hike in lending rate. Under this situation, the net worth of risky borrowers is suddenly eroded and will possibly leading to non-performance and loan defaults. Jimenez et al. (2014) suggested that, under such condition, it is prudent to reduce the short-term interest rate again to bring down the lending rate in order to lower the credit risk of all outstanding loans faced by Spanish banks. This move will make the banks more willing to again accept credit risk, thereby reducing the tensions in the Spanish credit markets.

Campbell and Cocco (2015) conducted a study on the impact of contractionary monetary policy on the default rate of mortgage loan in the US over the sample period of 1987 – 2012. They discovered that mortgage with adjustable rate tend to default when short-term interest rate increases. This is because high interest rate increases the required mortgage payments, thus tightening borrowing constraints of borrowers and triggering defaults.

In the context of default on corporate loans, Mokas and Nijskens (2019) found that upward movement of short-term interest rates are among the most important drivers of corporate loan defaults in the Netherlands, which captures the illiquidity channel of corporate default. This finding suggests that tightening of monetary policy could cause tremors in the corporate loan market. Similarly, Gonzalez-Aguado and Suarez (2015) discovered that a rise in short-term interest rate will create temporary credit risk across all US corporates because of the extra cost of the outstanding debt. Nevertheless, Mokas and

Nijskens (2019) contended that the type of corporate loans that are exposed the most to credit risk are those with shorter maturity debt with variable interest rates due to its potentiality in creating large strain on the balance sheets of those corporates.

Were and Wambua (2014) investigated the impact of contractionary monetary policy on the movement of lending rate in Kenya. By using fixed-effect model over the sample period of 2002 to 2011, they discovered monetary policy tightening tends to lead to even higher lending rates. Their explanation is that higher lending rates tend to attract more risky borrowers, and banks will generally increase lending rates to compensate for the higher credit risk in the event that borrower default. Similarly, Paligorova and Santos (2017) found that US banks tend to charge riskier borrower with higher premiums in the periods of tight monetary policy and is prevalent among banks with greater risk appetite.

By using pooled OLS, fixed effect and random effect models over the sample period of 2010 to 2015, Bhattarai (2015) examined the impact of default risk associated with non-performing loans on the movement of lending rate of Nepalese banks. The author discovered that an increase in the share of non-performing loans in the total loan portfolio held by Nepalese banks does increase their lending rates. This finding is supported by Bredl (2018), as the latter author further added that a high stock of non-performing loans caused by borrower's default is usually associated with higher lending rates if it is not sufficiently covered by loan loss reserves by banks. Therefore, Bhattarai (2015) suggested the need for strengthening the bank lending rate policy through effective and efficient regulation and supervisory framework.

3.8 Empirical Evidences on the Pass-through Mechanism in the Sample Countries

Similarly, to most developing countries, the SAARC countries, especially the four major countries focused on in this study, have recently received increased attention on the efficiency of their transmission mechanisms as they are considered to be, or are in transition to become emerging economies. The majority of the existing studies on the four major SAARC countries have been based on symmetric adjustments of the interest rates, such as the studies of Qayyum, Khan and Khawaja (2005), Singh (2011), Mohsin (2011), Mohsin and Rivers (2011), Fazal and Salam (2013), Ansari (2013), Dhal and Ansari (2013), Sengupta (2013), Ansari and Goyal (2014), Ghazanchyan, Jonas and Schneider (2014), Ahmad (2015), Mishra et al. (2016) and Pathberiya (2017). On the other hand, only a minimal number of studies have focused on examining on asymmetric properties of interest rate adjustments in these countries, these include the studies of Amarasekara (2009), Nguyen et al. (2012), Das (2015), and Perrera (2016).

Utilising the symmetric panel method, Ansari (2013), Dhal and Ansari (2013) and Ansari and Goyal (2014) studied the lending rate pass-through levels of a panel of banks in India. In their studies, they found incomplete pass-through in the long-run from the short-term interest rate to the lending rates. As noted by Ansari (2013), this moderate rate of pass-through could be attributed to the tendency of the studied banks to provide risk-free loans to government securities instead of risk-bearing loans to individual borrowers. Furthermore, Ansari (2013) and Ansari and Goyal (2014) discovered that the pass-through level was significantly dependent on the level of competition in the Indian banking system. Similarly, Mohsin (2011) and Mohsin and Rivers (2011) used panel data to estimate pass-through performance in Pakistan. They also found sluggish and incomplete pass-through for both the

deposit rate and lending rate. Furthermore, they argued that the level of pass-through would be higher for the lending rate than for the deposit rate in the foreseeable future.

Several studies have also used symmetric time series analysis such as vector autoregressive (VAR) and error correction models. In the case of VAR models, Singh (2011) discovered incomplete and rigid interest rate adjustments from the short-term interest rates to both the deposit and lending rates in India. The author attributed the sluggishness of the deposit rate adjustment to future expectation formations on the interest rate, while for the lending rate, it was due to the inability of banks to re-price the fixed deposit rates, the presence of menu costs and borrower's aversion to recurrent cash flow fluctuations. Using the same method, Ahmad (2015) found incomplete and sluggish short-run pass-through, but it tended to be more complete with the deposit rate which adjusted quicker than the lending rate in the long-run. The findings contradicted greatly with the findings of Mohsin (2011) and Mohsin and Rivers (2011) who found opposing evidence in Pakistan. Ghazanchyan et al. (2014) also found incomplete pass-through in Sri Lanka when using the VAR model.

Sengupta (2013) and Mishra et al. (2016) adopted the structural VAR framework to examine the pass-through level in India. They found less than complete pass-through during the sample period of 1997-2014. However, Sengupta (2013) contended that the pass-through level in India had improved after the implementation of the LAF in 2000 due to higher transparency and stability in the money market. Although the pass-through was incomplete, Mishra et al. (2016) argued that the monetary transmission was very likely to be channelled through the interest rate channel in India.

Regarding the studies that used symmetric error correction models, such as the studies of Fazal and Salam (2013) for Pakistan and Pathberiya (2017) for Sri Lanka, it was

found that the short-run and long-run pass-through to both the deposit and lending rates were incomplete. Similarly, to Ansari (2013), Fazal and Salam (2013) attributed the incomplete pass-through to the lending rate in Pakistan being due to the behaviour of banks in providing relatively risk-free sovereign bonds and securities rather than lending to the private sector and charging risk premiums. Furthermore, both Fazal and Salam (2013) and Pathberiya (2017) discovered that the lending rate generally had a higher pass-through level than the deposit rate, and if left unsolved, this may lead to a higher interest rate spread and less effective monetary policy as well as an inefficient banking system in both countries.

Qayyum et al. (2005) utilised the symmetric autoregressive distributed lag model to examine the pass-through mechanism in Pakistan. They found rigid pass-through from the T-bill rate to both the deposit and lending rates. They attributed this rigidity to the reluctance of banks to increase their deposit rate when the T-bill rate increased as it may have affected their profits in the short-run. On the other hand, the sluggishness of the lending rate could have been because of menu costs and oligopolistic structure of the banking system.

On the other hand, Amarasekara (2009), Das (2015) and Perrera (2016) used asymmetric error correction models with dummy variables to capture the asymmetries. In the case of India, Das (2015) found asymmetric adjustment behaviour for both the deposit rate and the lending rate, where they both exhibited downward adjustment rigidities. In addition, the latter author found mixed evidence in terms of the completeness of pass-through, as they discovered that the lending rate pass-through was incomplete while the deposit rate had over-complete pass-through. They also contended that the deposit rate adjusted faster than the lending rate, which was consistent with Ahmad (2015). In the case of Sri Lanka, Amarasekara (2009) and Perrera (2016) also discovered incomplete and

sluggish pass-through to both bank retail rates. However, Amarasekara (2009) found no evidence of asymmetric adjustments, while Perrera (2016) found that both bank retail rates exhibited upward adjustment rigidities. The latter author also supported the findings of Mohsin (2011) and Mohsin and Rivers (2011) where the lending rate was demonstrated to adjust faster than the deposit rate. Amarasekara (2009) conclude that such incomplete and rigid pass-through had hindered the success of monetary policy in Sri Lanka.

Lastly, Nguyen et al. (2012) found that the pass-through from the discount rate to the lending rate was asymmetric by utilising the TAR model and a threshold augmented ECM. In particular, they found that the lending rate exhibited upward adjustment rigidity which supported the customer reaction hypothesis. They were astounded by their finding because the interest rate spread was high in Bangladesh which should have provided support to the collusive pricing behaviour hypothesis. They hypothesised that this phenomenon could be attributed to the fact that the higher interest rate spread had caused the lending demand to become more elastic, hence customers were more sensitive to lending rate changes.

3.9 Literature Gaps

Based on the aforementioned literature reviews regarding the four major SAARC countries, it can be inferred that there have been a minimal number of pass-through studies related to these countries. A large part of this limited number of studies has been based on the symmetric framework, while only a small fraction of them have examined the presence of asymmetric adjustment behaviour. As a result, Qayyum et al. (2005) called for asymmetric econometric investigations to account for asymmetric arguments in explaining pass-through rigidities, while Amarasekara (2009) and Fazal and Salam (2013) also proposed an extensive investigation into the reasons for incomplete pass-through to uncover

the structures of the banking system and to validate the presence of collusive behaviour, adverse selection, moral hazard, menu costs, etc. This was supported by Aziakpono, Sander and Kleimeier (2012), who stated that asymmetrical pass-through frameworks were most useful for investigating the internal structure of a banking system as such models provide detailed information about the possibility of short-term and medium-term adjustments. Investigations of the banking structure are important as they allow policy makers to formulate structural policies to improve or even re-structure the banking system in a country.

Although there have been a few studies that have used asymmetrical pass-through models, most of them have used asymmetrical error correction models that have mainly used dummy variable to capture the asymmetries. As noted by Andries and Billon (2016), this kind of investigation into asymmetries is rather ad-hoc without being explicitly embedded in the model. Furthermore, the use of this method is unable to take account of any threshold adjustments, as there is a high possibility that the bank retail rates may only change when the changes in short-term interest rates have reached a certain threshold level. Hence, there is a need for a study that uses more advanced methodologies that can account for the asymmetrical and threshold adjustments between the interest rates so that more robust pass-through behaviour can be obtained in these SAARC countries.

To the best of our knowledge, there have been no studies that have implicitly examined the effect that interest rate volatilities have on the adjustment behaviour of bank retail rates in the four major SAARC countries studied. As empirically supported by past studies (see, for example, Cottarelli & Kourelis,1994; De Bondt, 2002, 2005), the interest rate plays an important role in influencing bank's retail rates adjustment behaviours, and that the effect can be either positive and negative. In the case of the four major SAARC countries,

interest rate volatility should be taken as one of the prime factors when examining the pass-through mechanism because of the frequent changes in, and the instability of the monetary policy regimes over the past decades. Among others, Perrera (2016) discussed the possibility of high interest rate volatility affecting the bank's retail rates adjustment in Sri Lanka. Furthermore, as far as this study is concerned, there has been little or no study on risk-taking behaviour, which is usually associated with bank leverage, in the studied countries. Taken together, there is a need to identify the effects of interest rate volatility and the presence of bank leverage in the banking systems of the four major SAARC countries.

3.10 Discussion on Asymmetrical Models

In the past, interest rate pass-through studies assume the adjustments between the retail rates and policy rates is symmetric. Recent studies have (see Section 3.4 for a thorough review on evidences on asymmetrical interest rate pass-through), however, discovered evidences of asymmetric adjustment of retail rates following changes in the policy rate. Accordingly, several non-linear models have been suggested in the interest rate pass-through literature to remedy the insufficiencies of linear models, and to better capture the observed asymmetric adjustment behaviour of the interest rate variables.

Non-linear models enable the interest rate variables to have different states, called regimes, within which they can exhibit different behaviour (McMillan & Wohar, 2010). Typically, there are two popular types of non-linear models. The first type of non-linear model is a non-threshold-type which assumes the regime switch is based on whether the deviations from the long-run equilibrium is either positive or negative. On the other hand, the second type model is a threshold-type which assumes the regime switch will be only be triggered when the deviations from the long-run equilibrium exceeds a certain threshold.

The most frequently used non-linear models in interest rate pass-through studies that assumes regime switch without threshold are the asymmetric ECM model of Granger and Lee (1989) and the NARDL model of Shin, Yu and Greenwood-Nimmo (2014). While, non-linear models that assumes regime switch triggered by threshold includes the TAR model of Tong (1978) and Tong and Lim (1980) and the STAR model of Chan and Tong (1986).

3.10.1 Asymmetrical Models without Threshold-Related Dynamics

Non-linear models without threshold-related dynamics such as the asymmetric ECM model and NARDL model assumes that the tendency of deviations to move toward a long-run equilibrium is present in every period (Balke & Fomby, 1997). In terms of the introduction of asymmetries into the adjustment process, these models use dummy variables that simply decomposes the regime into positive and negative changes to measure the effects of positive and negative changes of the independent variables to the dependent variable (Nguyen & Sato, 2018). In other words, these models are being confined to capture the asymmetry by assuming zero thresholds (Deb, Lee & Lee, 2020). Therefore, if the regime switch is only triggered when the deviations reaches a certain threshold, these non-linear models will be mis-pecified (Grasso & Manera, 2007). In addition, this kind of method of asymmetry introduction, especially the asymmetric ECM model, captures the asymmetry in an ad hoc manner, and therefore have the shortcoming of not testing the hypothesis of asymmetric cointegration per se (Andries & Billon, 2016).

Generally, the shortcomings of the asymmetric ECM model have brought upon the popularity of the NARDL model. In an asymmetric ECM model, the variables must be integrated of the same order, or $I(1)$ (Kocaarslan & Soytas, 2019); while this limitation is relaxed in an NARDL model and allows combining of variables with different orders of

integration, i.e. *I*(0) and *I*(1), and is thus more flexible (Lin, 2019; Li & Liu, 2019). In addition, the NARDL model strengthens the test power of small number of samples as compared to the asymmetric ECM model (Lin, 2019). Furthermore, the NARDL model also allows the joint analysis of non-stationarity and non-linearity and permits the identification of asymmetric effects of positive and negative changes in independent variables on the dependent variable in both short-run and long-run within a single equation framework (Rezitis, 2019; Alqaralleh, 2020), and is still able to distinguish between the short-run and long-run effects between the variables (Hoang, Lahiani & Heller, 2016). Nevertheless, the NARDL model has the limitation of inconclusive evidence of cointegration between the variables if the test statistics in bound test lies between the upper limit and lower limit of critical value provided by Pesaran, Shin and Smith (2001) and Shin et al. (2014) (Lin, 2019).

3.10.2 Asymmetrical Models with Threshold-Related Dynamics

In contrast to non-linear models without threshold-related dynamics, non-linear models with threshold-related dynamics assume regime switch happens only when the deviations reach a certain threshold. In other words, these models introduce asymmetries into the models by decomposing the regimes to upper regime and lower regime based on a certain threshold, whereby the deviations will not be adjusted until the deviations exceed a certain threshold (Durlauf & Blume, 2016). The presence of threshold effects is usually related to the presence of costs of adjustment, which posits that small deviations from the long-run equilibrium will not be corrected, and will only be corrected when the deviations are large enough for the benefits of adjustment to outweigh the costs of adjustment (Posedel & Vizek, 2011; Phiri, 2017).

3.10.2.1 Threshold Autoregressive (TAR) Models

The first type of non-linear model with threshold-related dynamics is the threshold autoregressive model, which includes the TAR and MTAR models. In comparison, the asymmetric behaviour in trough or peak movements of the series are detected by TAR model. On the other hand, M-TAR model is rather used to assess if the momentum of a series is larger in a given direction relative to the momentum in the alternative directions, and thus can efficiently capture asymmetric sharp contractionary and expansionary movements of the series when they diverge from their long run equilibrium (Ngene, 2012). Both models are based on discrete indicator functions characterised by discrete transition between two or more distinct regimes, with the threshold variable is either in one of the regimes or the other regimes (Clayton, 2011; Merkusheva & Rapsomanikis, 2014).

Both models posit that the regime switch is observed when the threshold variable crosses a fixed threshold, and that the regime switching process is assumed to be discrete, abrupt and discontinuous (Hasanov & Omay, 2008; Tonguc, 2010; Guney, 2015). In an economic sense, a discontinuous regime switch happens when a threshold variable suddenly switches to the other regime following discontinuous and abrupt decision or intervention by policymakers, which may then lead the economy to simultaneously and instantaneously switches to totally different dynamics (Stefano & Mainardi, 2001; Tong, 2011). Therefore, threshold autoregressive models assume the regime change is clear cut (McMillan & Wohar, 2010). Accordingly, the TAR and MTAR models are economically meaningful because the series is clearly divided into two different sets of regimes, and thus allows the more proper and accurate examination of the dynamics of the series between the two different sets of regimes (Artis, Galvao & Marcellino, 2007).

The key component in fitting the threshold autoregressive models is the estimation of the threshold value which separates the series into two or more distinct regimes (McMillan & Wohar, 2010; Yau, Tang & Lee, 2015). However, there has been some issues associated with the estimation of the threshold value. If the threshold enters into the model unrestrictedly, the problem of estimating a consistent threshold value will emerge (Grasso & Manera, 2007). Therefore, the grid search method of Chan (1993) is typically adopted to identify the single optimal threshold value in the threshold models, which is based on the minimisation of the sum of squared residuals (McMillan & Wohar, 2010). However, although this grid search method yields a super consistent estimator of the threshold value (Grasso & Manera, 2007), the estimated residuals could be very close and could result in over-estimated residuals (Liao & Goo, 2019). In addition, the identification of the threshold value may be constrained by insufficient observations in one or more distinct regimes, especially for relatively small observations. Furthermore, if the threshold models are used for cointegration analysis and the Engle-Granger (1987) single equation approach is followed, the location of the threshold value may be affected by the bias in the Engle-Granger static long-run regression. This bias has been found to be more serious when the residuals are highly correlated, and to decline only slowly with larger sample sizes (Stefano and Mainardi, 2001).

3.10.2.2 Smooth Transition Autoregressive (STAR) Model

The second type of non-linear model with threshold-related dynamics is the smooth transition autoregressive (STAR) model, which is generalised from the TAR model by replacing the fixed threshold value with a smooth transition function (Zhou, 2010). There are two different specifications of the STAR model, which specifications are determined by the choices of the smooth transition function. If the function is specified as a logistic type

based on cumulative logistic distribution, the resulting STAR model is the logistic STAR (LSTAR) model; while if the function is specified as an exponential type based on inverted normal density function, the resulting STAR model is the exponential STAR (ESTAR) model (Merkusheva & Rapsomanikis, 2014). In comparison, LSTAR model allows for differing behaviour depending on whether the series are positive or negative, while the ESTAR allows for differing behaviour between large and small values of the series regardless of sign (Hasanov & Omay, 2008). The STAR model models the regime switch as a continuous process dependent on the transition variable measured by a smooth transition function (Leon & Najarian, 2003), and it typically assumes a continuum of segment or states bounded within a finite number of extreme regimes (Hubrich & Terasvirta, 2013; Xaba, 2014).

In contrast to the TAR and MTAR models whereby the regime switch occurs abruptly and discontinuously at a specific threshold value, the STAR model allows a more gradual transition between the regimes. In an economics sense, the notion of gradual switch between regimes can be related to an economy characterised by a huge number of economic agents with different timing of reactions to the decision and intervention of policymakers (Clayton, 2011). Accordingly, the regime shifts lie in the heterogenous reaction of the economic agents to changes in the threshold variable, with each of the economic agent responding differently, especially to changes occurring in the proximity of the threshold value. In this perspective, the switch between the regimes would become blurred (Stefano & Minardi, 2001). Therefore, the STAR models allow for incorporating regime switching behaviour both when the exact time of the regime change is not known with certainty and when there is a short transition period to a new regime due to the regime switch takes place smoothly over time (Kavkler, Mikek, Bohm & Borsic, 2008; Ekner & Nejstgaard, 2013).

Given the smooth transition nature between the regimes of which the threshold variable may have the possibility of being determined by both regimes, the STAR model typically has blurred threshold that separates the regimes, with one regime are allowed to have more impacts in some times and other regime to have impact in other times (Stefano & Minardi, 2001). Accordingly, the STAR model technically would have no clear-cut regime, and hence made the proper identification of the current regime becoming increasingly difficult (Hahn, Steward, Blayney & Davis, 2016). In addition, a precise smoothness parameter in the transition function of the STAR model that determines the smoothness of the transition from one regime to the other tends to be very hard to obtain when the value of the transition function is very large, unless the number of observations around the threshold are many (Van Dijk, 1999; Van Dijk, Terasvirta & Franses, 2002; Tong, 2011). Taken together, these issues have highlighted the problem of imprecision in the estimation of the exact smooth transition function around the threshold value. Also, the smoothness parameter in the LSTAR model is also often reported to have a positive sample bias (Ekner & Nejstgaard, 2013). Furthermore, although the LSTAR model nests the TAR model as a special case, however, it does so only in the form of a limiting case when the regime switch becoming infinitely fast, which renders standard nested tests impotent. This is supported by the recent simulation study of Gao, Ling & Tong (2018) which shows that the test statistic under the STAR model follows a chi-squared distribution, while the TAR model one can be expressed as a functional of a chi-squared process.

3.10.3 Justification on the Asymmetrical Model Used

As discussed in earlier subsections, there are generally two types of non-linear models, which are the threshold-type and non-threshold type, capable of modelling the asymmetric relationship between the retail rates and the policy rate. Nevertheless, this study will adopt the threshold-type non-linear models for this purpose. The presence of thresholds in the retail rate adjustments following changes in the policy rate can be justified by, and thus is very important in interest rate pass-through studies, given the profit maximising nature of banks, of which banks will only adjust their retail rates when it is profitable for them. This is usually related to the costs of adjustment frequently faced by the banks, which may cause them to be reluctant to change their retail rates following small changes or deviations in the policy rate, while will only change retail rates when the changes or deviations from the policy rate is large enough. In other words, the factor of costs of adjustment may lead to banks to revise their retail rates only when the discrepancy between their retail rates and the policy rate has reached a certain threshold. In addition, non-threshold type non-linear models assumes continuous adjustment of retail rates following changes in the policy rate. Nevertheless, this is often not the case since this will affect the volatility of their bank profits and also reduce their credibility towards their customers. Therefore, this study argues that banks will only adjust their retail rates when the benefits of adjustments exceed the costs of adjustments, or when the divergence between their retail rates and the policy rate has reached a critical threshold that is in their favour. Accordingly, this justifies the use of threshold-type non-linear models.

As the threshold-type non-linear models has been selected in this study, the issue now is to determine whether to adopt the abrupt transition model, i.e. the TAR model, or the smooth transition model, i.e. the STAR model, both of which has different assumptions on

the regime switch behaviour. In reality, policymakers will have a clear-cut decision on the implementation of monetary policy, which is to cut policy rate under an expansionary policy or to increase policy rate under a contractionary monetary policy. Unlike the STAR model, given its assumption of a smooth regime switch behaviour, it has no clear-cut regime as the regime switch behaviour will be hard to determine with precision due to potentially blurred threshold point between the regimes. Accordingly, the current state of monetary policy, either expansionary or contractionary, cannot be clearly differentiated by the economic agents, and thus may cause confusion. Therefore, as the exact time of changes in monetary policy stance by central banks can be clearly differentiated, i.e. increase policy rate under a contractionary monetary policy or decrease policy rate under an expansionary monetary policy, the TAR model fits this notion and will be economically meaningful. This is because the monetary policy stance will be clearly divided into two distinct regimes under the TAR model, i.e. expansionary or contractionary regime (Artis, Galvao & Marcellino, 2007), and thus allows a more precise distinction of the effects between contractionary and expansionary monetary policy stances have on the adjustment of retail rates. Furthermore, as interventions of the central banks in monetary policy is often discontinuous which may lead to a switch to a different dynamic (Tong, 2011), the use of the TAR model will be preferred over the STAR model given the assumption of discontinuous regime switch behaviour posited by the TAR model.

Furthermore, the STAR model assumes different reaction of banks towards monetary policy changes which leads to smooth retail rates adjustment over time; while the TAR model assumes homogenous reaction of banks towards monetary policy changes. Nevertheless, this study would argue that banks will tend to act simultaneously and in the same direction following changes in the monetary policy stance. If each bank has different

cost of changing their retail rate as posited by the STAR model, then the adjustment may be smooth. However, since all banks have similar if not the same cost of fund, whereby they obtain funding from the single money market regulated by the central bank in a country, they all will have the same cost in adjusting their retail rates, as this cost of fund technically applies to all banks in the country. Furthermore, other factors such as banking competition may also encourage banks to adjusts their retail rates in order to remain competitive with each other. In addition, central banks may also use various monetary policy tools at its disposal to force banks into adjusting their retail rates according to the current monetary policy stance, which will then have to be strictly obeyed by all the banks in the country at the same time. Accordingly, it is expected that the banks will adjust their retail rates simultaneously and in the same direction following changes in the monetary policy stance by the central banks, and thus justifies the use of the threshold autoregressive models, i.e. the TAR and MTAR models, in this study.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter presents the methodologies used for the estimation of the pass-through rates in the four major SAARC countries, namely; Bangladesh, Pakistan, India and Sri Lanka. The data used for the empirical estimations is explained in Section 4.2, while the theoretical and conceptual frameworks are described in Section 4.3 and 4.4, respectively. The research design is presented in Section 4.5. In Section 4.6, the methodologies that will be used are extensively described, which includes the Augmented Dickey-Fuller (ADF) (1979), Phillips-Perron (PP) (1988), Enders and Granger (1998) TAR and MTAR unit root tests, the Ender and Siklos (2001) TAR and MTAR cointegration tests, the Wang and Lee (2009) EC-EGARCH (1,1)-M model, as well as a battery of post-estimation diagnostic tests.

4.2 Data Description

The money market rates used in this study will be proxied either by the call money rate and T-bill rate, while the deposit rate and the lending rate will be used as the proxies for the bank retail rates. The specific choice of money market rate for each sampled country was determined based on their importance as the main short-term interest rate used by the respective central banks in transmitting their monetary policy decisions to the economies. Specifically, the call money rate will be used as the proxy of the money market rate for India (Kumar, Prakash & Kushawaha, 2017; Sarkar & Sensarma, 2019), Bangladesh (Hamim, 2012; Choudhury, 2015) and Sri Lanka (Abeygunawardana, Amarasekara & Tilakaratne,

2017; Perera, 2018), while the T-bill rate will be used as the proxy for Pakistan (Ali, Rafiq & Gul, 2015; Omer, 2016)[12].

This study utilises monthly interest rate series because the examination of pass-through requires high-frequency data (Qayyum et al., 2005), and time aggregation may bias the pass-through estimates (Cottarelli & Kourelis, 1994). Moreover, monthly data are more relevant than quarterly data for the purpose of policy analysis (Cottarelli & Kourelis, 1994). The selection of the sample period was based on when the sampled countries intensified the usage of interest rates as their main monetary policy instruments, and also due to the availability of data. Specifically, the sample period for Pakistan spans from 2004M1 to 2017M12, India spans from 2001M1 to 2017M12, while Bangladesh and Sri Lanka span from 2003M1 to 2017M12. The data for CMR (call money rate) of India, Bangladesh and Sri Lanka; TBILL (treasure bills rate) of Pakistan; DR (deposit rate) of Pakistan, Bangladesh and Sri Lanka; and LR (lending rate) of all four sample countries were sourced from CEIC database, while the data for DR (deposit rate) for India was sourced from Datastream.

4.3 Theoretical Framework

The main formal theory of bank behaviour in setting their bank retail rates is established by Rousseas (1985). Known as the marginal cost pricing model, it postulates that banks in a loan market are primarily price-setters because they set their rates as a mark-up (profit margin) over variable costs, which is shown with the following equation:

$$i = k(u) \qquad \text{Equation 4.1}$$

[12] The data plots for the money market rate and bank retail rates of each sample countries are plotted in Figures A.1 to A.4 in the Appendix.

Where *i* is the loan interest rate, *k* is the mark-up or profit margin over variable costs and *u* represents the unit prime or variable costs.

The variable costs of banks are mainly determined from the cost of funding their lending activities and is presumed to be exogenously determined (Bogoev & Petrevski, 2012). Accordingly, this variable cost or the cost of funding essentially refers to the central bank's short-term interest rate because it is determined outside the scope of the decision-making processes of the banks (Rousseas, 1985; Ho & Saunders, 1981). Hence, changes in the lending rates are mainly determined by changes in the cost of funding where the profit margin is taken to be constant over the business cycles, and this implicitly implies that the interest rate is expected to be in an equilibrium relationship in the long-run (Bogoev & Petrevski, 2012).

De Bondt (2002) expanded the model of Rousseas (1985) to explain the long-run relationship between money market rates and bank retail rates. De Bondt (2002) claimed that central banks have the sole ability to determine the money market rates since they have dominant control over money market conditions. Adjustments in the money market rates will subsequently affect bank retail rates. According to De Bondt (2002), bank interest rates on loans and deposits are determined by an interest rate which represents the marginal cost of funding of the bank and is augmented by a constant mark-up, where:

$$RR = m(MMR) \qquad \text{Equation 4.2}$$

Where, *RR* is the bank retail rates, *m* is the mark-up or mark-down of the bank retail rates, and *MMR* is the money market rate which is assumed to be exogenously determined by the central bank. The variable *RR* is the price set by banks and represents the endogenous administered interest rate. The variable *MMR* is the marginal cost of price approximated by

comparable market interest rates corresponding to the money market rate, which is assumed to be exogenous. The underlying idea is that the money market rate is the most appropriate marginal cost of price because of its accurate reflection of the marginal cost of funding faced by banks (Zulkhibri, 2012).

4.4 Conceptual Model

The augmented marginal cost pricing model by De Bondt (2002), shown in Equation 4.3 is represented below:

$$RR_t = \alpha_0 + \beta_1 MMR_t + \mu_t \qquad \text{Equation 4.3}$$

Where *RR* is the retail rates, which are the deposit and lending rates, *MMR* is the money market rate, which is proxied by the call money rate or T-bill rate. α_0 represents the degree of average mark-up or mark-down on the deposit or lending rates, which can be understood as the profit margin that banks locks in between the deposit or lending rates and their marginal cost of funding (Schluter, Busch, Hartmann-Wendels & Sievers, 2012; Ndirangu & Nyamongo, 2016). Banks will typically mark-up the retail rates, especially the lending rates, to cover the cost or any losses that may incur due to increase in the short-term interest rates; while mark-down the retail rates when the short-term interest rate decreases (Haugton & Iglesias, 2012; Bogoev & Petrevski, 2012).

While, β_1 is the magnitude of the pass-through on the deposit or lending rates in the long term, respectively. μ is the error term. The coefficient β_1 is expected to be theoretically positive, which suggests a positive relationship between money market rates and bank retail rates (Doojav & Kalirajan, 2016). In terms of the positive relationship between the money market rate and deposit rate, it is posited that an increase in money market rates will make

alternative risk-free securities, such as government bills and bonds, more attractive to depositors which in turn lead to the reduction of deposits supply from deposits, and subsequently putting an upward pressure on deposit rate (Bikker & Gerritsen, 2018). As for the lending rate, since money market rates reflect the true cost of fund of banks, an increase in money market rates will increase the cost incurred by banks when they obtain funding from money market to provide loans, and thus forcing banks to shift the increased cost to borrowers through a higher lending rate (Sanusi, 2011; Dermine, 2013). However, there is no theoretical expectation for its magnitude as banks may under or over adjust their retail rates (Andries & Billon, 2016).

As discussed by Rousseas (1985) and De Bondt (2002, 2005), the magnitude of pass-through is measured by the coefficient β_1, which depends on the elasticity of demand for deposits and loans with respect to bank retail rates. If the demand for deposits and loans is inelastic, the coefficient β_1 is expected to be less than one which implies an under-adjust or incomplete pass-through. If the coefficient β_1 is equal to one, this implies a unitary elastic demand and complete pass-through. Accordingly, if the coefficient of β_1 is greater than one, this implies over-complete pass-through or elastic demand. In this study, the Wald test ($H_0: \beta = 1$) is used to econometrically identify the existence of complete pass-through from changes in the money market rates to bank retail rates.

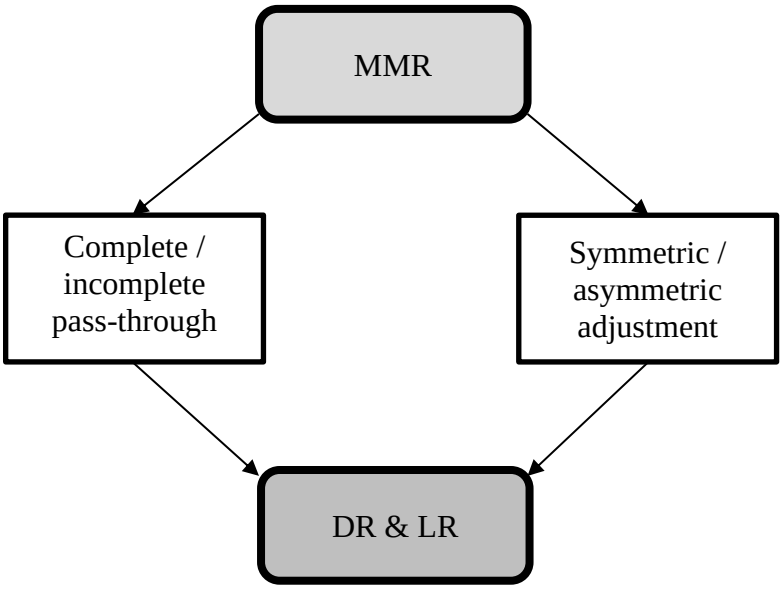


Figure 4.1: Conceptual Framework
(Source: Developed by the Author)

Several factors have been found to contribute to the incomplete pass-through and sluggishness in the speed of adjustment from money market rates to bank retail rates which causes asymmetric adjustment properties. For instance, imperfect substitutions between bank deposit and loan products with other money market instruments and non-bank financial sources (Egert et al., 2007), customer switching costs (Lowe & Rohling, 1992), weak banking system competition (Zulkhibri, 2012), financial system depth and development (Yuksel & Ozcan, 2013; Andries & Billion, 2016), information asymmetries (Stigliz & Weiss, 1981), the level of economic growth (Sznajderska, 2013) and bank expectations on macroeconomic conditions (Jamilov & Egert, 2014) have been found to contribute to the non-unitary pass-through. In addition, several theories have also been proposed in past literature to explain the causes behind asymmetries in the adjustment of bank retail rates to changes in the money market rates. For example, the collusive pricing behaviour and adverse customer reaction hypotheses by Hannan and Berger (1991) and Neumark and Sharpe

(1992), and also the adverse selection and moral hazard hypotheses under information asymmetries as proposed by Stigliz and Weiss (1981)[13].

The examination of pass-through is usually performed in a bi-variate setting as seen in many studies (see, for example, Sander & Kleimeier, 2004, Sander & Kleimeier 2006, Wang & Lee, 2009, Wang & Thi, 2010, Zhang et al., 2017), as other variables were excluded to keep the estimated model sufficiently concise (Cottarelli & Kourelis, 1994). Furthermore, it is not possible to examine these three interest rate variables simultaneously, as doing so may cause biased results possibly attributed to the displacement or offsetting of the exogenous effect of money market rates, or because the pass-through process is from the deposit rate to the lending rate, or vice-versa (Wang & Thi, 2010). Equations (3) is also the empirical model of this study.

4.5 Research Design

In terms of the estimation process, first, we will examine the stationarity properties of the interest rate series by using the ADF and PP unit root tests. This is because the cointegration test, which is the following estimation step, requires that the variables are not stationary at level but stationary after first differencing. After the series are identified to be I(1), this study proceeds to the TAR and MTAR non-linear cointegration tests to detect the presence of asymmetrical long-run relationships among the interest rate variables.

We will then proceed to study the short-run dynamics of the interest rate variables, but we are constrained by the choice between two models, which are; the asymmetric ECM and its expanded version which is known as the EC-EGARCH (1,1)-M model. To identify

[13] For a detailed explanation on the factors and theories, please refer to Section 1.3.1.

which model is the most appropriate in this study, the residuals from the asymmetric ECM derived from Equation 4.3 will be examined for volatility clustering and conditional heteroscedasticity using the Ljung-Box (1978) Q-statistics as well as the Engle (1982) autoregressive conditional heteroscedasticity Lagrange multiplier (ARCH-LM) test. If the residuals of the asymmetric ECM are found to be heteroscedastic, this study will employ the EC-EGARCH (1,1)-M model to examine the short-run dynamics. Furthermore, the EC-EGARCH (1,1)-M model also has the advantage of incorporating the element of interest rate volatility into the estimation process, which is known to be able to influence the bank's retail rate adjustment behaviour. Finally, a battery of diagnostic tests will follow to verify the robustness of the results from the EC-EGARCH (1,1)-M.

4.6 Methodologies

4.6.1 Unit Root Tests

4.6.1.1 ADF Unit Root Test

The ADF unit root test was pioneered by Dickey and Fuller (1979) to test the assumption of stationary time series. The test regression is expressed as:

$$\Delta p_t = \mu + \beta t + \alpha p_{t-1} + \sum_{i=1}^{k} \psi_i \Delta p_{t-i} + \varepsilon_t \qquad \text{Equation 4.4}$$

where, Δ denotes the first difference, p_t is the natural logarithm of the interest rate variable, k is the lag length of the autoregressive process, t is the time trend, μ, β, α, ψ are the parameters to be estimated, ε_t is a variable that adjusts the errors of autocorrelation and Δp_{t-i} is the lagged difference to account for auto correlation in ε_t.

The null and alternate hypotheses for the test regression are:

$$H_o: \alpha = 0$$

$$H_1: \alpha < 0$$

The null hypothesis is “unit root exists” or “non-stationary”, while the alternate hypothesis is “unit root does not exist” or “stationary”. The null hypotheses of this test are rejected when the computed t-statistic is negative and smaller than the critical values at the significance levels of 1%, 5% and 10%. If the null hypotheses are rejected, the interest rate variables may be concluded as stationary (do not contain unit root). Conversely, if the computed t-statistic is negative and larger than the critical values at the significance levels of 1%, 5% and 10%, the null hypotheses cannot be rejected and it may be concluded that the interest rate variables are not stationary (contain unit root).

If the null hypothesis cannot be rejected at the significance levels of 1%, 5% and 10% where $\alpha = 0$, this implies that unit root exists in the interest rate variable in the level form. However, if the null hypothesis can be rejected at the significance levels of 1%, 5% and 10% where $\alpha < 0$, this implies that the test is significantly negative from zero and hence the unit root does not exist in level form. If the interest rate variable is not stationary at level form (rejected null hypothesis), the test in the first difference (and so on) has to be performed until the interest rate variable is stationary.

4.6.1.2 PP Unit Root Test

Phillips and Perron (1988) proposed a generalised Dickey-Fuller procedure with weakly dependent errors to accommodate the assumptions of an uncorrelated error term and constant variance in the distribution theory. A correction factor of a non-parametric serial correlation is utilised in this test to handle the errors that are serially correlated and to ensure that the testing for long-term variance in the error procedure is consistent (Castro, Rodrigues

& Taylor, 2013). Consequently, this technique is incorporated in the Dickey-Fuller t-test statistic for the null hypothesis of non-stationarity testing and to derive the z-statistics. As an alteration of the Phillips-Perron test is found on the Dickey-Fuller t-statistics, the tabulation of the z-statistic follows the asymptotic distribution of the t-statistic. The z-statistic's critical values are obtainable from Mackinnon (1996).

In the regression estimates, the test does not require the user to specify the lag length (Shi, Bin & Alexiadis, 2012). To illustrate the PP test, Y_t is regarded as a variable for estimation. The regression equations to test Y_t are formulated as:

$$\Delta Y_t = \varepsilon_1 + \delta Y_{t-1} + \mu_{1t} \qquad \text{Equation 4.5}$$

and

$$\Delta Y_t = \varepsilon_2 + \vartheta t + \rho Y_{t-1} + \mu_{2t} \qquad \text{Equation 4.6}$$

Where, ΔY_t is the $I(1)$ of variable Y_t, ε_1 and ε_2 are the drift terms or constants, t is the deterministic time trend, μ_{1t} and μ_{2t} are the residuals for the regressions and δ, ϑ, ρ are the parameters for estimation.

Equation 4.6 is tested before Equation 4.5. When the random walk is without non-linear trend and drift, the null hypothesis of $H_0: \rho = 0$, $\vartheta = 0$ and $\varepsilon_2 = 0$ is tested against the alternative hypothesis of $H_1: \rho < 0$, $\vartheta \neq 0$ and $\varepsilon_2 \neq 0$. The adjusted t- and F-statistics, namely; $Z(t_\beta)$, $Z(\Phi_2)$ and $Z(\Phi_3)$ are applied in the hypothesis testing of Equation 4.5. Equation 4.5 will be used for the estimates if the null hypothesis for Equation 4.6 is not rejected. As a result, the random walk which is without drift is tested without using the null hypothesis of $H_0: \rho = 0$ and $\varepsilon_2 = 0$ against the alternative hypothesis of $H_1: \rho < 0$ and

$\varepsilon_2 \neq 0$. For the hypothesis testing of Equation 4.5, only the adjusted statistics of $Z(t_\alpha)$ and $Z(\Phi_1)$ are employed for the estimates.

4.6.1.3 Enders and Granger TAR and MTAR Unit Root Tests

Due to the underlying assumption of symmetric adjustment process, the Dickey-Fuller (DF) unit root test and its extensions, such as the ADF unit root test, are only adequate for the detection of stationarity for symmetric variables and will be mis-specified if the adjustment process is in fact asymmetric. To address this shortcoming, Enders and Granger (1998) proposed the TAR and MTAR asymmetric unit root tests as a formal way to examine asymmetric adjustment process which were extended based on the ADF unit root test. The specifications are given as:

$$\Delta y_t = I_t \rho_1 (y_{t-1} - \tau) + (1 - I_t)\rho_2 (y_{t-1} - \tau) + \varepsilon_t \qquad \text{Equation 4.7}$$

Where, I_t is the Heaviside indicator. In the TAR model, the Heaviside indicator is defined as:

$$I_t = \begin{cases} 1 \; if \; y_{t-1} \geq \tau \\ 0 \; if \; y_{t-1} < \tau \end{cases} \qquad \text{Equation 4.8}$$

In the MTAR model, the Heaviside indicator is defined as:

$$I_t = \begin{cases} 1 \; if \; \Delta y_{t-1} \geq \tau \\ 0 \; if \; \Delta y_{t-1} < \tau \end{cases} \qquad \text{Equation 4.9}$$

Where, τ is a threshold with unknown value and has to be estimated by minimising the residual sum of squares. Equations 4.7 and 4.8 represents the TAR model, which captures the aspects of deep movements in the sequence; while, the MTAR model is represented by Equations 4.7 and 4.9, which captures the aspects of sharp movement in the sequence. If the

system is convergent, $y_t = \tau$ is the long-run equilibrium value of the sequence. In the event where y_t (in the TAR model) and Δy_t (in the MTAR model) are above its long-run equilibrium value, the adjustment is $\rho_1 y_{t-1}$; while if y_t and Δy_t are below its long-run equilibrium value, the adjustment is $\rho_2 y_{t-1}$.

The ϕ statistic, which follows the F statistic[14], will be employed to examine the stationarity of the interest rate variables by testing the null hypothesis of a unit root, i.e. $H_0: \rho_1 = \rho_2 = 0$. If the null hypothesis of non-stationarity is rejected, then it is possible to further examine the asymmetries of the interest rate variables by testing the null hypothesis of a symmetric adjustment, i.e. $H_0: \rho_1 = \rho_2$. If the null hypothesis of a symmetric adjustment is rejected, then the result is in favour of asymmetric adjustment in the sequence.

4.6.2 TAR and MTAR Asymmetric Cointegration Models

Enders and Siklos (2001) addressed the weaknesses of the Engle-Granger (1987) linear cointegration test by providing alternative specifications, which are; the TAR and MTAR models, to test for non-linear cointegration among the interest rate variables. The TAR and MTAR models are given below:

$$\Delta\hat{\mu}_t = I_t \rho_1 \hat{\mu}_{t-1} + (1 - I_t)\rho_2 \hat{\mu}_{t-1} + \varepsilon_t \qquad \text{Equation 4.10}$$

If autocorrelation is present in Equation 4.10, then it should be re-written as:

$$\Delta\hat{\mu}_t = I_t \rho_1 \hat{\mu}_{t-1} + (1 - I_t)\rho_2 \hat{\mu}_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta\hat{\mu}_{t-j} + \varepsilon_t \qquad \text{Equation 4.11}$$

[14] The F statistic is calculated as $F = \frac{R^2/(k-1)}{(1-R^2)/(T-k)}$, where R^2 is the R-squared statistic, k is the number of independent variables, T is the number of observations.

Where, I_t is the Heaviside indicator and $\hat{\mu}_t$ is the error term from Equation 4.3. In the TAR model, the Heaviside indicator is specified as:

$$I_t = \begin{cases} 1 \; if \; \hat{\mu}_{t-1} \geq \tau \\ 0 \; if \; \hat{\mu}_{t-1} < \tau \end{cases} \qquad \text{Equation 4.12}$$

While in the MTAR model, the indicator can be specified as:

$$I_t = \begin{cases} 1 \; if \; \Delta\hat{\mu}_{t-1} \geq \tau \\ 0 \; if \; \Delta\hat{\mu}_{t-1} < \tau \end{cases} \qquad \text{Equation 4.13}$$

where, τ is the unknown threshold value. The TAR model represents the estimation of Equation 4.10 or Equation 4.11 and Equation 4.12, while the MTAR model is estimated by using Equation 4.10 or 4.11 and Equation 4.13. If the value of $\hat{\mu}_{t-1}$ (in the TAR model) or $\Delta\hat{\mu}_{t-1}$ (in the MTAR model) is greater than or equal to the value of the threshold (τ), the adjustment speed of residuals is ρ_1 and the adjustment margin will be $\rho_1\hat{\mu}_{t-1}$. Conversely, if the value of $\hat{\mu}_{t-1}$ or $\Delta\hat{\mu}_{t-1}$ is less than the value of the threshold (τ), the adjustment speed of residuals is ρ_2 and the adjustment margin will be $\rho_2\hat{\mu}_{t-1}$ (Wang & Thi, 2010). We follow the procedure proposed by Chan (1993) to obtain a consistent estimator for the unknown threshold value (τ) for both the TAR and MTAR models, as follows:

i. Rearrange the residuals ascendingly from the smallest value to the largest value, regardless of time, and;

ii. To account for outliers, the smallest and largest 15% of the observations are excluded, preserving only 70% of the observations, and finally;

iii. Use standard OLS to estimate the TAR and MTAR models continually with all of the probable threshold values (τ), and then chooses the one that has the lowest residual sum of squares.

Once the TAR and MTAR models are estimated, the Φ statistic (which is the *F* statistic[15]) is employed to examine the null hypothesis of $\rho_1 = \rho_2 = 0$ that tests for the presence of a cointegration relationship. If the null hypothesis is rejected, this indicates that cointegration exists between the money market rates and bank retail rates. Then, this study will continue to test whether the cointegration is symmetric by examining the null hypothesis of $\rho_1 = \rho_2$. If the null hypothesis is rejected, it can be concluded that the interest rate variables have an asymmetric long-run relationship among them, and vice-versa.

In comparison, the TAR model detects the asymmetrical behaviour in contractionary or expansionary movements of the interest rate variables and is used to capture the persistence of positive and negative deviations of the interest rate variables from the long-run equilibrium. In contrast, the MTAR model is used to examine non-linear sharp trough or peak movements of the interest rate variables when they deviate from long-run equilibrium (Yuksel & Ozcan, 2013). The TAR and MTAR models differ mainly on the types of asymmetry considered. The TAR model assumes that the adjustment speed of the residuals (ρ_1, ρ_2) differs depending on whether the lagged value of the residuals is above or below the threshold value (τ), while the MTAR model considers the asymmetry that may be caused by the change in the $\hat{\mu}_{t-1}$ rather than its level form (Deger, 2012). The MTAR model allows

[15] The *F* statistic is calculated as $F = \frac{R^2/(k-1)}{(1-R^2)/(T-k)}$, where R^2 is the R-squared statistic, k is the number of independent variables, T is the number of observations.

for the identification of different effects between upward and downward changes in the error terms over time. Particularly, it serves as a better platform for policy implications with regard to interest rates than the TAR model since it demonstrates whether the $\hat{\mu}_t$ series exhibits more momentum in one direction or the other (Enders & Siklos, 2001). As the real nature of the non-linearity is unknown, both the TAR and MTAR models will be used to examine the pass-throughs of the sample countries.

4.6.3 Asymmetric EC-EGARCH (1,1)-M Model

If the money market rates and bank retail rates are cointegrated symmetrically or asymmetrically, symmetric or asymmetric ECMs based on Equation 4.3 will be used to examine their short-run adjustment process towards the long-run equilibrium. However, if its residuals are not white noise, then it is insufficient in providing the most accurate short-run estimates of the adjustment process (Haughton & Iglesias, 2012). Therefore, the asymmetric EC-EGARCH (1,1)-M model which comprises of two sets of equations will be adopted. The first set of equations is the conditional mean equation and is specified as:

$$\begin{aligned}\Delta RR_t = d_0 + \sum_{i=1}^{p} d_i \, \Delta RR_{t-i} + \sum_{j=1}^{q} \varphi_j \, \Delta v_{t-j} + m\Delta MMR_t \\ + s\sqrt{\sigma_t^2} + \eta_1 I_t \hat{u}_{t-1} + \eta_2 (1 - I_t)\hat{u}_{t-1} \\ + v_t v_t | \Omega_{t-1} \sim N(0, \sigma_t^2)\end{aligned} \qquad \text{Equation 4.14}$$

where, in Equation 4.14, ΔRR_t is the differenced retail rates which comprised of deposit and lending rates, ΔMMR_t is the differenced money market rates and *m* is its parameter that captures the short-run adjustment margin of the deposit rate or the lending rate in response to an adjustment in the money market rates. ΔRR_{t-i} is the lagged

autoregressive term, $AR(p)$, and Δv_{t-j} is the moving average term, $MA(q)$, which were added to rectify the autocorrelation problem. $\sqrt{\sigma_t^2}$ is the time-varying standard deviation of the error term (v_t) that denotes the effect of interest rate volatility in the mean equation, while the parameter *s* captures its effect on the deposit rate or lending rate. A significant and positive parameter *s* implies that the volatility of the interest rate will positively affect the adjustment behaviour of the deposit rate or lending rate, and vice-versa. $\eta_1 I_t \hat{u}_{t-1}$ and $\eta_2(1 - I_t)\hat{u}_{t-1}$ are the MTAR asymmetric error correction terms which represent the short-run dynamics of the model, where $\hat{u}_{t-1}$ is the error term of the previous period from Equation 4.11 which was derived from Equation 4.3, and is also the error correction term. η_1 and η_2 are the speed of adjustment parameters of the positive and negative error correction terms, respectively. If the latter parameters are positive, it indicates that the deposit rate or the lending rate are very responsive to changes, as it oscillates to a larger value with the long-run equilibrium error, and the reverse holds true if the parameters are negative.

Equation 4.14 can be also used to detect the presence of short-run adjustment rigidities of the deposit rate or the lending rate following an adjustment in the money market rate. When $\Delta\mu_{it-1} \geq \hat{\tau}$, this suggests that the adjustments of the deposit rate or the lending rate are greater than the change of the long-run equilibrium error after the interest rate changed and, therefore, the adjustment margin of the deposit rate or the lending rate must be reduced. On the contrary, $\Delta\mu_{it-1} \leq \hat{\tau}$ implies the reverse and, therefore, the adjustment margin of the deposit rate or the lending rate must be increased. The variation margin of the deposit rate or lending rate can be adjusted upward or downward via the error correction term $I_{it}\hat{u}_{it-1}$ and $(1 - I_{it})\hat{u}_{it-1}$. When η_1 is different from η_2, then there exist adjustment rigidities in the deposit rate or the lending rate. If $|\eta_1| > |\eta_2|$, then there exist upward

adjustment rigidities in the deposit rate or lending rate, while $|\eta_1| < |\eta_2|$ means that there exist downward adjustment rigidities in the deposit rate or the lending rate[16].

The second set of equations in the asymmetric EC-EGARCH (1,1)-M model is the conditional variance equation proposed by Nelson (1991) to allow for the analyses of asymmetric and leverage effects in the conditional variance. It is specified as:

$$\log(\sigma_t^2) = \omega + \alpha\left|\frac{v_{t-1}}{\sigma_{t-1}}\right| + \gamma\frac{v_{t-1}}{\sigma_{t-1}} + b\log(\sigma_{t-1}^2) \qquad \text{Equation 4.15}$$

Where, ω is a constant, α and γ captures the absolute value of standardised residual and standardised residuals, respectively. The v_{t-1} is the news about volatility from the previous period and is measured as the lag of the squared residuals from the mean equation (ARCH term), while σ_{t-1} is the last period forecast of the conditional variance (GARCH term). The most important parameter in Equation 4.14 is γ which shows the asymmetric effect of the conditional variance of the interest rates. When $\gamma \neq 0$ and is significant, this implies the existence of the asymmetric effect; if $\gamma < 0$ and is significant, this implies the existence of the leverage effect. The leverage effect suggests that a reduction in the interest rate will cause greater interest rate volatility. The empirical investigation of the existence of these effects are imperative and informational, as it clarifies whether the interest rates respond more to negative shocks or positive shocks (Fadiran & Ezeoha, 2012).

The asymmetric EC-EGARCH (1,1)-M model is estimated using the Bollerslev and Wooldridge (1992) quasi-maximum likelihood method (QML). The QML method produces robust estimates that are consistent, asymptotically normal and robust against error mis-

[16] The reasons for adjustment rigidities are sufficiently discussed in Chapter 1.

specifications even under the absence of conditional normality in the residuals, provided that the model is correctly specified (Weiss, 1986; Bollerslev & Wooldridge, 1992; Dahl & Iglesias, 2008; Fan, Qi & Xiu, 2014). The log-likelihood function is defined as:

$$\text{Log}L = -(T/2)\log(2\pi) - (1/2)\sum_{t=1}^{T}\log(\sigma_t^2) - (1/2)\sum_{t=1}^{T}(v_t^2/\sigma_t^2) \quad \text{Equation 4.16}$$

4.6.4 Diagnostic Tests

4.6.4.1 Jarque-Bera Test

The Jarque-Bera test (Jarque & Bera, 1987) is a goodness-of-fit test that examines whether the interest rate variables have the skewness and kurtosis that is identical to a normal distribution. The test statistic is formulated as follows:

$$JB = \frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4}\right) \quad \text{Equation 4.17}$$

Where *N* is the number of observations, *S* is the sample skewness and *K* is the sample kurtosis, which are respectively defined as follows:

$$S = \frac{\hat{\mu}_3}{\hat{\sigma}^3} = \frac{\hat{\mu}_3}{(\hat{\sigma}^2)^{\frac{3}{2}}} \quad \text{Equation 4.18}$$

$$K = \frac{\hat{\mu}_4}{\hat{\sigma}^4} = \frac{\hat{\mu}_4}{(\hat{\sigma}^2)^2} \quad \text{Equation 4.19}$$

where,

$$\hat{\mu}_3 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^3 \qquad \text{Equation 4.20}$$

$$\hat{\mu}_4 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^4 \qquad \text{Equation 4.21}$$

$$\hat{\sigma}^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2 \qquad \text{Equation 4.22}$$

Where $\hat{\mu}_3$ and $\hat{\mu}_4$ are the estimates of the third and fourth central moments, respectively. $\bar{x}$ is the sample mean. $\hat{\sigma}^2$ is the estimate of the second central moment which is also referred to as the sample variance.

The null hypothesis is a joint hypothesis of whether the skewness is 0 and the kurtosis is 3, which are the values of a normal distribution. This test statistic asymptotically follows a Chi-square distribution with two degrees of freedom. The null hypothesis of normality can be rejected when the *p*-value is greater than the α-level of significance.

4.6.4.2 Ljung-Box Autocorrelation test

The Ljung-Box (1978) test is employed to examine whether the interest rate variables, the residuals of the asymmetric ECM and the standardised residuals of the EC-EGARCH (1,1)-M model exhibit autocorrelation. A correctly specified EC-EGARCH (1,1)-M model should contain no autocorrelation in both the levels and the squared standardised residuals up to a given lag *k*. The test statistic can be formulated as follows:

$$Q(L) = N(N+2)\sum_{l=1}^{L}\frac{r_k^2}{N-k} \qquad \text{Equation 4.23}$$

Where, N is the number of observations, L is the number of lags included in the test statistics, r_k is the sample autocorrelation of the residuals at lag k. The asymptotic distribution of $Q(L)$ can be approximated by a chi-square (χ^2) distribution with L degrees of freedom. The null hypothesis is that the residuals are free from autocorrelation and, therefore, can be rejected and it can be concluded that the standardised residuals exhibit autocorrelation when the *p*-value is greater than the α-level of significance.

4.6.4.3 ARCH Test

The Engle (1982) autoregressive conditional heteroscedasticity Lagrange multiplier (ARCH-LM) test is used to test for evidence of ARCH effects in the residuals of the asymmetric ECM to justify the appropriateness of the EC-EGARCH (1,1)-M model, and also on the standardised residuals of the EC-EGARCH (1,1)-M model to ensure the robustness of the empirical results. The main reasoning for an ARCH test is that the magnitude of the current residuals for the asymmetric ECM tends to be non-linearly related to the magnitude of its past residuals.

To examine the null hypothesis of no ARCH effect up to lag q in the residuals, the ARCH-LM test statistic is generated through an auxiliary test regression as follows:

$$v_t^2 = \beta_0 + \left(\sum_{\vartheta=1}^{q} \beta_\vartheta \, v_{t-\vartheta}^2 \right) + e_t \qquad \text{Equation 4.24}$$

Where v is the residual. The squared residuals are regressed with a constant and lagged squared residuals up to lag q. The statistics of the LM test can be computed as follows:

$$LM = T.R^2 \sim \chi^2(q) \qquad \text{Equation 4.25}$$

Where T is the number of observations, R^2 is computed from Equation 4.24 and q is the number of restrictions placed on the model. The null and alternative hypotheses of the LM test are given as follows:

$$H_0: \beta_1 = \beta_2 = \cdots \beta_i = 0$$

$$H_a: \text{At least one of the } \beta_1 \neq \beta_2 \neq \cdots \beta_i \neq 0$$

The null hypothesis of no ARCH effects can be rejected when the p-value is greater than the α-level of significance. If the null hypothesis is rejected, the asymmetric ECM and the EC-EGARCH (1,1)-M model do exhibit signs of volatility clustering.

4.6.4.4 Sign Bias Test

The adequacy of the EC-EGARCH (1,1)-M model specification is extremely imperative. As such, the sign bias test, the negative size bias test, and the positive size bias test of Engle and Ng (1993) will be employed to detect whether there exists asymmetric effect in the standardised residuals of the EC-EGARCH (1,1)-M model. The aforementioned test is specified as:

$$\left(\frac{\hat{v}_t}{\sigma_t}\right)^2 = \kappa + c_1 S_t^- + c_2 S_t^- \hat{v}_{t-1} + c_3 S_t^+ \hat{v}_{t-1} + \iota_t \qquad \text{Equation 4.26}$$

Where, $\left(\frac{\hat{v}_t}{\sigma_t}\right)$ is the standardised residual and ι_t is the error term. S_t^- and S_t^+ is a dummy variable which is equal to 1 when $\hat{v}_{t-1}$ is less than 0, or else, it is equal to 0. If the bank retail rate models for each of the sample countries are correctly specified, we will perform significance tests on the parameters by conducting the joint test with the null

hypothesis of $H_0: c_1 = c_2 = c_3 = 0$. The rejection of the null hypothesis indicates the absence of an asymmetric effect in the standardised residuals of the model.

CHAPTER 5

EMPIRICAL FINDINGS AND DISCUSSION

5.1 Introduction

This chapter provides interpretation and discussion on the empirical results of the interest rate pass-through mechanism of the four selected SAARC countries which were attained through empirical analyses using the methodologies discussed in Chapter Four. The descriptive statistics of the first-differenced interest rate variables are presented in Section 5.2. Section 5.3 describes the correlation matrix of the interest rate variables, while Section 5.4 presents the unit root tests results. Section 5.5 presents the results for the first stage of interest rate pass-through mechanism, which is a complementary analysis to this study. Section 5.6 discusses the main empirical analysis of this study, which is the second stage interest rate pass-through mechanism, and this section also provides discussions on the empirical findings for the second stage interest rate pass-through mechanism.

5.2 Descriptive Statistics

The descriptive statistics of the variables are displayed in Table 5.1. Except for all of the interest rate variables of Pakistan and the DR and the lending rate (LR) of Sri Lanka, most of the interest rate variables have negative means, which indicates that these sample countries had decreased their interest rates more than increase over the sample period. As for the standard deviation of the CMR and DR, India is the highest, while for the LR, Sri Lanka is the highest. This indicates that the CMR and the DR are very volatile in India, as compared to the other sample countries. The distribution of the interest rate variables is leptokurtic as all of the kurtoses are more than 3, suggesting the presence of fat tails in the distribution. In terms of skewness, the DR and the LR of India and all of the interest rate

variables of Sri Lanka are negatively skewed, which indicates that the distributions of these variables are asymmetrical to the left, suggesting the prevalence for the probability of contractionary monetary policy over the sample period. While, the distributions for other sample countries are asymmetrical to the right as they are positively skewed. In addition, the Jarque-Bera (1987) test statistics are significant across all of the interest rate variables, indicating that the interest rate variables are not normally distributed. Overall, the interest rate variables of the sample countries are found to exhibit asymmetries, high volatility, to be leptokurtic and to have longer tails than a normal distribution.

A series of volatility clustering tests were carried out to examine the presence of conditional heteroscedasticity. The Engle (1982) ARCH-LM test is conducted for each of the interest rate variables of all of the sample countries. It is evident from Table 5.2 that all of the interest rate variables exhibited ARCH effects, with the exception of the LR of India. In addition, the result of the Ljung-Box (1978) test is significant in either the level or the squared interest rate variables, with the exception of the LR of India. This indicates that these interest rate variables are autocorrelated either in the level or in the squared form, and hence further suggesting the presence of conditional heteroscedasticity and volatility clustering. Hence, in order to model the volatility dynamics while capturing the ARCH effect (conditional heteroscedasticity and volatility clustering) in the interest rate variables of the sample countries, conditional heteroscedasticity models are used in this study.

As one of the specific objectives of this study is to examine whether asymmetry or leverage effects are present in conditional variance of bank retails rates in the selected SAARC countries, asymmetric GARCH model that are able to identify the presence of asymmetry or leverage effects in a series will be used. Generally, there are two popular

asymmetric GARCH models, which are the exponential GARCH (EGARCH) model by Nelson (1991) and the threshold GARCH (TGARCH) model by Zakoian (1994). Nevertheless, the EGARCH model will be used in this study due to its flexibility by relaxing the non-negativity constraint on the parameters of the conditional variance equation, given its log specification which guarantees the positivity of the conditional variance as compared to the TGARCH model (Bampinas, Ladopoulos & Panagiotidis, 2018). As argued by Nelson (1991), imposing non-negativity constraint will cause difficulties in model estimation and thus may require additional non-negativity restrictions to be implemented when estimating the model, and will also tend to rule out random volatility behaviour through the imposed implication that an increase in volatility of any period will always lead to an increase in the volatility of the following period.

Table 5.1: Descriptive Statistics of the Interest Rate Variables (in First Difference)

Variables	Mean	Standard Deviation	Skewness	Kurtosis	Q (12)	Q^2 (12)	JB	ARCH
				Pakistan				
TBILL	0.026	0.396	0.361	8.434	37.006***	37.749***	209.119***	3.038*
DR	0.014	0.419	0.863	5.493	33.956***	16.761	63.983***	3.374*
LR	0.012	0.372	0.706	5.056	30.785***	41.267***	43.280***	13.825***
				India				
CMR	-0.018	3.912	2.304	51.166	95.075***	83.289***	19802.900***	42.243***
DR	-0.018	1.415	-0.195	50.235	37.414***	54.339***	18873.350***	52.14***
LR	-0.015	0.328	-7.646	86.451	3.629	0.200	60883.04***	0.002
				Bangladesh				
CMR	-0.022	3.187	0.026	27.331	28.000***	46.400***	4415.432***	46.06***
DR	-0.018	0.158	0.383	10.367	12.451	19.007*	409.176***	4.344**
LR	-0.018	0.274	0.003	8.300	24.561**	18.500	209.484***	5.236**
				Sri Lanka				
CMR	-0.008	1.715	-0.063	28.802	140.750***	88.726***	4965.477***	39.049***
DR	0.011	0.226	-0.807	8.344	372.200***	23.049**	232.437***	14.876***
LR	0.001	0.593	-0.131	7.263	58.052***	115.340***	136.057***	23.107***

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. JB denotes Jarque-Bera normality test. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect.

5.3 Correlation Matrix

Table 5.2 depicts the correlation matrix for the different types of money market rate and bank retail rate of the 4 sample countries in first difference. In terms of the correlation between the money market rates and bank retail rates, the highest and positive correlation of 0.811 is found between the T-bill rate and the deposit rate of India. On the other hand, Bangladesh and Sri Lanka has the lowest correlation coefficient, of about 0.026 and -0.002, respectively. As for the correlation between the money market rate and lending rate, Pakistan has the highest correlation (0.354), while Sri Lanka has the lowest correlation (0.019).

Table 5.2: Correlation Matrix of the Interest Rate Variables (in First Difference)

Pakistan			
	TBILL	**DR**	**LR**
TBILL	1.000	-	-
DR	0.285	1.000	-
LR	0.354	0.395	1.000
India			
	CMR	**DR**	**LR**
CMR	1.000	-	-
DR	0.811	1.000	-
LR	0.020	0.023	1.000
Bangladesh			
	CMR	**DR**	**LR**
CMR	1.000	-	-
DR	0.026	1.000	-
LR	0.038	-0.061	1.000
Sri Lanka			
	CMR	**DR**	**LR**
CMR	1.000	-	-
DR	-0.002	1.000	-
LR	0.019	0.272	1.000

5.4 Unit Root Tests Results

As a preliminary check, the ADF and PP unit root tests are conducted to identify the stationarity properties of the interest rate variables and the results are reported in Table 5.3. According to the ADF unit root test result, all of the interest rate variables with the exception of the call money rate (CMR) of Bangladesh are integrated of order one, since the null hypothesis of non-stationarity is not rejected at level but is rejected after first differencing at the 5% significance level. On the other hand, the PP unit root test indicated that all of the interest rate variables are integrated of order one, except for the deposit rate (DR) of India, as well as the CMRs of India, Bangladesh and Sri Lanka.

Based on the results of the unit root tests in Table 5.3, both tests provided some contradictory evidence on the stationarity of the interest rate variables, i.e. the DR of India and the CMRs of India and Sri Lanka, whereby the ADF unit root test suggested $I(1)$ while the PP unit root test suggested $I(0)$. Nevertheless, as noted by Arltova and Federova (2016), the main disadvantage of PP unit root test over ADF is that the former test is based on asymptotic theory, and therefore works well only in large samples. This is supported by Leybourne and Newbold (1999), whereby the PP unit root test suffers from severe size distortions in small samples and even in moderately large samples. Size distortion happens when the actual size of a test in small samples is very different from the size of the test indicated by asymptotic theory (Ogaki, 1993). Similarly, DeJong, Nankervis, Savin and Whiteman (1992) have also discovered that the PP unit root test are found to suffer from serious size distortions and have very low power when the errors are autoregressively correlated, as compared to the ADF unit root test.

Moreover, the PP unit root test is more sensitive to model misspecification than the ADF unit root test (Schwert, 2002). Given the advantages of the ADF unit root test and the relatively small observations used in this study, the ADF unit root test results will be prioritised in this study. Therefore, under the symmetric unit root test category in this study, all of the interest rate variables are considered to be integrated of the order one or *I*(1) at the 5% significance level, with the exception of the CMR of Bangladesh.

Table 5.3: ADF and PP Unit Root Tests Results

Variables	ADF		PP	
	Level	**First Difference**	**Level**	**First Difference**
		Pakistan		
T-BILL	-2.304 (1)	-10.201 (0)***	-2.163 (5)	-10.616 (6)***
DR	-1.704 (1)	-17.146 (0)***	-1.772 (4)	-16.898 (4)***
LR	-2.158 (4)	-4.046 (3)***	-1.779 (8)	-11.899 (8)***
		India		
CMR	-2.976 (4)	-16.529 (3)***	-10.580 (4)***	-
DR	-3.175 (4)	-10.084 (3)***	-5.449 (4)***	-
LR	-2.568 (1)	-13.942 (0)***	-2.581 (4)	-13.96 (2)***
		Bangladesh		
CMR	-5.796 (0)***	-	-5.892 (6)***	-
DR	-2.002 (2)	-12.242 (0)***	-1.784 (3)	-12.242 (0)***
LR	-0.464 (3)	-3.795 (6)***	-0.444 (3)	-14.597 (4)***
		Sri Lanka		
CMR	-2.045 (5)	-5.936 (4)***	-3.867 (5)**	-
DR	-3.301 (3)	-3.032 (2)**	-1.97 (10)	-6.577 (7)***
LR	-3.156 (6)	-2.959 (5)**	-1.842 (8)	-11.213 (7)***

Note: Figures in the parenthesis are the lag lengths. Asterisk (**) and (***) denotes significance at 5% and 1% levels, respectively. The chosen optimal lags in the ADF and PP unit root tests are selected automatically based on Akaike Information Criterion and Newey-West Bandwidth, respectively. The unit root tests are estimated with a constant and a linear time trend for the variables in levels, and a constant without linear time trend for the variables in first difference.

Nevertheless, the ADF unit root test may be mis-specified if the real adjustment dynamics of the variable is asymmetric due to its assumption of linearity. Therefore, in line with the adoption of the TAR and MTAR asymmetric cointegration test in the later subsection of this study, the Enders and Granger (1998) TAR and MTAR unit root tests will also be adopted to examine the presence of asymmetric stationarity in the interest rate variables.

As can be observed in Table 5.4, the TAR unit root test suggested that: i) the CMR of India, Bangladesh and Sri Lanka, ii) the DR of India Bangladesh, and iii) the LR of Pakistan and Sri Lanka, are stationary at level and the adjustment is asymmetric, given the rejections of the null hypotheses of both the Φ test and *F* test at level at 5% level of significance. While, i) the DR of Pakistan and Sri Lanka, ii) the LR of India and Bangladesh is stationary at first difference and the adjustment is asymmetric since the null hypotheses of the Φ test is not rejected at level, but is rejected at the first difference along with the null hypothesis of the *F* test. Only the DR of Pakistan is stationary at first difference with symmetric adjustment.

On the other hand, the MTAR unit root test (see, Table 5.5) suggest that all of the interest rate variables of all sample countries are stationary at first difference since the null hypothesis of the Φ test is not rejected at the level but is rejected at the first difference at 5% level of significance, with only the exception for the CMR of Bangladesh. After observing stationarity of all variables at the first difference, a further examination on the presence of asymmetric adjustment revealed that: i) the CMR of India and Sri Lanka, ii) the DR of Pakistan, India and Sri Lanka, and iii) the LR of Pakistan, Bangladesh and Sri Lanka exhibited asymmetric adjustments as the null hypothesis of the *F* test are rejected at 5% level

of significance. While, the adjustment of: i) the TBILL of Pakistan, ii) the DR of Bangladesh, and iii) the LR of Sri Lanka is symmetric at the first difference.

As argued by Enders and Granger (1998), the tests for the MTAR unit root test has greater power and better fit than the test for the corresponding TAR unit root test. Thus, the conclusion for stationarity with asymmetric adjustment of the interest rate variables will follow the empirical results produced by the MTAR unit root test. Therefore, this study concludes that almost all of the variables are stationary at the first difference or integrated at $I(1)$, and that a majority of them exhibits MTAR-type asymmetric adjustments.

Table 5.4: Enders and Granger (1998) TAR Unit Root Test

Variables	Level			First Difference		
	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	Lag	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	Lag
Pakistan						
TBILL	5.006	-	1	32.7552 **	0.0930	1
DR	3.1896	-	1	62.8946 **	9.3275 **	1
LR	10.0581 **	18.1222 **	4	-	-	-
India						
CMR	14.3700 **	28.2859 **	5	-	-	-
DR	3.2838	1.4951	2	15.0002 **	6.1318 **	2
LR	12.7078 **	23.8792 **	5	-	-	-
Bangladesh						
CMR	34.1865 **	66.6908 **	6	-	-	-
DR	17.4283 **	30.2733 **	2	-	-	-
LR	5.4210	-	5	11.8394 **	11.3883 **	6
Sri Lanka						
CMR	7.8956 **	11.2847 **	4	-	-	-
DR	52.3311 **	102.5049 **	4	-	-	-
LR	4.3197	-	2	47.3952 **	4.9245 **	1

Note: Asterisk (**) denotes significance at 5% level. The null hypothesis of the Φ test is defined as the variables in the estimated model are non-stationary, while the null hypothesis of *F* test is defined as the adjustment dynamic of the variable is symmetric. The chosen optimal lags are selected based on Akaike Information Criterion.

Table 5.5: Enders and Granger (1998) MTAR Unit Root Test

Variables	Level			First Difference		
	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	Lag	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	Lag
Pakistan						
TBILL	5.0067	-	1	32.7256 **	0.0421	1
DR	6.1649	-	1	61.9922 **	5.8141 **	1
LR	5.3128	-	6	13.0967 **	2.3319 **	5
India						
CMR	2.9487	-	5	52.7602 **	11.8316 **	2
DR	6.7255	-	3	7.4748 **	5.7821 **	2
LR	5.1919	-	5	7.8046 **	3.3855 **	4
Bangladesh						
CMR	7.6930 **	0.1982	2	-	-	-
DR	2.8684	-	2	32.9110 **	1.0811	1
LR	2.1123	-	5	13.5482 **	13.9967 **	6
Sri Lanka						
CMR	4.6202	-	4	62.6120 **	15.4852 **	4
DR	6.6042	-	4	87.3716 **	59.8259 **	3
LR	4.8025	-	2	46.7291 **	2.4658	1

Note: Asterisk (**) denotes significance at 5% level. The null hypothesis of the Φ test is defined as the variables in the estimated model are non-stationary, while the null hypothesis of *F* test is defined as the adjustment dynamic of the variable is symmetric. The chosen optimal lags are selected based on Akaike Information Criterion.

5.5 First Stage Interest Rate Pass-through: From the Policy Rates to the Money Market Rates

The interest rate pass-through mechanism is a two-stage process through which shifts in the policy rate by the central bank are transmitted to the bank retail rates. In the first stage, changes in the policy rate are transmitted to the money market rates. In the second stage, banks adjust their retail rates, i.e. deposit and lending rates, following changes in the money market rates (Andries, 2015). Typically, the literature finds that the first stage of the pass-through is usually complete (see, for example, the studies of Gigineishvili, 2011; Rajan & Yanamandra, 2015; Chileshe & Akanbi, 2016); while, the second stage is usually incomplete and rigid which depends on the structure and regulatory environments of the banking system of the country. Therefore, most studies on interest rate pass-through typically focuses on the second stage of the pass-through mechanism as the main subject of their studies and assumes the first stage pass-through to be complete.

Nevertheless, as argued by Rajan and Yanamandra (2015), the first stage pass-through is unnecessarily complete as contended by previous studies. Also, the performance of the first stage pass-through mechanism is very important in the beginning of the transmission mechanism of monetary policy, since a proper functioning of the first stage pass-through mechanism serves as a prerequisite for the second stage of the pass-through to work. Therefore, in order to empirically prove that whether the first stage of the pass-through mechanism of the sample countries are indeed complete as argued by previous studies, this study will also include the examination of the first stage of the pass-through mechanism as a complementary analysis (see Appendix C). Then, the examination of the second stage of the pass-through mechanism, which is typically the main focus in the field of interest rate

pass-through studies, will be investigated and discussed in great depth in the later subsections.

As shown in Table C.8 in Appendix C, the presence of asymmetric cointegration is detected between the policy rates and money market rates of Pakistan, India and Sri Lanka, except for Bangladesh. This posits that there is a long-run relationship between these two interest rates in Pakistan, India and Sri Lanka. The existence of strong long-run relationships between the policy rates and money market rates has also been supported by the presence of a complete long-run pass-through in Pakistan, and over-complete pass-throughs in India and Sri Lanka as shown in Table C.7 in Appendix C.

In addition, the short-run adjustment behaviour of money market rate on towards changes in the policy rate is asymmetric (see Table C.8 in Appendix C), whereby upward adjustment rigidities were found for Pakistan and India and downward adjustment rigidity were found for Sri Lanka. Nevertheless, as depicted in Table C.7 in Appendix C, the magnitude of the short run pass-through of Pakistan and India is rather high, while Sri Lanka had an over-complete pass-through in the short-run.

Despite the presence of asymmetric adjustments and rather incomplete pass-through in the short-run between the policy rates and money market rates of Pakistan, India and Sri Lanka, the pass-through mechanism is still complete in the long run, with the exception of Bangladesh. Therefore, other than Bangladesh, we can conclude that the first stage interest rate pass-through mechanism in Pakistan, India and Sri Lanka is complete and effective in the long run, and these findings are consistent with the arguments of previous studies such as those of Gigineishvili (2011), Rajan and Yanamandra (2015) and Chileshe and Akanbi (2016). Given the completeness of the first stage of the pass-through mechanism of the most

of the sample countries, it can be postulated that the prerequisites for the second stage of the pass-through mechanism is functioning properly in the sample countries.

5.6 Second Stage Interest Rate Pass-through: From the Money Market Rates to the Bank Retail Rates

As evidenced by the previous subsection, the first stage interest rate pass-through mechanism is complete in Pakistan, India and Sri Lanka, but not for Bangladesh. Therefore, it can be inferred that the interest rate pass-through mechanism in the beginning of the monetary policy transmission mechanism in the sample countries, i.e. pass-through from changes in the policy rate induced by the central banks to money market rates, is effective. Subsequently, this subsection will proceed to examine the effectiveness of the second stage of the interest rate pass-through mechanism in the sample countries, which is the pass-through from changes in the money market rate to bank retail rates.

5.6.1 TAR and MTAR Models Asymmetric Cointegration Estimation Results

Before estimating the magnitude of the long-run pass-through in the second stage of the pass-through mechanism, i.e. from changes in the money market rate to the bank retail rates for the sample countries, cointegration test will be utilised to inspect the presence of long-run relationships among the interest rate variables. To examine such long-run relationships, symmetric cointegration test such as the Engle and Granger (1987) two-step procedure and the Johansen-Juselius maximum likelihood procedure have been frequently used in past literature (see, for example, Fadiran, 2014, Gambacorta, Illes & Lombardi, 2014, Ogundipe & Alege, 2014, Okello, 2014, Lindholm, 2016).

However, recent studies (see, for example, Enders & Siklos, 2001, Payne, 2006, Payne & Waters, 2008, Vishwakarma, 2013) have argued that the adjustments among

interest rate variables are mostly asymmetric in nature, and the standard symmetric cointegration test may be mis-specified and have lower power in the presence of asymmetric adjustments. Based on these arguments, the TAR and MTAR asymmetric cointegration models are utilised in this study to examine the presence of asymmetric cointegration among the interest rate variables of the sample countries and the results are presented in Table 5.6.

Table 5.6: TAR and MTAR Asymmetric Cointegration Tests Results for the Second Stage Pass-through

Model	TAR				MTAR			
	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	τ	Lag	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	τ	Lag
Pakistan								
DR	5.171	0.455	-0.544	2	16.558**	21.916**	-0.392	2
LR	9.023**	6.194	0.484	5	10.278**	8.533**	0.207	5
India								
DR	10.638**	11.417**	-0.524	10	10.638**	11.417**	-0.522	10
LR	2.498	1.249	1.018	5	3.924	2.788	-0.008	5
Bangladesh								
DR	2.662	0.594	0.494	2	10.659**	16.164**	-0.185	2
LR	2.681	3.052	-1.649	1	9.268**	16.059**	-0.220	1
Sri Lanka								
DR	4.972	3.180	-1.822	9	11.839**	16.364**	0.207	9
LR	10.230**	14.339**	-1.319	10	24.596**	42.078**	-0.539	10

Note: Asterisk (**) denotes significance at 5% level. τ is the threshold value calculated with Chan (1993) method. The null hypothesis of Φ test is defined as the variables in the estimated model are not cointegrated, while the null hypothesis of *F* test is defined as the cointegration is symmetric. The chosen optimal lags in the TAR and MTAR asymmetric cointegration tests are selected automatically based on Akaike Information Criterion. The critical values of each of the Φ and *F* tests is simulated with Monte Carlo simulation[17].

[17] A brief description on Monte Carlo simulation and bootstrapping are given in Appendix D.

5.6.1.1 Pakistan

For Pakistan, the TAR model result shows that no cointegration exists in the DR model since the null hypothesis of no cointegration of the Φ test cannot be rejected at the 5% level of significance. In the LR model, cointegration is found, based on the TAR model as the Φ test is significant at the 5% level, and further examination found that the cointegration is symmetric since the null hypothesis of symmetric cointegration of the *F* test cannot be rejected. On the other hand, the MTAR model indicates cointegration between the bank retail rates and the T-bill rate of Pakistan as the Φ test is significant at the 5% level. Since cointegration is found between the interest rate variables in the MTAR model, it is possible to examine whether the cointegration is symmetric. Based on the results, the null hypothesis of symmetric adjustment of the *F* test are rejected at the 5% level of significance, indicating the presence of asymmetric adjustment between the bank retail rates and the T-bill rate of Pakistan.

5.6.1.2 India

The TAR and MTAR models result show that cointegration exists only in the DR model of India as the null hypothesis of the Φ test is significant at the 5% level. On the other hand, no cointegration is found in the LR model by either the TAR and MTAR models due to the non-rejection of the null hypothesis of the Φ tests at the 5% level. Since a cointegration relationship is found in the DR model of India, further analysis is carried out to examine whether the long-run relationship is symmetric. Based on the results of the TAR and MTAR models, the null hypothesis of a symmetric cointegration relationship of the *F* test is rejected at the 5% level of significance. Hence, there is strong statistical evidence to support the presence of asymmetric cointegration in the DR model of India.

5.6.1.3 Bangladesh

The TAR model shows the absence of asymmetric cointegration in the DR and LR models of Bangladesh, since the null hypothesis of no cointegration and symmetric adjustment of the Φ and *F* tests, respectively, cannot be rejected at the 5% significance level. In contrast, the MTAR model is able to detect the presence of asymmetric cointegration between the interest rate variables, given the significance of the Φ and *F* tests at the 5% level. This shows that based on the MTAR model, the bank retail rates and the call money rate of Bangladesh have a long-run relationship and that the relationship is asymmetric.

5.6.1.4 Sri Lanka

As for Sri Lanka, the TAR model is unable to detect the presence of cointegration in the DR model, as the Φ test is insignificant, while asymmetric cointegration is found for the LR model after the null hypotheses of symmetric cointegration, as depicted in both the Φ and *F* tests where are rejected at the 5% significance level. In the MTAR model, the Φ and *F* tests of both bank retail rates are significant at the 5% level. Based on the MTAR model, there exists an asymmetric long-run relationship between the bank retail rates with respect to the call money rate in Sri Lanka.

Overall, the TAR and MTAR models provide contradictory results. Among the eight interest rate models, the TAR model found the existence of cointegrating relationships in three models, i.e. two asymmetric cointegration and one symmetric cointegration relationship. On the other hand, the MTAR model successfully identified asymmetric cointegrating relationships in seven out of the eight interest rate models. As noted by Enders and Siklos (2001), the power of the MTAR model is many times higher than the TAR model for a plausible range of adjustment parameters, and it best describes the behaviour of interest

rates and is more suitable for policy making purposes as compared to the TAR model. Based on this notion, as the MTAR model results support the hypothesis of asymmetric cointegration between the interest rate variables of the sample countries, this study will model the asymmetric EC-EGARCH (1,1)-M bank retail rate models under the MTAR specification to examine the short-run adjustment dynamics among the interest rate variables.

5.6.2 Long-Run Pass-through Estimation Results

As the long-run relationships among the interest rate variables have been established by the MTAR models in Section 5.6, the long-run parameters of the DR and LR models for the sample countries are estimated and the results are presented in Table 5.7. The parameter α_0 indicates either a fixed mark-up or mark-down effect, whereby it denotes a fixed mark-up if it is significantly positive, and a fixed mark-down if it is significantly negative. The parameter β_1 indicates the magnitude of pass-through from the short-run interest rate to bank retail rates in the long-run, where β_1<1 indicates incomplete pass-through, β_1>1 means over pass-through and β_1=1 indicates a complete pass-through. The Wald test ($H_0: \beta_1 = 1$) will be utilised to statistically verify the existence of a complete pass-through in each of the bank retail rate models in the long-run.

Table 5.7: Long-Run Parameters Estimation Results the Second Stage Pass-through

Model	α_0	β_1	$H_0: \beta_1 = 1$	BG	ARCH
Pakistan					
DR	-0.102	0.603***	206.152***	98.985***	33.465***
LR	2.113***	0.913***	5.113**	99.828***	26.559***
India					
DR	3.774***	0.481***	34.810***	187.484***	167.414***
LR	10.638***	0.013	1016.323***	85.086***	0.189
Bangladesh					
DR	4.787***	0.081***	1020.043***	146.539***	120.540***
LR	11.228***	0.110***	302.051***	159.818***	99.111***
Sri Lanka					
DR	4.377***	0.355***	105.742***	155.284***	134.621***
LR	2.318***	0.997***	0.001	52.007***	8.701***

Note: Asterisk (***) denotes significance at 1% level. Coefficients α_0 and β_1 are estimated from Equation (3). α_0 is the fixed mark-up or mark-down of bank retail rates, while β_1 represents the magnitude of long-run pass-through. The null hypothesis of completeness of long-run pass-through, denoted as $H_0: \beta_1 = 1$, is estimated with Wald test, whereby the rejection of the null hypothesis indicates incomplete long-run pass-through. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. BG is the Breusch-Godfrey (1978) Lagrange multiplier test for autocorrelation. The retail rate models were estimated using Newey-West heteroskedasticity and autocorrelation consistent (HAC) robust standard errors to correct for the presence of heteroskedasticity and autocorrelation in the estimated models.

5.6.2.1 Pakistan

For the bank retail rate models of Pakistan, the insignificance of α_0 indicates that the banks do not mark-up nor mark-down the deposit rate, but instead mark-up the lending rate by 2.133% on average since the parameter α_0 in the LR model is positive and statistically significant at the 1% level of significance. In both models, the parameter β_1 is statistically significant at the 1% level of significance, with a coefficient of 0.603 for the DR model and 0.913 for the LR model. This finding indicates that, albeit, the Pakistani T-bill rate is able to pass-through to the bank retail rates in the long-run, it is incomplete. The rejection of the null hypothesis of the Wald test for both bank retail rate models further

indicates the incompleteness of the pass-throughs. Nonetheless, the pass-through from the T-bill rate to the lending rate is found to be higher than the pass-through to the deposit rate.

5.6.2.2 India

The significantly positive α_0 at the 1% level of significance in the DR and LR models of India indicates that Indian banks mark-up both bank retail rates, whereby the average mark-up is 3.744% for the deposit rate and 10.638% for the lending rate. Contrary to the significantly positive β_1 of the DR model with a coefficient of 0.481 at the 1% level of significance, the insignificance and low coefficient value of 0.013 of β_1 in the LR model indicates the non-existence of pass-through from the call money rate to the lending rate in the long-run. The Wald test also supports the incompleteness of the pass-through for both bank retail rate models, as the null hypothesis of a complete pass-through is rejected at 1% level of significance. This finding reveals that the lending rate is not responsive to the monetary policy impulses implemented by the RBI. Nonetheless, the pass-through still exists in the DR model of India in the long-run, despite the pass-through being incomplete since β_1 is less than 1.

5.6.2.3 Bangladesh

It is discovered that the α_0 of both the DR and LR models of Bangladesh are significantly positive at the 1% level of significance which indicates that the Bangladeshi banks mark-up both bank retail rates by a fixed margin when the call money rate increases, with an average mark-up of 4.787% for the deposit rate and 11.228% for the lending rate. In terms of the long-run pass-through, as indicated by β_1, its significance at the 1% level of significance indicates that the bank retail rates of Bangladeshi banks are responsive to the adjustments of the call money rate conducted by the BB. However, although both bank retail

rate models do indicate the existence of pass-throughs in the long-run, they are very minimal. The lending rate has a slightly higher pass-through than the deposit rate with pass-through coefficients of 0.110 and 0.081, respectively. A further examination of the outcome of the Wald test also indicates incomplete long-run pass-throughs, as the null hypotheses of complete long-run pass-throughs for both bank retail rate models are rejected even at the 10% level of significance.

5.6.2.4 Sri Lanka

As for the case of Sri Lanka, similarly to most of the other sample countries, the banks imposed a fixed mark-up to both of the bank retails rates as the parameter α_0 is found to be significantly positive at the 1% level of significance, with an average mark-up of 4.377% for the deposit rate and 2.318% for the lending rate. While the long-run pass-through parameter β_1 is significant at the 1% level of significance for both of the bank retail rate models, the LR model has a coefficient of 0.997, which is close to one, indicating complete pass-through. This is reinforced by the insignificance of the null hypothesis of the Wald test for the LR model, which in turn indicates that the pass-through from the call money rate to the lending rate is complete in the long-run. On the other hand, the DR model only has a pass-through coefficient of 0.355 indicating an incomplete pass-through in the long-run, which is also supported by the significance of the Wald test. By comparison, the findings in Sri Lanka reveal that the LR model has a complete and significantly higher pass-through than the DR model of Sri Lanka in the long-run.

5.6.3 EC-EGARCH (1,1)-M Model Estimation Results

The empirical findings in the preceding sections have highlighted several important facts about the interest rate variables of this study – i) the presence of asymmetric cointegrating relationships, as indicated by the MTAR model, and ii) the presence of volatility clustering and conditional heteroscedasticity among the interest rate variables as indicated by the ARCH-LM test in Section 5.2. To further support the strong existence of conditional heteroscedasticity and volatility clustering in the interest rate variables, which is a common characteristic found in the analysis of interest rates, the widely-used asymmetric ECM, as used in the past studies (see, for example, De Bondt, 2002; Valadkhani & Anwar, 2012; Mihaylov, 2016) is estimated and tested for ARCH effects.

According to the empirical results of the asymmetric ECM in Tables 5.8 to 5.11 under the heading of "ECM", most of the Q and Q^2 statistics are significant, which indicates the existence of autocorrelation in both the level and squared form of the residuals. In addition, the Engle (1982) ARCH-LM test that assesses the presence of conditional heteroscedasticity in a time series, known as ARCH effects, are statistically significant at least at the 5% level, except for the LR model of India. Taken together, these findings indicate that the traditional asymmetric ECM that assumes homoscedasticity may result in less robust estimation results, as the presence of ARCH effects will violate the assumptions of the classical linear regression model which the asymmetric ECM is estimated with. To eradicate this issue, a conditional heteroscedastic model that is able to model the time-varying variance, will be more appropriate under the context of this study (Sjolander, 2011). Therefore, this study adopts the asymmetric EC-EGARCH (1,1)-M model. This conditionally heteroscedastic model is able to prevent biased estimation results by capturing the ARCH effects that have been detected in the asymmetric ECM models.

The asymmetric EC-EGARCH (1,1)-M model estimation results are displayed in Tables 5.8 to 5.11. In the conditional mean equation, parameter *m* indicates the short-run pass-through from the money market rates to bank retail rates, while parameter *s* represents the effect that the volatility of the interest rate has on the bank retail rates adjustment behaviour. Parameters η_1 and η_2 represent the speed of adjustment of the short-run positive and negative deviation, respectively, towards their long-run equilibrium values. They also provide an indication of either the upward or downward adjustment rigidities exhibited in bank retail rates in response to adjustments in the money market rates, which in turn determines the banking structure hypothesis. On the other hand, parameter γ in the conditional variance equation detects the existence of asymmetric and leverage effects of the conditional variance of the interest rate variables.

5.6.3.1 Pakistan

The EC-EGARCH (1,1)-M model results for the bank retail rate models of Pakistan are displayed in Table 5.8. In the conditional mean equation, the parameter *m* is significant and positive for both the DR and LR models which indicates that the adjustment of both the DR and LR are positively related to the adjustment of the T-bill rate. As for the parameter *s*, it is significantly positive in both models which shows that the volatility of the interest rate has a positive effect on the bank retail rates. The parameters η_1 and η_2 in the conditional mean equation are significantly negative, indicating that the bank retail rates do adjust back to the long-run equilibrium whenever there are any short-run positive or negative deviations.

Based on the empirical findings, the adjustment speed for positive deviations of the deposit rate is 11.2% while for negative deviations, it is 36.6%. This indicates that the DR model exhibits downward adjustment rigidity ($|\eta_2| > |\eta_1|$), whereby the DR adjusts quicker towards an increase in the T-bill rate. On the other hand, the LR model exhibits upward

adjustment rigidity ($|\eta_1| > |\eta_2|$), as the speed of adjustment for the positive deviation (43.5%) is higher than the negative deviation (33.3%), which indicates that the LR adjusts faster when there is a decrease in the T-bill rate. These findings indicate that the adverse customer reaction hypothesis is supported by Pakistan.

As for the conditional variance equation in Table 5.8, the parameter γ in the DR model is significantly negative ($\gamma < 0$) which indicates the presence of a leverage effect. The parameter γ is significant and positive for the LR model, indicating an asymmetric effect of the conditional variance but no leverage effect.

The insignificance of the Ljung-Box (Q) test in both level and squared standardised residuals indicates that the standardised residuals of both bank retail rate models are white noise. The ARCH-LM test is insignificant, indicating the absence of any remaining ARCH effect in both bank retail rate models. Moreover, the insignificance of the joint sign bias test (JSB) which is a joint hypothesis for sign and size bias lends support that there are no model selection errors in both bank retail rate models. When comparing with the diagnostic tests of the ECM, the insignificance of all of the diagnostic tests indicates that the model is able to tackle the issues of volatility clustering and conditional heteroscedasticity, as compared to the ECM model.

Table 5.8: EC-EGARCH (1,1)-M Model Estimation Result for the Second Stage of Pass-through of Pakistan

Parameter	ECM		EC-EGARCH (1,1)-M	
	DR	LR	DR	LR
			Mean Equation	
m	0.219	0.382	0.269	0.193
	(0.001)***	(0.000)***	(0.000)***	(0.001)***
η_1	-0.124	-0.304	-0.112	-0.435
	(0.020)**	(0.000)***	(0.003)***	(0.000)***
η_2	-0.726	-0.155	-0.366	-0.333
	(0.000)***	(0.003)***	(0.000)***	(0.000)***
s	-	-	3.103	0.432
			(0.000)***	(0.074)*
			Variance Equation	
ω	-	-	-3.548	-1.815
			(0.000)***	(0.000)***
α	-	-	0.325	0.662
			(0.000)***	(0.000)***
γ	-	-	-0.186	0.599
			(0.001)***	(0.000)***
β	-	-	0.451	0.938
			(0.000)***	(0.000)***
	Diagnostic Tests			
Q (6)	13.985	18.432	7.222	3.231
	(0.030)**	(0.005)***	(0.301)	(0.357)
Q (12)	27.334	38.920	17.984	11.693
	(0.007)***	(0.000)***	(0.116)	(0.231)
Q^2 (6)	10.219	38.943	1.684	1.175
	(0.116)	(0.000)***	(0.946)	(0.978)
Q^2 (12)	14.328	40.146	4.027	2.576
	(0.280)	(0.000)***	(0.983)	(0.998)
ARCH	4.354	22.801	0.090	0.157
	(0.037)**	(0.000)***	(0.764)	(0.692)
JSB	-	-	3.584	0.840
			(0.310)	(0.840)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols m, η_1, η_2 and s for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation 4.14, while symbols ω, α and β for the variance equation results of the EC-EGARCH (1,1)-M follows Equation 4.15. Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

5.6.3.2 India

According to the empirical results of the conditional mean equations for the DR and LR models of India, as depicted in Table 5.9, the parameter *m* is significant and positive for the DR model but insignificant for the LR model. This finding provides evidence that changes in the call money rate will be able to pass-through to the deposit rate but not to the lending rate in the short-run. The parameter *s* reveals that interest rate volatility has no effect on both the deposit rate and the lending rate, as it is insignificant in both bank retail rate models.

As the deposit rate and the call money rate are asymmetrically cointegrated, the further examination on their asymmetric adjustment pattern reveals downward adjustment rigidity. This is evidenced by the faster speed of adjustment of the negative deviations rather than the positive deviations of the deposit rate ($|\eta_2| > |\eta_1|$) at 35.7% and 1.6% respectively, although the parameter $|\eta_1|$ is insignificant even at the 10% level of significance. As for the LR model, no cointegration is found by the MTAR model, thus making the examination of the speed of adjustment for both deviations irrelevant. Based on these findings, the short-run adjustment dynamics of the DR model supports the adverse customer reaction hypothesis.

The coefficient of the parameter γ in the conditional variance equation of the LR model is statistically significant and positive, but it is statistically insignificant for the DR model. This suggests the existence of an asymmetric effect in the conditional variance of the LR model of India only.

The diagnostic tests of the DR and LR models of India as shown in Table 5.9 indicates that both bank retail rate models are appropriately specified as the Ljung-Box tests in both level and squared standardised residuals are insignificant. The insignificance of the

ARCH-LM test indicates that the standardised residuals of both bank retail rate models are indeed homoscedastic. The insignificance of the JSB test in both bank retail rate models indicates no model selection errors. Comparing the diagnostic tests of the bank retail rate models in the ECM which are statistically significant, the diagnostic tests of the ECM-EGARCH (1,1)-M model are insignificant, and this means that it is more robust than the former model.

Table 5.9: EC-EGARCH (1,1)-M Model Estimation Result for the Second Stage of Pass-through of India

Parameter	ECM		EC-EGARCH (1,1)-M	
	DR	LR	DR	LR
			Mean Equation	
m	0.324	0.002	0.273	0.003
	(0.000)***	(0.787)	(0.000)***	(0.660)
η_1	-0.191	-	0.016	-
	(0.002)***		(0.784)	
η_2	-0.392	-	-0.357	-
	(0.000)***		(0.001)***	
s	-	-	-0.299	0.006
			(0.257)	(0.941)
			Variance Equation	
ω	-	-	-0.465	-0.660
			(0.000)***	(0.036)**
α	-	-	0.470	-0.158
			(0.000)***	(0.664)
γ	-	-	0.131	0.205
			(0.140)	(0.050)*
β	-	-	0.893	0.701
			(0.000)***	(0.000)***
		Diagnostic Tests		
Q (6)	13.666	1.535	4.588	4.533
	(0.034)**	(0.957)	(0.468)	(0.605)
Q (12)	28.629	3.662	13.201	6.343
	(0.000)***	(0.989)	(0.280)	(0.898)
Q^2 (6)	66.240	0.048	1.331	0.202
	(0.000)***	(1.000)	(0.970)	(1.000)
Q^2 (12)	77.361	0.199	8.093	0.370
	(0.000)***	(1.000)	(0.778)	(1.000)
ARCH	6.809	0.002	0.254	0.005
	(0.009)***	(0.969)	(0.614)	(0.945)
JSB	-	-	1.631	0.214
			(0.652)	(0.975)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters Symbols m, η_1, η_2 and s for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation 4.14, while symbols ω, α and β for the variance equation results of the EC-EGARCH (1,1)-M follows Equation 4.15. Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

5.6.3.3 Bangladesh

Table 5.10 shows the empirical results of the EC-EGARCH (1,1)-M model for both bank retail rate models of Bangladesh. In the conditional mean equations, the parameter *m* in the DR model is significantly negative, while it is insignificant in the LR model. This provides empirical support of the inexistence or weak short-run pass-through from the call money rate to bank retail rates in Bangladesh. In both bank retail rate models, the parameter *s* is statistically significant, indicating that interest rate volatility negatively affects the adjustment behaviour of the deposit rate but positively affects the lending rate.

The parameters η_1 and η_2 in the conditional mean equations of both bank retail rate models are significant (except for the coefficient of η_2 in the DR model), implying that both bank retail rates will adjust back towards their long-run equilibria when they deviate away from them in the short-run. The empirical finding of the DR model indicates upward adjustment rigidity since $|\eta_1| > |\eta_2|$ (1.1% > 0.9%), while downward adjustment rigidity is found for the LR model as $|\eta_2| > |\eta_1|$ (7.1% > 1.9%). These findings reveal that the adjustment speed of the deposit rate is quicker in response towards a decrement in the call money rate, whereas the lending rate adjusts faster when the call money rate is rising. Taken together, this highlights the presence of collusive pricing behaviour based on the interest rate data of Bangladesh.

In the conditional variance equation of both bank retail rate models, the parameter γ is insignificant in the DR model but is statistically significant and positive in the LR model of Bangladesh. This finding indicates that the conditional volatility is asymmetric in the LR model, but is symmetrical in the DR model.

In Table 5.10, the insignificance of the Ljung-Box test on the level and squared standardised residuals of the DR and LR models of Bangladesh indicates that both models are free from any remaining autocorrelation problem. Moreover, the result of the ARCH-LM test is also insignificant, indicating that the ARCH effect has been remedied in both models as they are estimated with time-varying variance as compared to the asymmetric ECM under constant variance. Furthermore, the insignificance of the JSB test provides the support that the models are adequately selected.

Table 5.10: EC-EGARCH (1,1)-M Model Estimation Result for the Second Stage of Pass-through of Bangladesh

Parameter	ECM		EC-EGARCH (1,1)-M	
	DR	LR	DR	LR
			Mean Equation	
m	0.003	0.001	-0.012	-0.001
	(0.415)	(0.910)	(0.000)***	(0.924)
η_1	-0.029	-0.014	-0.011	-0.019
	(0.117)	(0.448)	(0.062)*	(0.074)*
η_2	-0.102	-0.052	-0.009	-0.071
	(0.032)**	(0.220)	(0.562)	(0.078)*
s	-	-	-0.546	0.611
			(0.000)***	(0.000)***
			Variance Equation	
ω	-	-	-4.818	-0.549
			(0.000)***	(0.001)***
α	-	-	2.020	0.586
			(0.000)***	(0.001)***
γ	-	-	0.045	0.173
			(0.831)	(0.095)*
β	-	-	0.210	0.964
			(0.000)***	(0.000)***
	Diagnostic Tests			
Q (6)	4.813	11.424	4.482	3.828
	(0.568)	(0.076)*	(0.106)	(0.281)
Q (12)	10.058	25.071	5.230	10.497
	(0.611)	(0.014)**	(0.733)	(0.312)
Q^2 (6)	17.570	18.683	4.124	1.758
	(0.007)***	(0.005)***	(0.660)	(0.941)
Q^2 (12)	19.177	19.848	5.489	4.363
	(0.084)*	(0.070)*	(0.940)	(0.976)
ARCH	4.525	5.395	0.861	0.225
	(0.033)**	(0.020)**	(0.353)	(0.636)
JSB	-	-	4.812	1.617
			(0.186)	(0.656)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols m, η_1, η_2 and s for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation 4.14, while symbols ω, α and β for the variance equation results of the EC-EGARCH (1,1)-M follows Equation 4.15. Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

5.6.3.4 Sri Lanka

As illustrated in the empirical results of the conditional mean equation of Sri Lanka in Table 5.11, the parameter *m* is insignificant in the DR model but it is significant in the LR model. This indicates that the call money rate is only able to pass-through to the lending rate in the short-run. As for the parameter *s*, both models indicate statistical insignificance meaning that interest rate volatility does not affect the adjustment behaviour of both bank retail rates.

The significantly negative parameters η_1 and η_2 in both bank retail rate models indicate that any short-run deviations in the bank retail rates will be able to converge to the long-run equilibrium. In the DR model, the empirical finding indicates that the deposit rate exhibits downward adjustment rigidity as it adjusts faster in response to a short-run disequilibrium when the call money rate is increasing since η_2 is larger than $|\eta_1|$ (12.3%>7.9%). As for the LR model, the short-run adjustment of the lending rate in response to adjustments in the call money rate exhibit upward adjustment rigidity since $|\eta_1|$ is larger than $|\eta_2|$ (32.3%>31.7%). Comparing the short-run adjustment dynamics between these two models, it can be inferred that the adverse customer reaction hypothesis is verified by Sri Lanka.

The significantly negative parameter γ in the conditional variance equation of the DR model indicates the existence of the leverage effect, whereby a decrement in the interest rates will cause larger interest rate volatility. In contrast, the parameter γ in the LR model is significantly positive which shows the existence of the asymmetry affect in the conditional variance of the LR model.

In contrast to the ECM model in Table 5.11 which has been empirically established to exhibit conditional heteroscedasticity and volatility clustering, the insignificance of the diagnostic tests of both bank retail rate models in the form of the EC-EGARCH (1,1)-M model indicates that both bank retail rate models are properly specified. Specifically, the Ljung-Box test on the level and squared standardised residuals are not significant, indicating that the standardised residuals are indeed white noise. The standardised residuals are no longer heteroscedastic as the ARCH-LM test is now insignificant. Furthermore, the results of the JSB test also indicates that the models have no selection errors.

Table 5.11: EC-EGARCH (1,1)-M Model Estimation Result for the Second Stage of Pass-through of Sri Lanka

Parameter	ECM		EC-EGARCH (1,1)-M	
	DR	LR	DR	LR
			Mean Equation	
m	0.006	0.101	-0.001	0.176
	(0.524)	(0.000)***	(0.914)	(0.000)***
η_1	0.017	-0.153	-0.079	-0.323
	(0.453)	(0.000)***	(0.075)*	(0.000)***
η_2	-0.050	-0.251	-0.123	-0.317
	(0.000)***	(0.000)***	(0.004)***	(0.000)***
s	-	-	-0.153	-0.287
			(0.371)	(0.167)
			Variance Equation	
ω	-	-	-2.149	-0.596
			(0.004)***	(0.000)***
α	-	-	0.952	0.446
			(0.000)***	(0.000)***
γ	-	-	-0.226	0.340
			(0.072)*	(0.000)***
β	-	-	0.628	0.890
			(0.000)***	(0.000)***
		Diagnostic Tests		
Q (6)	248.65	37.218	1.590	3.305
	(0.000)***	(0.000)***	(0.452)	(0.192)
Q (12)	320.43	42.539	8.715	8.337
	(0.000)***	(0.000)***	(0.367)	(0.401)
Q^2 (6)	10.354	85.706	0.939	9.121
	(0.111)	(0.000)***	(0.988)	(0.167)
Q^2 (12)	11.055	101.35	2.141	11.966
	(0.524)	(0.000)***	(0.999)	(0.448)
ARCH	6.321	48.599	0.457	0.908
	(0.012)**	(0.000)***	(0.499)	(0.341)
JSB	-	-	2.285	2.184
			(0.515)	(0.535)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols m, η_1, η_2 and s for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation 4.14, while symbols ω, α and β for the variance equation results of the EC-EGARCH (1,1)-M follows Equation 4.15. Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

5.6.4 Discussion on the Empirical Findings

The discussion on the empirical findings of this study is divided into three parts. The first part discusses the magnitude of the pass-through of the sample countries as shown in summary Table 5.12. The second part of the discussion critically scrutinises the asymmetric short-run adjustment dynamics among the interest rate variables and also the supported banking structure hypothesis as depicted in summary Table 5.13. The final part of the discussion focuses on the effect that interest rate volatility has on bank retail rates adjustment behaviour and also the presence of asymmetric and leverage effects in the conditional variance and is presented in summary Table 5.14.

5.6.4.1 Mark-up, Short-run and Long-run Pass-through

It can be inferred that most of the banking systems of the sample countries, mark-up their bank retail rates following an increment of the money market rates by the respective central banks (see, Table 5.12). The statistically significant fixed mark-up effect in all of the LR models across the sample countries supports the mark-up theory by Rousseas (1985) that posits that banks usually charge a mark-up margin on the lending rates to compensate the operating cost and the cost of funding of banks in providing loans. This phenomenon is more apparent in an oligopolistic banking structure, such as in Bangladesh, as it has the highest mark-up effects in both the DR and LR models.

At the same time, evidence of incomplete short-run and long-run pass-through are prevalent in most of the bank retail rate models of the sample countries, as the magnitude of the pass-throughs are less than 1. Such incomplete pass-throughs largely affirm with the findings of past studies such as Payne (2007), Payne and Waters (2008), Holmes et al. (2015) and Zhang et al. (2017). Also, the empirical findings indicate that banks in the sample

countries mark-up their bank retail rates when the short-run and long-run pass-throughs are incomplete. This finding is consistent with Wang and Lee (2009), which stated that banks usually mark-up bank retail rates when money market rates increase to cover their bank costs, especially when they are unable to completely pass-through the increment of money market rates to both bank retail rates.

Table 5.12: Summary of Short-Run and Long-Run Pass-Through for the Second Stage of Pass-through

Countries	Model	Short-run Pass-through (m)	Long-run pass-through		
			Mark-up / down (α_0)	Type of pass-through (β_1)	Total Pass-through (DR + LR)
Pakistan	DR	0.269 (Incomplete)	-	0.603 (Incomplete)	1.516
	LR	0.193 (Incomplete)	2.113 (Mark-up)	0.913 (Incomplete)	
India	DR	0.273 (Incomplete)	3.774 (Mark-up)	0.481 (Incomplete)	0.481
	LR	-	10.638 (Mark-up)	-	
Bangladesh	DR	-	4.787 (Mark-up)	0.081 (Incomplete)	0.191
	LR	-	11.228 (Mark-up)	0.110 (Incomplete)	
Sri Lanka	DR	-	4.377 (Mark-up)	0.355 (Incomplete)	1.352
	LR	0.176 (Incomplete)	2.138 (Mark-up)	0.997 (Complete)	

Note: Hyphen (-) denotes statistical insignificance even at the 10% level of significance. The summary for short-run pass-through is taken from Table 5.8 for Pakistan, Table 5.9 for India, Table 5.10 for Bangladesh and Table 5.11 for Sri Lanka. The summary for mark-up or mark-down and type of pass-through is taken from Table 5.7 for all 4 sample countries. The total pass-through (DR + LR) is calculated by summing the pass-through magnitudes of both retail rate models for each sample country.

5.6.4.2.1 Pakistan

The summary of empirical results in Table 5.12 indicates that Pakistan has the second highest long-run pass-throughs in the LR model and the highest in the DR model, among the sample countries. This indicates that Pakistan has more complete pass-throughs as compared to the other sample countries, albeit incomplete. Such high pass-throughs might be attributable to the implementation of the inflation targeting lite regime by the SBP which aims to control inflation by influencing aggregate demand through the use of the T-bill rate as its main monetary policy tool.

Due to the importance of the T-bill rate, the SBP has been stabilising it to strengthen the transmission of monetary policy decisions, using an interest rate corridor since 2000 (Omer, 2016). Since the T-bill rate is quite stable following the introduction of the corridor, banks are less reluctant to revise their bank retail rates following its adjustments, hence contributing to a higher level of pass-through.

However, despite having the highest pass-through in the DR model, it is still incomplete. Such incomplete pass-through might be attributable to the minimum deposit rate policy implemented by the SBP in an attempt to raise the deposit rates offered by banks to depositors (Omer, De Haan & Scholtens, 2014). Such a policy may have prevented the deposit rate to be effectively set at a market-clearing rate, thus negatively affecting the pass-through in the DR model in the long-run.

5.6.4.2.2 India

As a flexible inflation targeting country in which the interest rate is used as the main monetary policy instrument, it is not surprising that India has the second highest short-run and long-run pass-throughs in the DR model, as compared to the other sample countries.

Albeit, the long-run pass-through to the deposit rate is less than half (0.481) (see, Table 5.12), its second position among the sample countries could be possibly attributed to the introduction of the LAF in the early 2000s, which allowed the RBI to guide the call money rate within the formal corridor and hence stabilised the volatility of the call money rate (RBI, 2012). Subsequently, this resulted in higher monetary policy transparency and fewer uncertainties in the Indian money market. As a result, Indian banks tend to adjust their deposit rates following adjustments in the call money rate, hence resulting in higher pass-through in the DR model. Although the pass-through has enhanced following the introduction of the LAF as deemed by Sengupta (2013), the empirical finding of this study still indicates that the pass-throughs of both bank retail rate models, in the long-run, are still far from optimal.

In addition, the empirical result indicates the inexistence of short-run and long-run pass-through in the LR model of India. Although the interest rate is the main monetary policy instrument under its current inflation targeting framework, it is still ineffective in transmitting monetary policy impulses to the Indian loan market. Indeed, the report of the RBI (2018a) raised alarming concern about the absence of smooth transmission from the call money rate to the lending rate in India, whereby its lending rate is rigid and inflexible in response towards the overall direction of interest rates in the Indian economy, although it has been more than 20 years since the RBI deregulated the lending rate.

The possible cause of this phenomenon might be attributable to the high cost of funds caused by maturity mismatches and asymmetrical interest rate setting between the deposit and loan rates offered by Indian banks. A recent report by the RBI (2017) revealed that most bank deposits are at fixed rates and have longer maturity, while most of the bank loans are at floating rates. As the higher cost and longer maturity of deposits have increased the

average cost of deposits, banks will be reluctant to decrease their lending rates during monetary easing to protect their profit. As a result, they re-price their lending rates arbitrarily in response to adjustments in the call money rate. Undeniably, Indian banks charge high interest rates and are unwilling to lower rates when the RBI reduces the call money rate (Subramanian, 2009). Given such a phenomenon, it is possible that adjustments in the call money rate are not passed-through to the lending rate, while a rather incomplete pass-through from the call money rate to the deposit rate is observed in the long-run.

5.6.4.2.3 Bangladesh

Bangladesh, on the other hand, has the highest mark-up effect in both the DR and LR models, which could be possibly explained by the Fisher Effect which argues that high inflation usually causes the general interest rate to increase proportionately (see Table 5.12). During inflationary periods, the BB will increase the call money rate to combat inflationary pressures. As a response, due to possible high menu costs which may inhibit the Bangladeshi banks from immediately re-pricing their retail rates following adjustments in the call money rate, they will tend to set higher mark-ups in their retail rates to serve as a buffer to protect their profits from interest rate fluctuations. Indeed, the Bangladeshi economy has been suffering from a persistent and high degree inflation rate, mainly attributable to energy crises and demand-pull inflation (Uddin, Chowdhury & Hossain, 2014). Given this fact, it is possible that Bangladesh has the highest mark-up effect in both bank retail rate models as evidenced by the empirical results of this study.

The pass-throughs of both of the bank retail rates are very low, in fact, they are the lowest among the sample countries indicating ineffective pass-throughs. Coupled with the fact that Bangladeshi banks charge high mark-up on their retail rates, it can be inferred that

such an incidence may possibly be attributable to a possible high banking concentration and the oligopolistic nature of the Bangladeshi banking system, as explained by the mark-up theory of Rousseas (1985). Under such a banking structure, banks are free to set their retail rates at a higher margin to increase bank profits. Indeed, Nguyen et al. (2012) found evidence of a high interest rate spread in Bangladesh, which is an indication of a lack of competition and low banking system efficiency (Ghasemi & Rostami, 2016).

At the same time, such low pass-throughs might be attributable to the monetary aggregate targeting framework adopted by Bangladesh. Under this framework, the BB uses its direct control over reserve money as the operational target to achieve gross domestic product growth rate or the inflation rate set by it (Kayum, 2016). As reserve money is the main monetary policy instrument, the BB focuses control only on money supply growth and is not actively controlling market interest rates (Gichuki, Oduor & Kosimbei, 2012). Since the interest rate does not serve as the main monetary policy signalling device in this framework and hence sees less intervention by the BB, banks are incentivised to re-price their retail rates arbitrarily following adjustments in the call money rate to secure better bank profits. Accordingly, this justifies the low magnitude of pass-through in the Bangladeshi bank retail rate models.

Furthermore, another probable reason for the low pass-throughs in the Bangladesh banking system could be attributable to the implementation of an interest rate cap policy on the bank retail rates offered by Bangladeshi banks, which was introduced to prevent bank exploitation as a result of low banking competition in the Bangladeshi banking system. Such interest rate caps have hinder bank retail rates from being determined by market power, which ultimately leads to interest rate distortions and ineffective pass-throughs. As evidenced by Hossain (2012), the BB imposed deposit and lending rate ceiling as a measure

to reduce the interest rate spread, which was later replaced by an interest rate spread cap due to pressure from the IMF (Islam et al., 2014; Hossain, 2015). In addition, the Association of Banks Bangladesh, which is an advisory service organisation to private Bangladeshi banks, has been implementing and frequently revises deposit and lending rate caps on private banks to artificially keep the interest rate spreads within a specific range. Thus, the adoption of the abovementioned non-market-based instruments by the Bangladeshi authorities has caused the bank retail rates to be set uncompetitively by the banks, and hence rendered low pass-throughs in Bangladesh.

5.6.4.2.4 Sri Lanka

The empirical finding posits that Sri Lanka is the only country to achieve complete pass-through in the long-run, albeit, in the LR model only (see, Table 5. 12). This finding is justifiable because of the current adoption of a monetary policy framework by the CBSL that features a mixture of both monetary aggregate targeting and a flexible inflation rate targeting framework, which in turn has highlighted the importance of the call money rate as its operating target. The increasing significance of the call money rate in signalling the CBSL's monetary policy decisions has been supported by a recent report by the CBSL (2018), which mentioned that the CBSL has been actively conducting its monetary operations by steering the call money rate along the desired path that is in line with its monetary policy stance. It is also possible that such a high pass-through to the lending rate, low mark-up margins for both bank retail rate models and a low interest rate spread as compared to the other sample countries may also an indication of an efficient Sri Lankan banking system due to intense competition among banks in Sri Lanka, especially in the loan market (SBP, 2014b). As the demand for loans by borrowers is highly elastic, banks in a competitive banking system will compete among themselves in securing more loans from borrowers by keeping their bank

retail rates close to the call money rate which subsequently leads to a fuller lending rate pass-through.

In contrast, however, the pass-through to the deposit rate in the short-run is insignificant and has a significant low pass-through in the long-run. Considering this, and the fact that the long-run pass-through to the lending rate is complete, such a phenomenon might be caused by the problem of excess banking liquidity in the Sri Lankan banking system. Indeed, the study of Abeygunawardana et al. (2017) found an excess banking liquidity issue in Sri Lanka. Under such a situation, banks tend to closely follow the call money rate in pricing their lending rate, while greatly reducing the deposit rate or even refusing to accept consumer deposits (CBSL, 2017). In addition, as banks with an abundant of excess liquidity have no short-term funding needs (Ghazanchyan, 2014), they are less likely to obtain funding from the Sri Lankan call money market and the CBSL itself and, therefore, counteract the effect of the call money rate on the deposit rate. It has been empirically discovered that high banking liquidity impedes pass-through (Sorensen & Werner, 2006). As such, an excess liquidity problem could be a contributing reason to the incomplete pass-through in the DR model of Sri Lanka.

5.6.4.2.5 Comparisons on the Magnitude of Interest Rate Pass-through

In comparison, the total magnitudes of long-run pass-through across both retail rate models of the sample countries are different (see Table 5.12). In total, Pakistan (1.516) had the highest magnitude of long-run pass-through, followed by Sri Lanka (1.352) and India (0.481), while Bangladesh (0.191) had the lowest over the sample period. Based on the discussions of the empirical results by each individual country in the previous sub-section, the following possible root causes of these differences can be further drawn.

The first possible explanation of these differences could be due to the type of monetary policy framework adopted by each country over the sample period and the period when they started to implement the framework. Monetary policy decisions are mainly signalled to the economy through short-term interest rates in an inflation targeting central bank, and thus the central bank will fully focus on controlling the magnitude and direction of interest rate changes. For instance, the implementation of an inflation targeting lite framework by Pakistan since 2005 might be the main reason behind its highest pass-through among the sample countries. Sri Lanka comes in second, possibly due to adoption of an enhanced monetary policy framework by the CBSL since 2012, which uses both monetary aggregates and short-term interest rates as the main monetary policy tools, resulting in blurred focus of the CBSL in using short-term interest rates in conveying monetary policy stance. Bangladesh had the lowest total pass-through, because the short-term interest rates are not used as the main monetary policy tool in a monetary targeting regime, and thus is often left unmonitored and less intervened by the BB. Nevertheless, despite India is the first among the sample countries to formally adopt a full-fledged inflation targeting framework, although the full transition had just recently ended in 2016, the total magnitude of long-run pass-through is only a fraction of those of Pakistan and Sri Lanka, especially when there is no pass-through to the lending rate at all in the long run. Such a weak pass-through could provide an indication of the presence of other structural issues in the banking system of India, which will be discussed below.

Secondly, these differences might be attributable to the implementation of a system for guiding short-term market interest rates towards the central bank's policy rate, in the form of a policy rate corridor, which limits the movements of short-term interest rates from deviating too far away from the upper and lower bounds of the corridor formed by policy

rates. This can be evidenced by the use of interest rate corridor in Pakistan, liquidity adjustment facility in India and standing rate corridor in Sri Lanka. With these systems in place, the short-term interest rates in Pakistan, India and CBSL are always kept close to the policy rates of the SBP, RBI and CBSL, resulting in less uncertainty in the future direction of the short-term interest rates. Accordingly, the retail rates offered by banks in Pakistan, India and Sri Lanka will tend to follow closely to changes in the short-term interest rates, thus leading to a higher total pass-through. As for Bangladesh, the pass-through is significantly lower due to inexistence of a formal interest rate corridor. Without such a system, the movement of short-term interest rates are not explicitly controlled by the BB, and subsequently raises interest rate uncertainties faced by Bangladeshi banks. Accordingly, this causes Bangladeshi banks to be reluctant to change their retail rates in line with changes in the short-term policy rate.

Finally, the use of non-market-based and the presence of structural issues in the banking system could also partly explains these differences in the total magnitude of long-run pass-through among the sample countries. For instance, although the usage of interest rate caps and spread caps by the BB are aimed to prevent the exploitation of Bangladeshi banks on banking customers, nevertheless this had also directly prevented the retail rates to be set competitively at a market-clearing rate in line with the direction of short-term interest rates. As for Pakistan, the implementation of minimum deposit rate policy by the SBP had also reduced the sensitivity of deposit rate movement to the changes of short-term interest rates, while, fortunately, leaving the movement of lending rate to be set according to the market power, and thus leading to a substantially higher pass-through in lending rate than deposit rate. Even though India is officially an inflation targeting country, the presence of maturity mismatch in the Indian banking sector had negatively affected the pass-through to

both retail rates, especially the lending rate, due to a significantly higher cost of funding faced by banks. Despite Sri Lanka had the second highest total magnitude of pass-through among the sample countries, the issue of excess banking liquidity had severely impacted the pass-through as it had led Sri Lankan banks to demand less deposits due to less funding needs, or even discourage deposits altogether, by staggering the movement of deposit rates following changes in the short-term interest rates.

5.6.4.2 Asymmetries in the Short-run Adjustment Dynamics

Empirical evidence of cointegration between the bank retail rates and money market rates, and also the presence of asymmetric behaviour in the interest rate adjustments of the sample countries has been discovered by the MTAR model. A detailed analysis of the asymmetric adjustment is important as it reveals the prevalent banking structure currently existing in the banking systems of the sample countries, and that the underlying banking structure of a country is usually the main reason behind asymmetrical adjustment of bank retail rates following adjustments in the money market rates (Lim, 2001). Thus, this study adopts the EC-EGARCH (1,1)-M model to further examine the short-run asymmetric adjustment dynamics under the MTAR model. The summary of the empirical findings is presented in Table 5.13.

Table 5.13: Summary of Asymmetric Pass-through for the Second Stage of Pass-through

Countries	Model	Pass-through mechanism (MTAR)	Adjustment rigidity ($\|\eta_1\|, \|\eta_2\|$)	Hypothesis supported
Pakistan	DR	Asymmetric	Downward	Adverse customer reaction
	LR	Asymmetric	Upward	
India	DR	Asymmetric	Downward	Adverse customer reaction
	LR	-	-	-
Bangladesh	DR	Asymmetric	Upward	Collusive pricing arrangement
	LR	Asymmetric	Downward	
Sri Lanka	DR	Asymmetric	Downward	Adverse customer reaction
	LR	Asymmetric	Upward	

Note: Hyphen (-) denotes statistical insignificance even at the 10% level of significance. The summary for the pass-through mechanism under the MTAR model is taken from Table 5.6, while the summary for adjustment rigidity is taken from Table 5.8 for Pakistan, Table 5.9 for India, Table 5.10 for Bangladesh and Table 5.11 for Sri Lanka.

5.6.4.2.1 Pakistan

Based on Table 5.13, the DR model in Pakistan has downward rigidity while upward rigidity is found in the LR model. This finding indicates that the pattern of bank retail rate adjustments supports the adverse customer reaction hypothesis which is usually found in a competitive banking environment. Indeed, the competitive pressures in the Pakistani banking system have intensified since the implementation of the financial sector reforms in the early 1990s. Massive deregulation and financial liberalisation have contributed positively to banking competitiveness (Mirza, Bergland & Khatoon, 2016; Tahir, Shah & Afridi, 2017). The privatisation of state-owned banks, the removal of entry barriers for new private banks and the initiatives of the SBP in facilitating Islamic banking, branchless operations and micro-financing to promote access to financial services has managed to create a competitive banking environment and an efficient banking system (Khan & Hanif, 2017). At the same time, Pakistani banks are also facing stiff competition in the deposit market from the NSS

offered by the government of Pakistan through the SBP (IMF, 2001). Taken together, these factors have rendered Pakistani banks to be involved in intense competition among themselves in attracting borrowers and depositors.

5.6.4.2.2 India

The DR model of India supports the adverse customer reaction hypothesis as it exhibits downward adjustment rigidity (see, Table 5.13). This finding is supported by the fact that the Indian banking system is facing intense competition from other saving instruments which act as close substitutes available for Indian depositors. A recent report by the RBI (2017) expressed that Indian banks are unwilling to decrease their deposit rates following reductions in the call money rate by the RBI, as they fear losing deposits to other financial saving instruments, such as mutual funds offered by other financial intermediaries and Small Savings Schemes (SSS) offered by the MFI. Although bank deposits offer more stable returns than mutual funds and better liquidity than SSS, depositors still prefer these financial savings instruments as they provide tax relief which is a key advantage over bank deposits. In addition, SSS also offer higher deposit rates than banks. Given the above situation, Indian banks are forced to be involved in unhealthy competition with more advantageous, close substitutes, available to depositors by not reducing the deposit rate due to the fear of losing deposits, and hence contributing to the downward adjustment rigidity as evidenced by this study.

5.6.4.2.3 Bangladesh

In contrast to the other sample countries, the deposit rate of Bangladesh has upward adjustment rigidity and downward adjustment rigidity in the lending rate (see, Table 5.13). Taken together, these corroborate the presence of collusive pricing behaviour in the

Bangladeshi banking system, despite the decreasing trend of banking system concentration in recent years. Although private banks are gradually gaining more market share than state-owned banks in the Bangladeshi banking system, after the FRSP in the early 1990s (Batten et al., 2015), the under-developed banking system is still segmented, which leads to interest rate distortions by allowing banks to collude and the arbitrary setting of low deposit and high lending rates. This has resulted in a persistently high interest rate spread and predatory pricing practices in the banking system (Mujeri & Younus, 2009), which can be supported by the empirical findings of this study, as evidenced by the high mark-up of the lending rate and the lower mark-up of the deposit rate.

Also, the Bangladeshi banking system has historically been plagued by a high level of non-performing loans (Batten et al., 2015). Under such conditions, Bangladeshi banks have shown the tendency to counteract the cost of evaluating and supervising bad loans and the loss of profit due to non-performing loans through imposing higher lending rates (Hossain, 2012). The latter evidence also contributes to the persistently high interest rate spread in the country, as mentioned above. As interest rate spread reflects bank efficiency, the cost of intermediation and profitability of banks, the prevalent high interest rate spread reflects the inefficiency and low competition in the Bangladeshi banking system which ultimately leads to interest rate stickiness in the country. Indeed, it is evidenced that the high interest rate spread has hindered the effectiveness of pass-through as banks have sluggishly adjusted their retail rates, particularly the lending rate, following changes in the call money rate to maintain high bank profits (Al‐Mashat & Billmeier, 2007). Therefore, weak competition has allowed banks to arbitrarily charge higher interest rates, while the burdening costs of non-performing loans have rendered banks reluctant to adjust their retail rates accordingly following changes in the monetary policy stance to protect their profit.

Furthermore, extensive government direct intervention in the form of licenses, permits and directives, ownership of private banks and control of state-owned banks given to a few politically well-connected individuals, has led to cartels and interest rate fixing which ultimately resulted in an inefficient Bangladeshi banking system (Nguyen & Islam, 2010; Nguyen et al., 2012; Robin, Salim & Bloch, 2018). At the same time, there has also been a lack of substitute of banking services and products offered by banks which has forced depositors to deposit only in bank deposits, post office saving certificates or government bonds (Nguyen, Islam & Ali, 2011). Consequently, this has given the Bangladeshi banks an advantage in pricing their retail rates due to a lack of competition.

5.6.4.2.4 Sri Lanka

Similarly, to Pakistan, the interest rate adjustment pattern in Sri Lanka also supports the adverse customer reaction hypothesis as the deposit rate adjustment is rigid downwards while the lending rate is rigid upwards (see, Table 5.13). Such a pattern of asymmetric adjustment could be explained by the financial liberalisation that has taken place since the 1970s, which has, since that time, opened up the Sri Lankan banking system under a more open entry-exit policy. Consequently, the number of domestic and international banks operating in the country has increased substantially. At the same time, most of the banks offer similar banking services and products, while rapid changes in information and communication technology have expanded the outreach of banking activities to rural areas. Given the need to maintain competitiveness, Sri Lankan banks have made great efforts to publicise their products and services to the public by all available means. Subsequently, this has contributed to the improvement of banking competition and efficiency in the Sri Lankan banking system (Seelanatha, 2010; Hemachandra, 2013).

5.6.4.3 Interest Rate Volatility and Asymmetries in the Conditional Variance

Interest rate volatility has been found to significantly affect the adjustment behaviour of bank retail rates in two out of the four sample countries (see, Table 5.14). Particularly, it is significantly positive for the DR model of Pakistan but is significantly negative for Bangladesh. For the LR model, it is significantly positive in Pakistan and Bangladesh. On the other hand, it is insignificant for both of the bank retail rate models of India and Sri Lanka. These findings indicate that interest rate volatility, which translates to interest rate risk, has significant influences on the bank retail rate pricing behaviour of Pakistani and Bangladeshi banks, but has no effect for the case of Indian and Sri Lankan banks.

The insignificant effect of interest rate volatility signifies that interest rate risks are not a significant factor during retail rate pricing decisions by the Indian and Sri Lankan banks. Such phenomenon could be possibly attributable to the effective risk diversification and hedging techniques adopted by these banks, and also due to constant supervision and prompt monetary policy decisions made by their central banks to mitigate or dampen the adverse impact of interest rate risks. Such preventive measures have rendering them to be less exposed to interest rate risks. Therefore, it is possible that interest rate risk premiums, among other the risk premiums normally charged by banks, are not a significant factor in their retail rates pricing decisions.

Table 5.14: Summary of Effect of Interest Rate Volatility and Asymmetric Volatility for the Second Stage of Pass-through

Countries	Model	Effect of interest rate volatility (s)	Asymmetry of conditional variance (γ)
Pakistan	DR	Positive	Negative (Leverage effect)
	LR	Positive	Positive (Asymmetry effect)
India	DR	-	-
	LR	-	Positive (Asymmetry effect)
Bangladesh	DR	Negative	-
	LR	Positive	Positive (Asymmetry effect)
Sri Lanka	DR	-	Negative (Leverage effect)
	LR	-	Positive (Asymmetry effect)

Note: Hyphen (-) denotes statistical insignificance even at the 10% level of significance. The summary for the effects of interest rate volatility and asymmetry of conditional variance is taken from Table 5.8 for Pakistan, Table 5.9 for India, Table 5.10 for Bangladesh and Table 5.11 for Sri Lanka.

Indeed, for the case of India, the RBI actively monitors and controls the interest rate risk faced by Indian banks using various risk management tools, such as traditional gap analysis and duration gap analysis, to keep the limits of interest rate exposure of Indian banks within levels consistent with the policies of the RBI (Swamy, 2013). At the same time, the introduction of the LAF in India since the early 2000s has managed to lower the volatility of the call money rate, which also translates to a lower interest rate risk faced by banks (Mohan, 2006b). As for Sri Lanka, the CBSL made it compulsory for all licensed Sri Lankan banks to adopt the risk management guidelines as stated in the comprehensive Integrated Risk Management (IRM) Framework which covers interest rate risk management based on standard market practices through the identification, control and mitigation of such risks.

Given the above evidence, it is possible that interest rate risk is prudently managed by the Indian and Sri Lankan banks, hence, therefore, it is not a significant factor during the pricing process of their bank retail rates.

As far as the asymmetry effect of conditional variance of the bank retail rate models is concerned, the parameter γ is significant in all of the bank retail rate models of the sample countries except the DR models of Bangladesh and India (see, Table 5.14). The presence of the asymmetric effect in the conditional variance implies that shocks in the interest rate influences its own volatility, and that the volatility reacts differently to both negative and positive shocks[18]. When $\gamma < 0$, it is said that the leverage effect exists in the conditional variance of the bank retail rates models, which indicates that a reduction in the interest rate adjustment (negative shock) will lead to greater interest rate volatility, and vice-versa (Wang & Lee, 2009).

According to Table 5.14, the asymmetry effect of conditional variance is found in all of the LR models of all of the sample countries. This indicates that a positive interest rate shock may cause interest rate volatility to increase more than a negative shock of the same magnitude. In this context, when there is a positive shock to the interest rate, i.e. an increase in the lending rate following an increase in the money market rates, borrowers will have difficulties in repaying their loan commitments. Subsequently, this raises the probability of loan defaults and, hence, translates to a higher default risk to the banks. Empirical evidence has shown that banks tend to price the lending rate according to the probability of default by borrowers (see, for example, Madeira, 2018), and that the probability of loan default is

[18] A negative shock means an expansionary monetary policy, while positive shock means a contractionary monetary policy (Olayiwola & Ogun, 2019).

positively correlated to the movement of the lending rate (see, for example, Shuai, Yang & Zhou, 2014). Consequently, banks will require a higher rate of return by charging a higher lending rate to riskier borrowers to compensate for the higher probability of loan defaults which the banks may have to write off following such increases in the lending rate (Gambacorta, 2004, Rahman, Hoque & Siddique, 2019). Therefore, as exposure to potential default risks makes banks more sensitive towards adjustments of interest rates (Van den Heuvel, 2002, 2006; De Bondt, 2005), banks will tend to frequently re-price their lending rates to compensate for the default risk (Poghosyan, 2012). As such, the higher the lending rate following a contractionary monetary policy, the higher the default risk that will be faced by the banks, the more frequently the banks will adjust their lending rate to compensate for loan defaults, hence causing the lending rate to be more volatile.

In the context of the DR model, a leverage effect is found in Pakistan and Sri Lanka as the parameter γ is significantly negative (see, Table 5.14). Its presence in the deposit rates of these two sample countries implies that a negative interest rate shock may cause interest rate volatility to increase more than a positive shock of the same magnitude. Such a phenomenon may be clarified if the negative interest rate shock is associated with a reduction in the deposit rate after a decrement in the money market rates, which translates into a lower cost of funding for banks while reducing the loan profits receivable by banks due to lower lending rates (Valencia, 2011). Consequently, reach-for-yield banks with limited liability tend to lower their lending standards and increase new loan volumes to higher risk borrowers following the reduction of the cost of funds (European Central Bank, 2007), which then translates to higher bank leverage and hence risk. This argument is supported by Dell'Ariccia and Marquez (2013) as they also argued that lower deposit rates might cause an inefficient increment in bank risk-taking behaviour. Similarly, Sarkar and Sensarma (2019) also

contended that expansionary monetary policy increases bank leverage due to a fall in the cost of funds and thereby intensifies the risk exposure of banks. In other words, the tendency of banks to increase their leverage is higher after a loosening of monetary policy, which also subsequently raises their exposure to risks (Adrian & Hyun, 2010; Dell'Ariccia et al., 2013).

As previously mentioned, banks tend to be more sensitive to interest rate fluctuations when they are facing risks, and that they will usually readjust their retail rates to compensate for the risks. As evidenced by the empirical findings of this study, the deposit market is less competitive than the loan market in Pakistan and Sri Lanka as indicated by the lower pass-through in the deposit rate than the lending rate (see, Table 5.12). This indicates a lower elasticity of demand for deposits than loans. Thus, banks will tend to adjust their deposit rate to compensate for the risk as customers are less sensitive towards changes in deposit rates than lending rates, which subsequently results in more frequent adjustments in their deposit rates and hence their volatility (Van Leuvensteijn, Kok, Bikker & Van Rixtel, 2008). In addition, as banks can only absorb short-term deposits in a low interest rate environment (Geng, Grivoyannis, Zhang & He, 2016), this allows banks to easily re-price their deposit rates. Taken together, the more the deposit rate decreases following an expansionary monetary policy, the lower the cost of funds for banks, the more likely it is that banks will increase their leverage and re-price their deposit rates to compensate for risks, and hence inducing more volatility in the deposit rate. Interestingly, this evidence may also partly explain the incomplete pass-through in the DR model of Pakistan and Sri Lanka.

5.6.5 Implications of the Empirical Findings

Based on the empirical findings of this study, several implications can be drawn. This study implies that the type of monetary policy framework adopted by a country does not

fully determine the efficiency of the pass-through of the country. For instance, the pass-through in Bangladesh is extremely low due to the current adoption of a monetary aggregate targeting framework, which is understandable. Although India has officially adopted an inflation targeting framework, in which short-term interest rates are expected to be efficiently passed-through to bank retail rates, however, this study has discovered that its pass-through is quite low in the DR model and non-existent in the LR model. On the other hand, although Pakistan and Sri Lanka currently adopt a mixture of monetary aggregate and inflation targeting frameworks, their pass-through is significantly higher than that of India.

The various types of structural imperfections in the banking system and the use of non-market-based instruments causes inefficiency in the banking systems which ultimately impede the effectiveness of a country's pass-through. For instance, although the adoption of monetary aggregate targeting may explain the weak performance of pass-through in Bangladesh, it has been discussed that various types of government intervention and the use of interest rate caps might be the main contribution behind it. The use of a minimum deposit rate policy by the SBP, the problem of excess liquidity in the Sri Lankan banking system and the maturity mismatch between deposits and loans in India could be contributing factors for the incompleteness of pass-throughs in their respective countries.

Effective financial sector liberalisation and reforms have led to increased efficiency in the banking systems of countries by encouraging competition among banks. This can be evidenced from the empirical findings of this study, whereby financial reforms and liberalisation in Pakistan and Sri Lanka over the last few decades have rendered their deposit rates to adjust faster during a contractionary monetary policy and for their lending rates to adjust faster during an expansionary monetary policy, which indicates that the banks in these

countries are competing with each other to secure deposits from depositors and providing more funds to borrowers in their countries. Although Bangladesh has also undergone various reforms and liberalisation, however, the changes have not been very effective, mainly due to continuous government intervention and the use of non-market-based instruments in the banking system.

Interest rate volatility is found to affect the behaviour of setting bank retail rates, and changes in the monetary policy stance also affect the volatility of interest rates. Once the volatility of the interest rate is perceived as a significant risk by banks, they will pass it on to customers by charging risk premiums in their bank retail rates and this may cause the pass-through to be incomplete. On the other hand, changes in the monetary policy stance generate inefficiencies in the banking system of a country, i.e. an increase in the number of non-performing loans and excessive risk-taking behaviour by banks, which may also impede the effectiveness of pass-through in that country. For instance, changes in the monetary policy stance that cause interest rate volatility might partly explain the incompleteness of pass-through to the DR models of Pakistan and Sri Lanka.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Introduction

This concluding chapter summarises the crucial empirical findings and discussions in the preceding chapters, and also recommends relevant policies based on the empirical pass-through evidence of the selected SAARC countries. Section 6.2 provides the summary and conclusion of this study, followed by Section 6.3 which discusses relevant policy recommendations. Section 6.4 highlights the limitations of this study. Finally, Section 6.5 provide suggestions for future research.

6.2 Summary and Conclusion

The main objective of this study is to critically scrutinise the pass-throughs in the selected four SAARC countries, namely; Pakistan, India, Bangladesh and Sri Lanka. Several issues and justifications have been identified that demands the need for this study. These four sample SAARC countries have begun to increasingly reliant on the use monetary policy as the main economic tool in managing domestic aggregate demand, and have been actively using interest rates as the main operating target of their monetary policy decisions, which is line with their long-term monetary policy objective to transit to an inflation targeting monetary policy framework. Therefore, it is imperative to examine whether adjustments in money market rates are able to be passed-through to bank retail rates, which is the cornerstone of this framework, given the evidences on their ineffective monetary policy decisions in the past. In addition, banks play a predominant role as the main fund providers in these sample countries which affects investment and spending behaviour in the economy. Therefore, it is imperative to identify whether their banking systems are efficient and

competitive by examining the magnitude and possible asymmetries in the bank retail rate adjustment behaviour. In addition, the global recessions in 2008 and the recent Covid-19 pandemic which had opted central banks around the world, including those of these selected SAARC countries, to aggressively engages in accommodative monetary policy stance, which had been argued that consistently low interest rate environment may induce bank risk-taking, which may, ultimately leads to financial instability and crisis. This issue is particularly important, given the evidences on active bank risk-taking behaviour in the banking system of these selected SAARC countries. Furthermore, financial liberalisation recently taken place in these selected SAARC countries may have enabled the interest rate to be determined by the market, and consequently it may induce volatility in the money market rates and bank retail rates to a large extent. Thus, it is imperative to examine the effect of interest rate volatility on bank retail rates pricing behaviour, and whether changes in the monetary policy stance by central banks will also affect bank retail rates volatility, both of which, may have either direct or indirect impacts on the interest rate pass-through mechanism of these selected SAARC countries.

Several econometric methodologies are utilised to accomplish the objectives of this study. The magnitude of the long-run pass-through from money market rates to bank retail rates is estimated with a simple regression analysis. Next, the TAR and MTAR models are employed to investigate the existence of asymmetric cointegration relationships among the interest rate variables. Finally, the asymmetric EC-EGARCH (1,1)-M model is applied to investigate the short-run asymmetric adjustment dynamics of the interest rate variables, while simultaneously capturing the ARCH effect which is statistically present in the asymmetric ECM models. In addition, the application of the EC-EGARCH (1,1)-M model allows for the investigation of the effect that the conditional volatility of the bank retail rates

has on its adjustment behaviour, and also permits the discovery of the presence of the asymmetry and leverage effects in the conditional variance of the bank retail rates. Monthly data of the call money rate, the T-bill rate, deposit rate and lending rate are employed in the analysis. The sample period for each country is different and is determined mainly by the period in which the country intensifies the use of short-term interest rates as a monetary policy instrument and also due to the availability of data.

In summary, the first stage interest rate pass-through mechanism is complete in Pakistan and over-complete in India and Sri Lanka in the long run. However, it is rather incomplete in the short-run for these countries, except Sri Lanka, which had an over-complete short-run pass-through. While, there is no pass-through for Bangladesh in both short-run and long-run. In addition, the short-run adjustment behaviour of money market rates on towards changes in the policy rates is asymmetric for these three countries, whereby upward adjustment rigidities were found for Pakistan and India and downward adjustment rigidity were found for Sri Lanka. Therefore, other than Bangladesh, the first stage interest rate pass-through mechanism in Pakistan, India and Sri Lanka is complete and effective in the long run.

The second stage interest rate pass-through mechanism is incomplete for all of the four sample countries, except for the lending rate of Sri Lanka. Specifically:

i. Pakistan has the highest pass-through in the deposit rate model and second highest in the lending rate model in the long-run. Such performance is attributable to its current gradual transition to an inflation targeting framework in which the interest rate is the main operating target of the SBP. Under this framework, the SBP will closely monitor and ensure that changes in the T-bill rate are able to be fully reflected in bank retail rates before the

effect is channelled to the rest of the economy. In addition, the introduction of an interest rate corridor in Pakistan since 2000 has managed to stabilise the T-bill rate. This causes banks to be less reluctant to revise their retail rates following adjustments in the SBP T-bill rate, hence contributing to higher pass-through in the long-run. However, the minimum deposit rate policy currently implemented by the SBP could be one of the possible reasons behind the incomplete pass-through of the deposit rate model in the long-run.

ii. Sri Lanka has the highest pass-through in the lending rate model and third highest in the deposit rate model in the long-run. It is also the only country to achieve a complete pass-through in the lending rate model. This finding is attributable to its current adoption of a mixture of monetary aggregate targeting and flexible inflation targeting framework. Under this framework, the CBSL uses the interest rate as the operating target and constantly steers it along the desired path to ensure that it is effectively passed-through to bank retail rates. Furthermore, the complete pass-through in the lending rate model but incomplete pass-through to the deposit rate model in the long-run may be caused by excess liquidity in the Sri Lankan banking system. Such an issue has encouraged banks to price their lending rate close to the CBSL call money rate to increase the number of loans while remaining reluctant to revise their deposit rate.

iii. India has recently formally adopted an inflation targeting framework in which the RBI uses the interest rate as the main operating target of monetary policy. It ranks as the second highest pass-through in the deposit rate model in the

long-run as compared to the other sample countries, which may be attributable to the introduction of the LAF in the early 2000s. Indian banks tend to adjust their deposit rate following changes in the call money rate, as uncertainties caused by its instability have been reduced by the introduction of the LAF. However, the pass-through is not very high given that most of the deposits are fixed rate and have longer maturity terms. On the other hand, the non-existence of pass-through in the lending rate model in the long-run is a surprising finding given the importance of effective pass-through under this framework. Such an incidence may be caused by the maturity mismatch and asymmetric interest rate pricing behaviour by banks, whereby most of the loans issued with floating rates are funded by fixed deposits with longer maturity. Under such a situation, the banks simply cannot adjust their lending rate following adjustments in the call money rate to protect their profit because they could not adjust the high yet fixed deposit rate that serves as their cost of funding.

iv. Bangladesh which adopted monetary aggregate targeting has the lowest pass-through in both retail rate models in the long-run. This is justifiable as the BB uses reserve money as their operational target and focuses only on money supply growth, and is not actively engaged in controlling short-term interest rates. In addition, the implementation of non-market-based instruments, such as interest rate caps that serve to protect customers from bank exploitation has hindered the bank retail rates to be efficiently set by market power. Furthermore, Bangladesh has the highest mark-up effect for both bank retail

rate models, which may be caused by a high inflation rate, as well as being due to the oligopolistic nature of the Bangladeshi banking system.

Asymmetric short-run adjustment dynamics of the interest rates are found for all of the countries, except for the lending rate model of India. Specifically:

i. Pakistan supports the adverse customer reaction hypothesis which is commonly found in competitive banking environments. This finding is justifiable as the financial sector reforms that took place in the early 1990s in Pakistan led to the privatisation of state-owned banks, the removal of entry barriers for new private banks and also saw the initiatives of the SBP in facilitating Islamic banking, branchless operations and micro-financing to promote access to financial services. Such massive deregulation and financial liberalisation have led to a competitive banking environment and subsequently to an efficient banking system in Pakistan.

ii. Similarly, to Pakistan, Sri Lanka also supports the adverse customer reaction hypothesis. The financial liberalisation that has taken place since the 1970s has been effectively removing the barriers of entry for new banks. At the same time, most Sri Lankan banks are now offering close substitutes and rapidly expanding their services throughout the country. Taken together, these occurrences have created a more competitive banking system in Sri Lanka.

iii. India supports the adverse customer reaction hypothesis. Such a finding could be possibly due to the availability of close substitutes for bank deposits. Indeed, Indian banks have been facing intense competition from other

financial intermediaries, such as mutual funds and SSS that offer unique advantages to depositors.

iv. Bangladesh supports the collusive pricing behaviour hypothesis. Such a finding may be due to the underdeveloped and segmented Bangladeshi banking system that allows banks to operate in a less competitive environment. In addition, Bangladeshi banks have been historically plagued by a huge number of non-performing loans. Consequently, they tend to offset the related costs incurred by non-performing loans by charging lower deposit and higher lending rates, while arbitrarily readjusting their bank retail rates following adjustments in the call money rate by the BB, as can be evidenced from the presence of the high interest rate spread in the Bangladeshi banking system. Furthermore, extensive government intervention in the banking system and the lack of substitutes to banking products has diminished the overall efficiency and competitiveness of the Bangladeshi banking system.

In some countries, interest rate volatility has been discovered to significantly affect the adjustment behaviour of bank retail rates, and the asymmetric effects in the conditional variance of the bank retail rates are also discovered to be present. Specifically:

i. Interest rate volatility, which translates into interest rate risk, significantly influences the bank retail rate pricing behaviour of banks in Pakistan and Bangladesh. On the other hand, it is insignificant for India and Sri Lanka. Such findings may be attributable to the effective interest rate risk diversification and hedging adopted by Indian and Sri Lankan banks, as well as also being due to the constant supervision and prompt monetary policy

decisions made by the RBI and the CBSL to mitigate or dampen the effects of interest rate risks should they happen. Accordingly, these preventative measures have rendered Indian and Sri Lankan banks to be less exposed to interest rate volatility and, thus, their retail rate pricing decisions are not affected by interest rate risks.

ii. The asymmetric effect on conditional volatility is found in the lending rate models of all of the countries. This discovery indicates that positive interest rate shocks will increase lending rate volatility more than negative interest rate shocks of the same magnitude for all of the countries. If positive interest rate shocks are synonymous with contractionary monetary policy, whenever banks increase the lending rate following contractionary monetary policy, borrowers may have greater difficulties in making loan repayments, thus, causing banks to face higher default risks. Accordingly, this makes banks more sensitive to adjustments in interest rates, and they tend to frequently re-price the lending rate to compensate for the default risk. Thus, positive interest rate shocks, following a contractionary monetary policy, will lead to more volatile lending rates in all of the countries.

iii. The leverage effect on conditional volatility is found in the deposit rate models of Pakistan and Sri Lanka. In contrast to the asymmetric effect, the leverage effect indicates that negative interest rate shocks will increase deposit rate volatility more than positive interest rate shocks of the same magnitude. If negative interest rate shocks are synonymous with expansionary monetary policy, a reduction of the deposit rate will translate

to a lower cost of funding faced by banks while lower lending rates reduce the loan profits receivable by banks. This induces reach-for-yield banks to lower their lending standards and increase new loan volumes to higher risk borrowers which translates to higher bank leverage and, hence, risk. As the demand for deposits is less elastic than the demand for loans, Pakistani and Sri Lankan banks are more susceptible to re-adjust their deposit rate to compensate for such risks. The presence of the leverage effect in the deposit rate models of Pakistan and Sri Lanka may also partly explain the pass-through incompleteness in their deposit rate models as compared to the lending rate models.

6.3 Policy Recommendations

The main purpose of this study is to examine the pass-through in four selected SAARC countries, which are Pakistan, India, Bangladesh, and Sri Lanka. This study examines the pass-through from money market rates to bank retail rates, and also the presence of asymmetric adjustment behaviour between money market rates and bank retail rates. Furthermore, this study also investigates the effect of interest rate volatility on bank retail rates pricing behaviour, while examining the presence of asymmetry and leverage effects in the conditional volatility of the bank retail rates. Important empirical findings have been discovered by the empirical analyses of this study, and relevant country background-based justifications have been discussed to support the empirical findings. Accordingly, appropriate policy implications have been proposed based on the justifications and are discussed in this subsection.

6.3.1 Magnitude of Pass-through and Asymmetric Adjustments

6.3.1.1 Pakistan

Pakistan has the highest pass-through in the deposit rate model and the second highest in the lending rate model in the long-run, albeit incomplete. Its considerable performance of pass-through indicates that the SBP has been rather successful in transmitting its monetary policy impulses through the T-bill rate to Pakistani bank retail rates. Therefore, it can be said that the current inflation targeting lite regime implemented by the SBP is rather effective and it is on the right track in transitioning to a full-fledged inflation targeting monetary policy framework.

However, it is possible for the SBP to further improve the pass-through to the deposit rate to make the transition even more promising. Although the SBP has made a concerted effort to protect Pakistani depositors from the low deposit rates offered by Pakistani banks through a minimum deposit rate policy, this has prevented the deposit rate from being effectively determined by the market. At the same time, unhealthy competition among the Pakistani banks and from the NSS may have also contributed to the incomplete pass-through and support for the adverse customer reaction hypothesis.

Therefore, it is suggested that the SBP should reconsider the implementation of a minimum deposit rate policy. Instead, the SBP could encourage banks to offer more innovative cash deposit and savings products, as this will not only give them a competitive advantage against the NSS but will also automatically create competition among Pakistani banks to improve their deposit products to secure more deposits. In addition, the SBP should also implement relevant regulations in collaboration with the Pakistan Bank's Association to promote healthy competition in the Pakistani banking system.

At the same time, the SBP should also gradually restructure its NSS as it could be also a contributing factor to the unhealthy competition among Pakistani banks. For instance, it can be restructured to focus mainly on depositors in rural and semi-rural locations which are distant from the branches of Pakistani banks. That way, reduced competition from the NSS will reduce the pressure of unhealthy competition among Pakistani banks, while depositors in rural areas may also benefit from access to deposit facilities. Such an action may also contribute to the success of the National Financial Inclusion Strategy which was approved in 2015, as a national effort to increase financial inclusion in the country.

6.3.1.2 India

India has the second highest but incomplete pass-through in the deposit rate model in the long-run, while the pass-through to the lending rate model is non-existent and no long-run relationship has been statistically established (by the MTAR model) between the call money rate and the lending rate. As the short-term interest rate is the main monetary policy instrument of the RBI in this framework, the limited pass-through from the call money rate to bank retail rates should raise significant concern with the RBI, as the inefficiency of the transmission mechanism and interest rate distortions may have undermined the effectiveness of its inflation targeting framework. If the RBI is unable to effectively influence bank retail rates at the early linkages of the transmission mechanism, the final effect of its monetary policy decisions will be severely limited. Therefore, it can be inferred that the current inflation targeting framework implemented by the RBI is still in its infancy stage and various immediate remedial measures should be undertaken by the RBI.

It is possible that the maturity mismatch and asymmetric interest rate setting between the deposit and loan rates in the Indian banking system may be one of the contributing factors to the low pass-through. Most deposits in the Indian banking system have a longer maturity and higher rates, while most of the loans are made with a shorter maturity and with floating rates. This has constrained Indian banks from reducing their lending rate because doing so will reduce their loan profit while maintaining the same cost of deposit. At the same time, the longer maturity of fixed deposits has restricted banks from re-setting their deposit rate in a timely manner following changes in the monetary policy stance. Furthermore, unhealthy competition from SSS offered by the MFI has forced Indian banks to offer substantially higher than normal deposit rates to remain competitive, which also explains the reason behind the support of the adverse customer reaction hypothesis in the deposit rate model. Subsequently, this has hurt the loan market as banks are unable to reduce their lending rate due to such high costs of funding.

Therefore, it is recommended that the MFI should prioritise restructuring its SSS to reduce unhealthy competition with Indian banks. For instance, instead of setting the rates offered by the SSS administratively, the MFI could deregulate these administrative rates and link them to the market-determined benchmark interest rate equally enforced by the RBI to the Indian banking system. This would allow Indian banks and the SSS to compete in a fair environment. Subsequently, Indian banks would be more inclined to reduce their deposit rate, followed by the shortening of the maturity profile of their fixed deposits. Accordingly, as the cost of funding would have been decreased, Indian banks would be more inclined to lower and set their lending rate competitively according to the benchmark interest rate. The shortening maturity profile of fixed deposits would also contribute to less rigid deposit rate adjustments. Hence, it is expected that the lower maturity profile of fixed deposits and the

cost of funding will induce higher pass-throughs and more responsive lending rate adjustments following adjustments in the call money rate.

6.3.1.3 Bangladesh

Bangladesh has the lowest pass-through from the call money rate to both bank retail rates among all of the sample countries. This indicates a severe limitation in using short-term interest rate to manipulate the Bangladeshi bank retail rates. This finding is reasonable, as the interest rate is not the main operating target of monetary policy under the monetary aggregate targeting framework currently adopted by the BB. Given the low pass-through, it is empirically supported that the recommendation for the BB to transit to an inflation targeting framework is currently unfeasible. Therefore, various measures should be undertaken by the BB to first improve the pass-through before gradually transitioning to an inflation targeting framework.

The most critical measure that needs to be undertaken to alleviate the identified issues is further intensive reforms in the Bangladeshi banking system. The Bangladeshi government should reduce its direct intervention by removing all forms of government intervention, political connections as well as corruption in the Bangladeshi banking system, such as the arbitrary granting of banking licenses, permits and directives, ownership of private banks and giving control of state-owned banks to politically connected individuals that have been found to contribute to the high number of non-performing loans. Accordingly, this will provide more independence and transparency to the state-owned banks in their daily functioning and administrative tasks. At the same time, the Bangladeshi government may also consider encouraging additional privatisation of state-owned banks and allowing them to compete with other private banks in the Bangladeshi banking system. Following less

political intervention and increased pressures to become competitive, the efficiency of the privatised state-owned banks would be gradually improved, hence contributing to a sounder and more robust Bangladeshi banking system that would facilitate a fuller and speedier pass-through.

Although the level of banking concentration has been decreased following the FRSP in the early 1990s, the Bangladeshi banking system is still underdeveloped and segmented. This issue may have led to interest rate distortions and inefficiency in the Bangladeshi banking system that might have been caused by reduced competition among Bangladeshi banks, as evidenced by the support of the collusive pricing behaviour hypothesis. Therefore, it is recommended that the Bangladeshi banking system should have a lower barrier to entry for new banks, especially foreign banks, to reduce the oligopolistic nature of the Bangladeshi banking system. Accordingly, this would create competitive pressure for the existing Bangladeshi banks and also the privatised state-owned banks. In order to remain competitive, Bangladeshi banks will be more inclined to provide better financial services and offer more innovative yet competitively-priced banking products. Given a more competitive Bangladeshi banking system, the current implementation of interest rate caps to prevent bank exploitation could also be gradually reduced. Hence, this would allow the bank retail rates to be competitively priced according to market power.

6.3.1.4 Sri Lanka

Sri Lanka is the only country to achieve a complete pass-through albeit in the lending rate model only, while the country possessed the third highest pass-through in the deposit rate model. As for the bank retail rates, the lending rate, especially, is rather responsive to changes in the call money rate, this finding indicates the good potential of using the short-

term interest rate as the operating target of the CBSL in transmitting its monetary policy pulses to steer the Sri Lankan economy. In other words, this study provides favourable support for the CBSL to transit to an inflation targeting framework from its current adoption of a mixed monetary aggregate and flexible inflation targeting framework.

Nevertheless, the incomplete pass-through to the deposit rate model shall remain as the main concern for the CBSL to further improve the transmission mechanism. Excess liquidity in the Sri Lankan banking system may be a significant contributing factor to this phenomenon. Sri Lankan banks with excess liquidity do not need to obtain short-term funding from the Sri Lankan money market, nor from the CBSL itself, thus limiting the effect that the call money rate has on deposit rate. In addition, Sri Lankan banks also have a tendency to reduce their deposit rate or even refuse to accept customer deposits. Therefore, it is imperative for the CBSL to absorb the excess liquidity from the Sri Lankan banking system to improve the pass-through.

Several monetary policy tools could be considered by the CBSL to withdraw excess liquidity from the Sri Lankan banking system. For instance, the CBSL could perform reverse repurchase agreements through OMOs by selling off government securities, i.e. T-bills and bonds, or its own securities, i.e. CBSL securities and the Bond Borrowing Programme, to Sri Lankan banks to withdraw temporary excess liquidity from the Sri Lankan banking system. If the excess liquidity is large and is likely to persist, the CBSL could sell government securities in outright sale auctions to withdraw excess liquidity on a more permanent basis. As government securities, and to a large extent the CBSL's own securities, are generally default risk free and are tradeable for instant liquidity, they are considered as

an attractive investment alternative for Sri Lankan banks to invest their excess liquidity to generate returns.

In addition, the CBSL could also consider increasing the reserve requirement, which is the minimum amount of reserves that are commonly determined by a specific percentage of bank deposits, that Sri Lankan banks are obligated to keep at the bank or with the CBSL. Raising the reserve requirement would effectively reduce the availability of loanable funds that the Sri Lankan banks have to fulfil the demand for loans by borrowers. Accordingly, the Sri Lankan banks would be forced to increase competition among themselves in securing more deposits to increase the amount of loanable funds. Subsequently, Sri Lankan banks will have to constantly adjust their deposit rate in accordance to the call money rate to remain competitive in the deposit market and, hence, contribute to a fuller pass-through to the deposit rate model.

6.3.2 Effect of Interest rate Volatility on the Pricing Behaviour of Bank Retail Rates

The effect of interest rate volatility is significant for Pakistan and Bangladesh. However, higher interest rate volatility poses higher interest rate uncertainty, and hence the greater the interest rate risk for the value of assets and liabilities of banks to change. This may cause potential losses from unexpected fluctuations in interest rates which can significantly affect the profitability of Pakistani and Bangladeshi banks. Accordingly, Pakistani and Bangladeshi banks are inclined to switch the burden of interest rate risk to their clients by charging risk premiums on bank retail rates. Such findings may indicate that ineffective interest rate risk diversification and hedging techniques are currently being adopted by the Pakistani and Bangladeshi banking systems which might ultimately hamper the success of the monetary policy.

Therefore, it is imperative for the Pakistani and Bangladeshi banks to effectively manage their exposure to interest rate risks via effective asset and liability management. The initial step to effective interest rate risk management is the proper measurement of the amount and effect of the risk. There are several interest rate risk measurement tools that could be adopted by the Pakistani and Bangladeshi banks, ranging from basic tools, such as static gap analysis and duration gap analysis to advanced tools, such as sensitivity analysis by stress-testing Economic Value of Equity models. Subsequently, Pakistani and Bangladeshi banks may use a number of interest rate management tools, such as derivatives, i.e. interest rate options, futures and swaps to hedge their exposure to interest rate risk. In addition, the SBP and BB are also encouraged to conduct constant supervision and close scrutiny of the interest rate risk policies adopted by Pakistani and Bangladeshi banks to ensure that their exposure to interest rate risk is within appropriate limits.

6.3.3 Asymmetric Effect in the Conditional Variance

The asymmetry effect of conditional volatility is present for the lending rate models of all of the sample countries which implies that an increase in money market rates may increase the lending rate volatility more than a decrease in the money market rates of the same magnitude. A higher money market rate raises the cost of funds of the bank, and this induces banks to increase their lending rate that is charged to borrowers. Subsequently, borrowers may have heightened difficulties in servicing their loans. In view of this, banks require a higher rate of return, especially from riskier borrowers to compensate for the higher probability of loan default if the money market rates continue to rise. At the same time, exposure to default risk makes banks sensitive to interest rate movements. Hence, they will be more inclined to frequently reprice their lending rates following an increase in the money market rates to compensate for the default risk and, hence, inducing higher volatility in the

lending rate. It is, therefore, suggested that the central banks of the sample countries should be able to effectively measure and manage the potential default risk faced by banks before conducting contractionary monetary policy to prevent its potential effect on lending rate volatility. This can be achieved through effective credit risk management at the central bank as well as at the bank level.

Central banks could consider drafting an Internal Credit Risk Rating that would act as a set of guidelines that help the banks to develop their own internal rating systems to effectively manage and control their own exposure to credit risks, as well as managing the creditworthiness of their borrowers and the quality of credit transactions. In addition, central banks could also establish a credit bureau to collect and provide reliable and detailed credit information about borrowers from the banks, through the use of credit reporting databases. Given adequate credit information, banks could be more effective in screening and monitoring borrowers, as well as avoiding granting loans to risky borrowers. This may also lessen the effect of information asymmetries between the banks and borrowers and, hence, lessen the incidences of moral hazard and adverse selection, and ultimately lead to a sounder credit culture in the banking system.

As for the banks themselves, they may also impose stricter lending standards, especially to riskier borrowers with poor credit ratings. In addition, they may also take advantage of credit derivatives, such as credit default swaps, as a means to hedge against their potential losses from credit risk. Essentially, a credit default swap is a financial contract that allows banks to transfer their credit risk to the seller of the swap. In the event of negative credit events such as a loan default by the borrower, the seller of the swap will compensate the bank with the face value of the defaulted loan. Alternatively, banks may also disburse

mainly secured loans to borrowers by demanding that the borrower pledge an appropriate value of acceptable collateral to secure the repayment of the loan. In the event of loan defaults, banks will be able to legally take possession and then liquidate the pledged collateral to offset the loan defaults. In addition, the pledging of collateral may also reduce the lending rates charged by banks on borrowers, thus effectively reducing the probability of loan defaults.

6.3.4 Leverage Effect in the Conditional Variance

The leverage effect of conditional volatility is present for the deposit rate models of Pakistan and Sri Lanka. This suggests that a decrease in money market rates may cause an increase in deposit rate volatility greater than the increase in the money market rates of the same magnitude. Lower money market rates reduce the deposit rate that banks offer to depositors and, hence, lower the cost of funds for banks. Accordingly, reach-for-yield banks with limited liability tend to lower their lending standards and increase new loans including loans to higher risk borrowers, and this translates into higher bank leverage and greater risk exposure for banks. As exposure to risks makes banks more sensitive to changes in interest rates, and that the deposit market is less competitive than the loan market in these two countries, banks are more prone to re-price their deposit rate to buffer against the risk. Hence, the lower the cost of the funds following expansionary monetary policy, the higher the banks are leveraged, the more frequently the banks will re-price their deposit rate to compensate for the leverage risk, thus inducing the deposit rate to be more volatile. The presence of bank leverage in Pakistan and Sri Lanka may also partly explain the incomplete pass-through from money market rates to the deposit rate. Therefore, the SBP and the CBSL should regulate the level of bank leverage, especially before conducting any major expansionary monetary policy, as this may induce banks to undertake excessive leverage and henceforth impede the

pass-through. A highly leveraged banking system is also associated with financial instability which is more vulnerable to the occurrences of banking crises and banking system collapses, as witnessed in the Global Financial Crisis in 2008.

Therefore, the SBP and the CBSL are recommended to implement strong and prudential banking regulations on banking leverage, such as through capital requirement policies. For instance, they may consider to adhere to and increase the minimum regulatory leverage ratio introduced in the Basel III accord to limit the excessive build-up of leverage and risk-taking behaviour among banks. A higher leverage ratio essentially limits the bank's level of debt financing, such as from deposits and borrowings from the interbank money market, relative to capital financing on its assets, such as loans. Consequently, as loans are financed more with capital than from debt, the bank will be able to absorb losses with its own capital in the event of possible adverse situations, such as loan defaults by borrowers. At the same time, a higher leverage ratio may also limit the total number of loans that the bank can issue, if the bank does not have sufficient capital to meet the leverage ratio and, hence, lessen the probability of loan default in the case of adverse situations. Ultimately, this will lead to a lower probability of future banking crises in Pakistan and Sri Lanka.

6.3.5 Regional Policies for Promoting Regional Financial Cooperation and Development

Since the inception of the SAARC region in 1985, all the member countries have been actively engaging in promoting the development of economic and regional integration. The formation of the SAARC Preferential Trading Agreement (SAPTA) in 1993 marks the first mutual trade and economic cooperation initiative within the SAARC region. Recently, in 2014, the SAARC member countries have envisaged for a closer regional cooperation and integration by proposing the establishment of the South Asian Economic Union (SAEU),

which will eventually lead to the formation of a monetary union as its ultimate economic and regional development objective. Therefore, given the envisagement of these regional economic goals which requires extensive ongoing policy coordination among the SAARC member countries, this study will propose recommendations for regional policy in the context of regional monetary policy and financial system development coordination.

Firstly, the SAARC member countries could take the European Economic and Monetary Union (EMU) as a role model in embarking towards a closer regional cooperation and integration towards the ultimate establishment of a monetary union in the SAARC region. For instance, the SAARC member countries can engage in regional cooperation by developing a regionwide financial infrastructure to support each member country's domestic financial development by establishing a regional development bank, of which concept is rather similar to the European Union's European Bank for Reconstruction and Development (EBRD) and the European Investment Bank (EIB).

Secondly, since the common vision of the SAARC member countries is to form of a monetary union in the region in the near future, which will eventually leads towards a single financial market in the region, it is important for the SAARC member countries to work towards the establishment of a single entity for the region, i.e. a regional central bank, with the concept similar to the European Central Bank (ECB), which will be given the authority to design and develop a common monetary policy that applies to all of the member countries. With the establishment of a single central bank for the whole SAARC region, the single central bank will be given the authority in supervising, monitoring and coordinating the development of financial systems of the SAARC member countries. Similar to the operating framework of ECB, any decisions or policies on financial development and integration

proposed will be made through extensive discussions and scrutinisation among the national central banks of each SAARC member countries with their own expertise, and thus will be more effective, efficient and localised in achieving the shared financial development goals.

Furthermore, the SAARC member countries could also expand the use of SAARCFINANCE Network, which serves as a platform for the SAARC member countries to share their experiences on macroeconomic issues, by establishing a centralised supporting national system for the prudential regulation and supervision of domestic financial systems of the member countries, whereby they can actively share their experiences on the prevailing issues related to their domestic financial systems, and also to reach to a common remedial action plan to be adopted across the member countries. Also, the member countries could use this platform to discuss on the adaptation of international banking standards to their regional conditions through knowledge and experience sharing. Taken together, given greater regional cooperation among the SAARC member countries on developing their domestic financial systems, it is expected that their domestic financial system will become more efficient and effective, and is able to operate smoothly with less distortions, which will ultimately lead to a better interest rate pass-through mechanism.

6.4 Limitations of the Study

Although a series of extensive and detailed empirical investigation has been performed to investigate the interest rate pass-through mechanism in the selected SAARC countries, this study is only limited to examining the first stage and second stage of the monetary policy transmission mechanism, i.e. pass-through from policy rate to money market rate and from money market rate to bank retail rates. Nevertheless, as previously mentioned, the whole monetary policy transmission mechanism consists of a complex

system which begins with the pass-through from policy rate to bank retail rates, and then through various transmission channels, ultimately impacts the monetary policy objectives, i.e. output, inflation and employment. By only examining the first and second stage of the transmission mechanism, there is a missing link of monetary policy transmission beginning from the bank retail rates transmission stage towards the ultimate monetary policy goals. Therefore, this study could not fully examine the total effectiveness of monetary policy in achieving its ultimate goals, which if this study were to do so, it would require an extensive amount of time and is subjected to data availability.

In addition, this study is only limited to examine the magnitude, whether asymmetric adjustment is present, and the impact of interest rate volatility on the interest rate pass-through mechanism. Although the possible causes that may explain the patterns and/or evidences of the pass-through of each sample countries have been discussed in detail based on the country background, however, such possible causes have not been empirically examined. One of a more conclusive method to empirically examine the possible causes is by including proxy variables to proxy for the possible causes in the econometric estimations of the pass-through. This would, in effect, provides a more statistically concrete and robust evidences of the possible causes of the pass-through.

6.5 Suggestions for Future Research

This study has thoroughly investigated the pass-through and also the presence of asymmetric behaviour in the interest rate adjustments of four selected SAARC countries. The effect of interest rate volatility on the bank retail rates pricing behaviour and also the presence of asymmetry and leverage effects in the conditional volatility of the bank retail

rates have also been empirically investigated. The empirical findings of this study have produced several valuable directions for future research.

This study has examined the pass-through from money market rates to bank retail rates, which is the first and most important part of the whole transmission mechanism. Nevertheless, future studies may consider examining the whole transmission mechanism starting from changes in short-term interest rates by the central bank and its final effect on output and inflation through the various transmission channels, such as the exchange rate channel, credit channel, asset price channel, etc. With this, central banks could determine the strength of each channel and, hence, focus on the strongest channel to conduct their monetary policy decisions.

This study has discovered incomplete pass-through for all of the sample countries under estimation and possible justifications for the empirical findings are discussed. In order to examine the possible causes of the incomplete pass-throughs, future studies may consider to econometrically investigate the effects that various determinants have on the pass-throughs. As various risks have been identified to influence the pricing behaviour of bank retail rates, futures studies on these SAARC countries, as well as other countries, may incorporate various risks as the factors that affect pass-throughs, such as interest rate risk and credit risk.

Evidence of the leverage effect is discovered in the banking systems of Pakistan and Sri Lanka. Future studies on these two countries may consider to theoretically and empirically examine the risk-taking channel of monetary policy to investigate whether a low interest rate environment could indeed incentivise banks to undertake excessive leverage, and also the potential effects of bank leverage on bank's portfolios and performance.

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APPENDICES

Appendix A

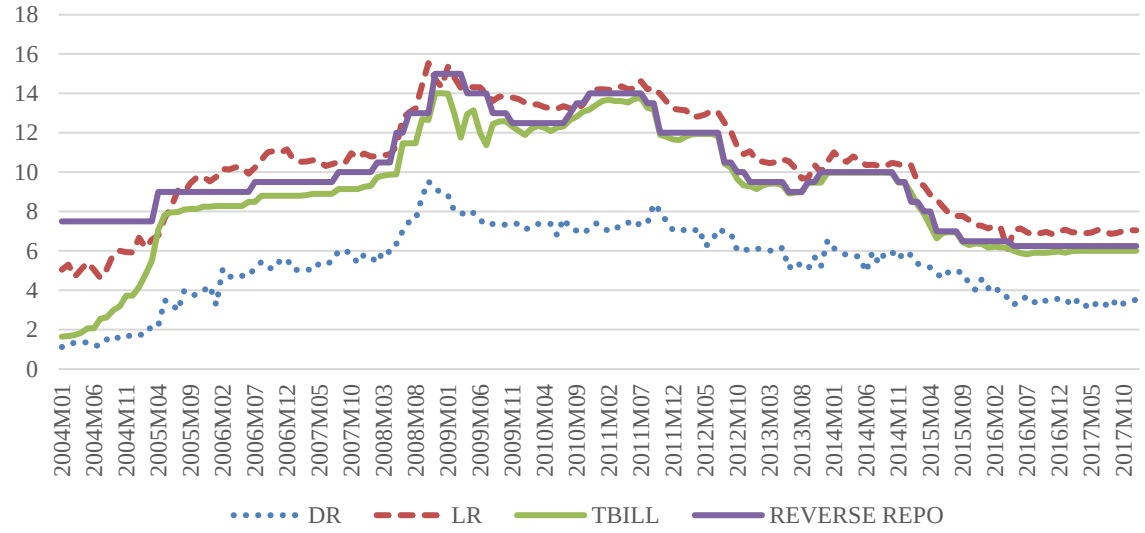


Figure A.1: Monthly Reverse Repo Rate, Treasury Bill Rate, Deposit Rate and Lending Rate (%), Pakistan, January 2004 – December 2017
(Source: CEIC database, 2019)

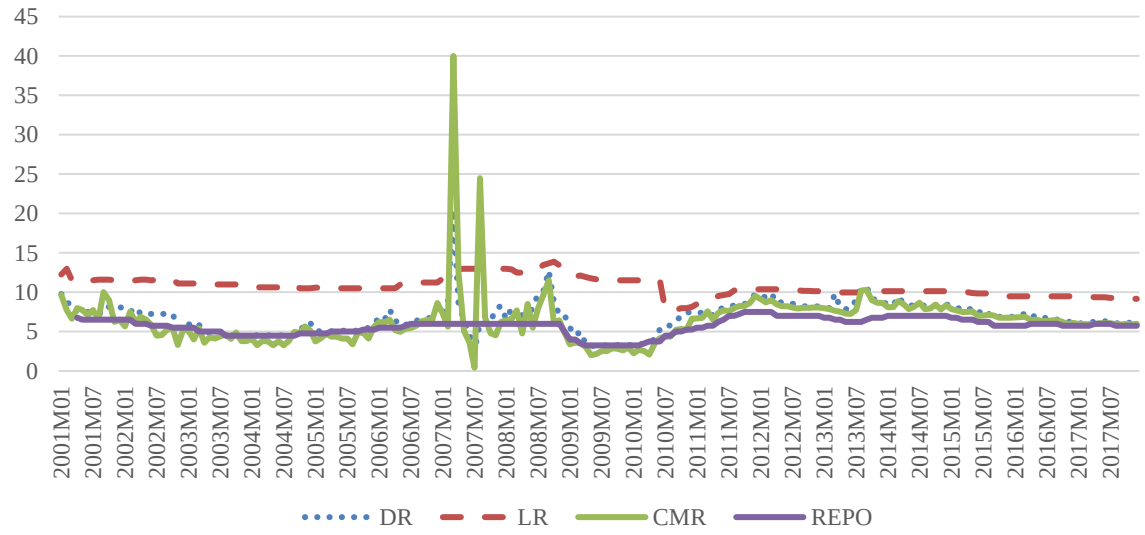


Figure A.2: Monthly Repo Rate, Call Money Rate, Deposit Rate and Lending Rate (%), India, January 2001 – December 2017
(Source: CEIC database and Reserve Bank of India website, 2019)

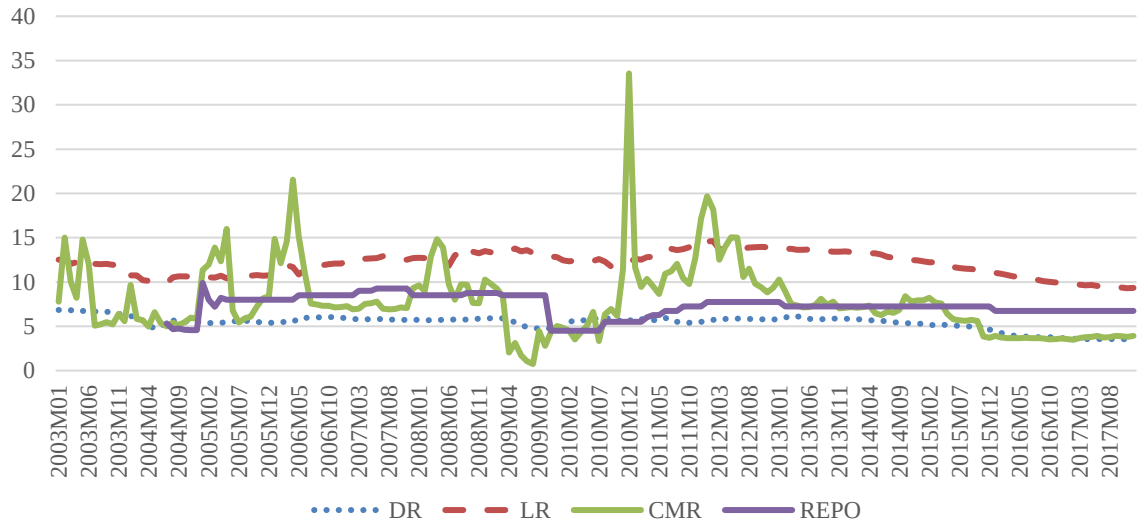


Figure A.3: Monthly Repo Rate, Call Money Rate, Deposit Rate and Lending Rate (%), Bangladesh, January 2003 – December 2017
(Source: CEIC database, 2019)

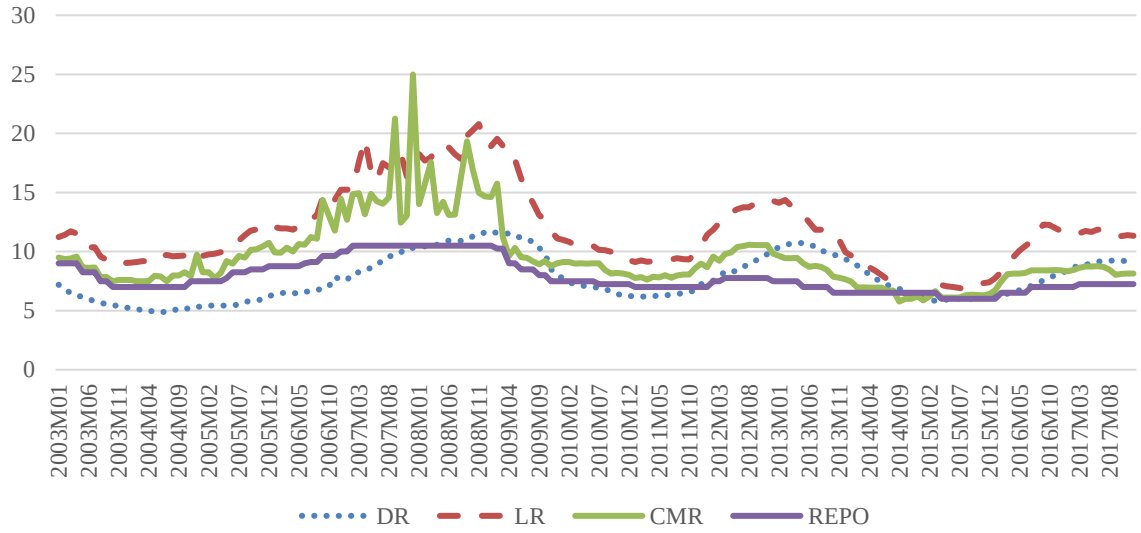


Figure A.4: Monthly Repo Rate, Call Money Rate, Deposit Rate and Lending Rate (%), Sri Lanka, January 2003 – December 2017
(Source: CEIC database, 2019)

Appendix B

This sub-appendix will discuss on the research design and the empirical models used for the estimation of the first stage interest rate pass-through mechanism, i.e. the pass-through from changes in the policy rates to the money market rates, in the sample countries. The empirical results of the first stage interest rate pass-through mechanism will also be provided at the end of this sub-appendix.

The empirical models used and the interpretation of empirical results for the first stage pass-through mechanism is identical to those of the second stage of the pass-through mechanism, as laid out in Chapter 4. Specifically, the presence of asymmetric cointegration relationship between the money market rates and the policy rates will be first examined with the TAR and MTAR models. Once the long-run relationship between these two interest rate variables have been empirically found by the MTAR model, this study will then proceed to estimate the long-run pass-through from the policy rate to the money market rates. After that, the short-run adjustment behaviours between these two interest rate variables will be investigated with the EC-EGARCH (1,1)-M model, in order to identify the presence of upward and downward adjustment rigidity of the money market rates following changes in the policy rate, as well as to examine the magnitude of the short-run pass-throughs.

The long-run pass-through model of the first stage of the pass-through mechanism can be represented by the augmented marginal cost pricing model of De Bondt (2002) as below:

$$MMR_t = d_0 + d_1 PR_t + \varepsilon_t \qquad \text{Equation A.B1}$$

where, MMR is the money market rates proxied by the call money rate or T-bill rate, and PR is the policy rates. d_0 represents the degree of average mark-up or mark-down on the money market rates, while d_1 is the magnitude of the pass-through from the policy rates to the money market rates in the long term. ε is the error term.

Similar to the second stage of the pass-through mechanism, the short-run pass-through model of the first stage of the pass-through mechanism is also represented in the form of an EC-EGARCH (1,1)-M model. The first set of the equations is the conditional mean equation as specified below:

$$\Delta MMR_t = \theta + \sum_{i=1}^{p} \vartheta_i \, \Delta MMR_{t-i} + \sum_{j=1}^{q} \delta_j \, \Delta v_{t-j} + r\Delta PR_t + k\sqrt{\sigma_t^2} + \lambda_1 I_t \hat{\varepsilon}_{t-1} + \lambda_2 (1 - I_t)\hat{\varepsilon}_{t-1} + v_t v_t | \Omega_{t-1} \sim N(0, \sigma_t^2) \quad \text{Equation A.B2}$$

Where, ΔMMR_t is the differenced money market rates which are proxied by the call money rate or T-bill rate, ΔPR_t is the differenced policy rates, and r is its parameter that captures the short-run adjustment margin of the money market rates in response to an adjustment in the policy rates. ΔMMR_{t-i} is the lagged autoregressive term, $AR(p)$, and Δv_{t-j} is the moving average term, $MA(q)$, which were added to rectify the autocorrelation problem. $\sqrt{\sigma_t^2}$ is the time-varying standard deviation of the error term (v_t), while the parameter k captures the effect of interest rate volatility on the money market rates. $\lambda_1 I_t \hat{u}_{t-1}$ and $\lambda_2 (1 - I_t)\hat{u}_{t-1}$ are the MTAR asymmetric error correction terms which represent the short-run dynamics of the model, where $\hat{\varepsilon}_{t-1}$ is the error term of the previous period derived from Equation (A.B1), and is also the error correction term. λ_1 and λ_2 are the speed of

adjustment parameters of the positive and negative error correction terms, respectively. When λ_1 is different from λ_2, then there exist adjustment rigidities in the money market rates. If $|\lambda_1| > |\lambda_2|$, then there exist upward adjustment rigidities in the money market rates, while $|\lambda_1| < |\lambda_2|$ means that there exist downward adjustment rigidities in the money market rates.

The second set of equations in the asymmetric EC-EGARCH (1,1)-M model is the conditional variance equation and is specified as:

$$\log(\sigma_t^2) = c + \varphi \left|\frac{v_{t-1}}{\sigma_{t-1}}\right| + \rho \frac{v_{t-1}}{\sigma_{t-1}} + h\log(\sigma_{t-1}^2) \qquad \text{Equation A.B3}$$

Where, c is a constant, φ and ρ captures the absolute value of standardised residual and standardised residuals, respectively. The v_{t-1} is the news about volatility from the previous period and is measured as the lag of the squared residuals from the mean equation (ARCH term), while σ_{t-1} is the last period forecast of the conditional variance (GARCH term). The asymmetric EC-EGARCH (1,1)-M model for the first stage pass-through mechanism is also estimated using the Bollerslev and Wooldridge (1992) QML method.

The data for the policy rates of each of the sample countries is selected based on the official policy rate currently in use by their central banks. Specifically, the reverse repo rate is used as the proxy for the policy rate of Pakistan, while the repo rate will proxy for the policy rates of India, Bangladesh and Sri Lanka[19]. For consistency, monthly interest rate data were used, and the sample period used for the estimation of the first stage pass-through mechanism is exactly the same as for the second stage pass-through mechanism, i.e. Pakistan from 2004M1 to 2017M12, India from 2001M1 to 2017M12, while Bangladesh and Sri

[19] The data plots for the policy rates of each sample countries are plotted in Figures A.1 to A.4 in Appendix A

Lanka from 2003M1 to 2017M12. The data for the reverse repo rate of Pakistan and repo rate for India, Bangladesh and Sri Lanka were obtained from CEIC database.

Appendix C

Table C.1: TAR and MTAR Asymmetric Cointegration Tests Results for the First Stage Pass-through

Model	TAR				MTAR			
	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	τ	Lag	$\Phi\ (\rho_1 = \rho_2 = 0)$	$F\ (\rho_1 = \rho_2)$	τ	Lag
Pakistan								
TBILL	2.592	9.268**	0.176	9	10.938**	13.885**	-0.108	9
India								
CMR	6.253	14.566**	-1.054	5	11.939**	17.744**	-0.860	5
Bangladesh								
CMR	6.594**	12.680**	3.825	1	2.503	10.391**	1.130	1
Sri Lanka								
CMR	0.772	5.573	0.778	9	16.231**	11.174**	-0.201	9

Note: Asterisk (**) denotes significance at 5% level. τ is the threshold value calculated with Chan (1993) method. The null hypothesis of Φ test is defined as the variables in the estimated model are not cointegrated, while the null hypothesis of *F* test is defined as the cointegration is symmetric. The chosen optimal lags in the TAR and MTAR asymmetric cointegration tests are selected automatically based on Akaike Information Criterion. The critical values of each of the Φ and *F* tests is simulated with Monte Carlo simulation.

Table C.2: TAR and MTAR Asymmetric Cointegration Tests Results for the First Stage Pass-through

Country	Model	d_0	d_1	$H_0: d_1 = 1$	BG	ARCH
Pakistan	TBILL	-1.153	1.070***	0.751	138.171***	158.415***
India	CMR	-3.152***	1.667***	70.587***	1.939	0.161
Bangladesh	CMR	3.291	0.625	8.203***	79.106***	1.510
Sri Lanka	CMR	-5.557***	1.925***	52.811***	9.699***	0.175

Note: Asterisk (***) denotes significance at 1% level. Coefficient d_0 is the fixed mark-up or mark-down of money market rates, while d_1 represents the magnitude of long-run pass-through. The null hypothesis of completeness of long-run pass-through, denoted as $H_0: d_1 = 1$, is estimated with Wald test, whereby the rejection of the null hypothesis indicates incomplete long-run pass-through. BG is the Breusch-Godfrey (1978) Lagrange multiplier test for autocorrelation. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. The money market rate models were estimated using Newey-West heteroskedasticity and autocorrelation consistent (HAC) robust standard errors to correct for the presence of heteroskedasticity and autocorrelation in the estimated models.

Table C.3: EC-EGARCH (1,1)-M Model Estimation Result for the First Stage of Pass-through of Pakistan

Parameter	ECM	EC-EGARCH (1,1)-M
		Mean Equation
r	0.531	0.656
	(0.000)***	(0.000)***
λ_1	-0.076	-0.035
	(0.000)***	(0.000)***
λ_2	-0.331	-0.042
	(0.000)***	(0.648)
k	-	0.367
		(0.032)**
		Variance Equation
c	-	-1.020
		(0.011)**
φ	-	0.814
		(0.000)***
ρ	-	0.031
		(0.795)
h	-	0.842
		(0.000)***
	Diagnostic Tests	
Q (6)	11.412	2.347
	(0.076)*	(0.799)
Q (12)	25.192	10.439
	(0.014)**	(0.491)
Q^2 (6)	85.634	0.551
	(0.000)***	(0.997)
Q^2 (12)	105.27	14.806
	(0.000)***	(0.252)
ARCH	34.759	0.017
	(0.000)***	(0.897)
JSB	-	0.421
		(0.936)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols r,λ_1, λ_2 and k for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation (A.B2), while symbols c, φ, ρ and h for the variance equation results of the EC-EGARCH (1,1)-M follows Equation (A.B3). Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

Table C.4: EC-EGARCH (1,1)-M Model Estimation Result for the First Stage of Pass-through of India

Parameter	ECM	EC-EGARCH (1,1)-M
		Mean Equation
r	1.496	0.657
	(0.011)**	(0.015)**
λ_1	-0.831	-0.624
	(0.000)***	(0.000)***
λ_2	-1.780	-1.031
	(0.000)***	(0.000)***
k	-	-1.113
		(0.000)***
		Variance Equation
c	-	-0.731
		(0.000)***
φ	-	1.178
		(0.000)***
ρ	-	-0.906
		(0.000)***
h	-	0.829
		(0.000)***
	Diagnostic Tests	
Q (6)	10.678	5.551
	(0.099)*	(0.235)
Q (12)	16.039	9.121
	(0.189)	(0.521)
Q^2 (6)	43.381	0.152
	(0.000)***	(1.000)
Q^2 (12)	43.652	0.226
	(0.000)***	(1.000)
ARCH	37.667	0.006
	(0.000)***	(0.937)
JSB	-	2.277
		(0.517)

Note: Asterisks (*), (**) and (***) denotes significance at 10%, 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols r,λ_1, λ_2 and k for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation (A.B2), while symbols c, φ, ρ and h for the variance equation results of the EC-EGARCH (1,1)-M follows Equation (A.B3). Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

Table C.5: EC-EGARCH (1,1)-M Model Estimation Result for the First Stage of Pass-through of Bangladesh

Parameter	ECM	EC-EGARCH (1,1)-M
		Mean Equation
r	-0.417	-0.408
	(0.515)	(0.165)
k	-	-0.038
		(0.638)
		Variance Equation
c	-	-0.344
		(0.023)**
φ	-	0.380
		(0.012)**
ρ	-	0.530
		(0.000)***
h	-	0.958
		(0.000)***
	Diagnostic Tests	
Q (6)	17.567	6.388
	(0.011)**	(0.381)
Q (12)	21.127	14.463
	(0.049)**	(0.272)
Q^2 (6)	40.937	7.564
	(0.000)***	(0.272)
Q^2 (12)	41.223	10.048
	(0.000)***	(0.612)
ARCH	39.811	0.315
	(0.000)***	(0.575)
JSB	-	2.711
		(0.438)

Note: Asterisks (**) and (***) denotes significance at 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters Symbols r,λ_1, λ_2 and k for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation (A.B2), while symbols c, φ, ρ and h for the variance equation results of the EC-EGARCH (1,1)-M follows Equation (A.B3). Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

Table C.5: EC-EGARCH (1,1)-M Model Estimation Result for the First Stage of Pass-through of Sri Lanka

Parameter	ECM	EC-EGARCH (1,1)-M
		Mean Equation
r	2.248	1.331
	(0.000)***	(0.000)***
λ_1	-0.867	-0.676
	(0.000)***	(0.000)***
λ_2	0.504	-0.635
	(0.012)**	(0.000)***
k	-	-0.085
		(0.483)
		Variance Equation
c	-	-0.399
		(0.000)***
φ	-	0.568
		(0.000)***
ρ	-	0.025
		(0.848)
h	-	0.974
		(0.000)***
	Diagnostic Tests	
Q (6)	38.621	3.092
	(0.000)***	(0.542)
Q (12)	55.180	8.639
	(0.000)***	(0.471)
Q^2 (6)	26.488	0.913
	(0.000)***	(0.989)
Q^2 (12)	30.683	15.273
	(0.000)***	(0.227)
ARCH	24.176	0.023
	(0.000)***	(0.880)
JSB	-	3.088
		(0.379)

Note: Asterisks (**) and (***) denotes significance at 5% and 1% levels, respectively. Figures in the parenthesis is the *p*-value. Hyphen (-) indicates irrelevant parameters. Symbols r,λ_1, λ_2 and k for the mean equation results of the EC-EGARCH (1,1)-M follows from Equation (A.B2), while symbols c, φ, ρ and h for the variance equation results of the EC-EGARCH (1,1)-M follows Equation (A.B3). Q is the Ljung-Box Q-statistics of the level variables and Q^2 is the Ljung-Box Q-statistics of the squared variables. ARCH is the Engle (1982) Lagrange multiplier test for ARCH effect. JSB is the Engle and Ng (1993) joint sign bias test for sign bias, negative sign bias and positive sign bias.

Table C.7: Summary of Short-Run and Long-Run Pass-Through for the First Stage of Pass-through

Countries	Short-run Pass-through (r)	Long-run pass-through	
		Mark-up / down (d_0)	Type of pass-through (d_1)
Pakistan	0.656 (Incomplete)	-	1.070 (Complete)
India	0.657 (Incomplete)	-3.152 (Mark-down)	1.667 (Over-complete)
Bangladesh	-	-	-
Sri Lanka	1.331 (Over-complete)	-5.557 (Mark-down)	1.925 (Over-complete)

Note: Hyphen (-) denotes statistical insignificance even at the 10% level of significance. The summary for short-run pass-through is taken from Table C.3 for Pakistan, Table C.4 for India, Table C.5 for Bangladesh and Table C.6 for Sri Lanka. The summary for mark-up or mark-down and type of pass-through is taken from Table C.2 for all 4 sample countries.

Table C.8: Summary of Asymmetric Pass-through for the First Stage of Pass-through

Countries	Pass-through mechanism (MTAR)	Adjustment rigidity ($\lambda_1, \lvert\lambda_2\rvert$)
Pakistan	Asymmetric	Downward
India	Asymmetric	Downward
Bangladesh	-	-
Sri Lanka	Asymmetric	Upward

Note: Hyphen (-) denotes statistical insignificance even at the 10% level of significance. The summary for short-run pass-through is taken from Table C.3 for Pakistan, Table C.4 for India, Table C.5 for Bangladesh and Table C.6 for Sri Lanka.

Appendix D

Monte Carlo simulation is a type of statistical simulation that relies on repeated random sampling and statistical analysis to compute the results (Raychaudhuri, 2008). The underlying basis for Monte Carlo simulation is the ability to generate a sequence of independent random numbers (Bonate, 2001), in order to provide approximate solutions to mathematically complex optimization or simulation problems (Sin & Espuna, 2020). This method is also used to estimate the distribution of variables when it is impossible or impractical to determine that distribution theoretically (Zelditch, Swiderski, & Sheets, 2012).

Bootstrapping is a statistical procedure which is used to generate confidence intervals that uses either resampled data or simulated data to estimate the sampling distribution. This is a type of statistical resampling method that employs Monte Carlo simulation applied to observed data, and it involves drawing a series of random samples from the original sample with replacement in a very large number of times (Ratick & Schwarz, 2009). This method allows the calculation of standard errors, construct confidence intervals, and perform hypothesis testing for numerous types of sample statistics, and is considered as an alternative approach to traditional hypothesis testing. Although this method is more computationally demanding, it do not require that the sampling distribution be known. As a result, they provide a robust and straightforward method to estimate confidence intervals (Nelson, 2008).

Bootstrapping has several advantages over the traditional hypothesis testing, especially when the typical assumptions of regression analysis are violated (Hansen, Evans and Shultz, 1999). Firstly, this method does not require the assumption of normality in the sampling distribution, due to the central limit theorem (Wood, 2005). This theorem posits that the sampling distribution, or the probability histogram, for many sample statistics,

approaches the standard normal curve as the sample size increases, even if the data distributions were not initially normal (Barreto & Howland, 2006). Secondly, this method can reduce the impact of outliers present in the data (Davidson, Hinkley & Young, 2003; Chernick, Gonzalez-Manteiga, Crujeiras & Barrios, 2011). Finally, this method can also produce standard errors that are robust to heteroscedasticity and autocorrelation, and thus still allows inferences to be made even if the errors do not have constant variance or are serially correlated (Jeong & Kang, 2006; Kayhan and Titman, 2007; Hosseini, Latifi & Kelishadi, 2017).

In this study, the bootstrapping procedure via Monte Carlo simulation were applied to establish the long-run relationships among the interest rate variables by using the TAR and MTAR models given the presence of heteroscedastic and autocorrelated (and possibly not normally distributed) residuals of the first stage of pass-through (see Table C.2) and the second stage of pass-through (see Table 5.7), and also the existence of outliers in some of the interest rate variables (see Figures A.1 to A.4 in Appendix A). As the bootstrapping procedure would still be able to produce valid hypothesis testing even if the typical assumptions of regression analysis were violated in our models, therefore, we would still be able to produce valid and robust inferences to be made from our empirical results in this study.