Interest Rate Pass-through in Sri Lanka

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Abstract

The Central Bank of Sri Lanka has increasingly been relying on interest rates as the instrument for conducting monetary policy. Changes to the key monetary policy variables, the Repo and the Reverse Repo rates, are initially expected to be reflected in the OMO rates and the call money market rates, before being passed-through to commercial bank retail interest rates. It is important to obtain a good understanding of the speed and magnitude of the interest rate pass-through to make timely monetary policy decisions in order to meet the objective of economic and price stability. This paper examines the size and speed of the pass-through from policy interest rates to call money market rates and from call money market rates to commercial bank retail interest rates. The paper concludes that the CBSL policy decisions are efficiently transmitted to the short end of the money market within a matter of days. Also, the pass-through from policy interest rates to the call money market rate is almost complete. However, the pass-through from call money market rates to both lending rates and deposit interest rates of commercial banks is sluggish and incomplete. The only exception is, perhaps, the rates on lending to prime customers, which show a faster and a fuller pass-through. Also, there is no evidence of an asymmetry of pass-through over different phases of the interest rate cycle. (JEL E43, E52)

I. Introduction

During the Past few decades, interest rate has become the most important policy instrument used by the Central Bank of Sri Lanka (CBSL) in its monetary operations. The CBSL has gradually moved away from non-market oriented policy instruments to the use of policy interest rates as a market oriented framework in the conduct of the country's monetary policy. This has been an evolutionary process where the CBSL introduced the Repurchase (Repo) facility in October 1993, Reverse Repurchase (Reverse Repo) facility in November 1998 and more active open market operations (OMO) in March 2003.

Interest rate is a key channel of the monetary policy transmission mechanism, through which a central bank attempts to influence the short-term money market interest rates, and

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thereby the commercial bank lending and deposit rates, in order to curtail inflationary pressures while providing adequate lubrication for economic growth. The success of the interest rate channel in conducting monetary policy operations primarily depends on the speed of adjustment of market interest rates and the degree of pass-through. A quicker and fuller pass-through of policy rates and market interest rates to retail bank interest rates strengthens monetary policy transmission.

Researchers have observed that interest rate pass-through is often not an immediate adjustment and usually not a one-for-one change. Therefore, with the market orientation of the conduct of monetary policy in Sri Lanka, with policy interest rates as the key monetary policy instrument, it is necessary to have a clear understanding of the interest rate pass-through process. A clear perception of this process could be quite important for the timing of monetary policy action.

The aim of the present study is to address three issues relating to the interest rate pass-through process in Sri Lanka. These are as follows:

1. Is there a one-to-one pass-through from policy interest rates to call money market rates or else, at what rate does a unit change in policy rates impact upon the call money market rates in the short-run and in the long-run?

2. Is there a one-to-one pass-through from call money market rates to commercial bank retail interest rates (lending rates / deposit rates) or else, at what rate does a unit change in call money market rates impact upon the commercial bank retail interest rates in the short-run and in the long-run?

3. Is there an asymmetry of pass-through during different phases of an interest rate cycle? In other words, is the pass-through of rising interest rates significantly different from the pass-through of falling interest rates?

In order to analyse these issues, this paper is organised as follows: The rest of this chapter explains the monetary policy transmission mechanism, and in particular, the interest rate channel of monetary policy transmission. It will also introduce the concepts of interest rate pass-through and interest rate stickiness and provide a brief background of the use of interest rates as a key instrument in the conduct of monetary policy in Sri Lanka. Section II will review the existing literature on the subject and discuss the nature of the pass-through in other countries as measured by other researchers. Deriving from the research methodologies adopted by international researchers, section III will discuss the data and statistical and econometric tools used in this study while in section IV data are analysed and the findings of the analyses are outlined. Section V will wrap up the discussion on the interest rate pass-through.

A. Channels of Monetary Policy Transmission and Transmission Lag

The transmission mechanism of monetary policy is defined as how changes to the monetary policy instruments of a central bank affect changes in price levels and output of a country. This is a process that works through several economic and financial variables in an economy. Economists often refer to five channels of monetary policy transmission, which are usually interrelated. These channels are

a) Interest rate channel,
b) Exchange rate channel,

c)   Other asset effect channel,
d)   Credit channel, and
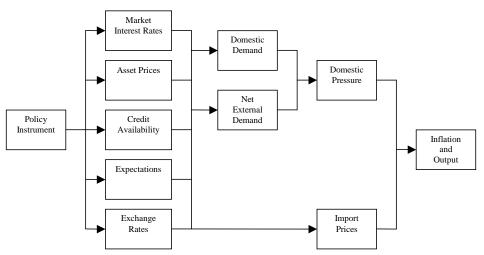e)   Expectations.

Figure 1: Channels of Monetary Transmission Mechanism

The interest rate channel is the traditional monetary policy transmission channel as explained by Keynesians. Under this channel, monetary expansion along with associated decline in interest rates, lower the cost of borrowing for firms and consumers leading to increased investment and consumption. This increases aggregate demand and output gap leading to increasing prices and inflation.

The exchange rate channel can work through either net exports or import prices. Increased money supply lowers the interest rate leading to a depreciation of the exchange rate. This increases competitiveness improving the trade balance as well as generating higher demand. The depreciation of the exchange rate also raises import prices, which directly affect the price level, thus creating inflation.

The asset price channel has two channels involving Tobin's q theory of investment and wealth effects on consumption. Lower interest rates increase the present value of future income flows and therefore asset prices. This raises wealth, which will affect demand. Increased wealth may also increase bank lending by reducing problems related to asymmetric information between banks and firms.

The credit channel is of two types, i.e., bank lending and balance sheet channels. Bank lending is important for small firms and consumers who cannot raise their own funds. Balance sheet channel is based on the principle that healthier balance sheets lead to freer borrowing conditions.

Expectations about the future stance of monetary policy are also important as a transmission channel. If economic agents believe that the current policy is inappropriate, it leads to creating expectations about future actions of the central bank. Inflation expectations also matter in shaping the monetary transmission mechanism.

There is neither an agreement among economists on the existence of the five channels mentioned above nor with regard to the importance of these monetary policy transmission channels. This is because the importance of each channel differs from economy to economy, from time to time and under different circumstances. Not only the importance but also the speed and the size of the effect of each channel are not constant. However, if monetary policy actions are to become successful, a central bank needs to have a proper assessment of the working of the monetary policy transmission mechanism through various channels of an economy. As Mishkin (1996) emphasized, "[a]n understanding of the monetary policy transmission mechanism is essential to understand what monetary policy can and should do and at what point in time, actions should be undertaken to contain or offset disturbances that could threaten the achievement of the targets."

Changes to monetary policy variables do not transmit to other economic variables instantaneously. On the contrary, it has been demonstrated that the effects of monetary policy work are felt on the final targets after long and variable lags. Figure 2 explains the lags in monetary policy transmission as shown by Vaish (2000).

The inside lag is the time lag within the central bank between the time when action is needed and the time when action is practically implemented. The intermediate lag is known to be the lag between the time when the central bank takes action and the time when a sufficient effect on interest rates and other credit conditions to influence the spending decisions of economic agents significantly. The outside lag is the lag between the time when changes in interest rates and other credit conditions occur and the time when the initial impact of these changes is reflected in price levels and output of the economy.
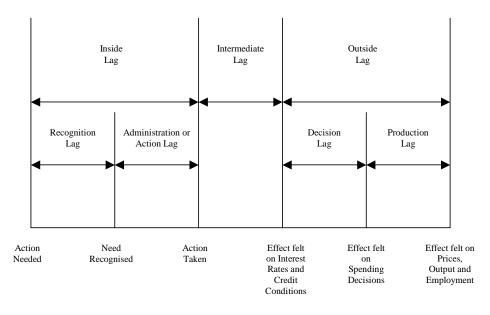
Figure 2: Lags in Monetary Policy Transmission

Modelling the entire monetary policy transmission mechanism is an enormous task. Therefore, the focus of this paper is limited to analysing the initial stages of the interest rate channel of the monetary transmission mechanism. Within this framework, emphasis is made on the intermediate lag where monetary policy action is transmitted to the retail market interest rates.

B. Interest Rate channel, Pass-through and Stickiness

The interest rate channel of monetary policy transmission has a long history which goes back to the times of Keynes. Initially, this channel was considered to be affecting price levels and output through firms' business decisions on investment decisions, but later the scope has been broadened to capture consumer decisions on expenditure on housing and consumer durables as well. According to Mishkin (1996), the emphasis of the interest rate channel is on the real rather than the nominal interest rate and often on the real long-term interest rate and not the short term interest rate, "since it is the real long term interest rate that is viewed as having the major impact on spending". Although some economists, such as Bernanke have shown that the existence of a separate interest rate channel has been undermined by the fact that there is a stronger credit channel, some others such as Taylor (1995) have indicated that there is strong evidence to establish the existence of a strong interest rate channel working through consumption and investment.

With increased reputation of policy interest rates as the main monetary policy instrument in many economies, it is essential that a central bank make required adjustments to its policy interest rate at present in order to achieve monetary policy objectives in the future. Movements of the policy interest rates are expected to influence the entire term structure of market interest rates, although in practice, it has been observed that while short-term market interest rates adjust more closely with the changes to the policy interest rates, the impact on long term rates depends on inflation expectations following the adjustments in the policy rates.

Most literature on the transmission mechanism of monetary policy implicitly assumes that once a central bank's policy rate is changed, short-term market and retail banking rates will follow suit, i.e., that there will be immediate and complete "pass-through" to commercial bank rates. Interest rate pass-through is generally defined as the extent to which changes in central bank policy interest rates and/or money market interest rates are reflected in changes in commercial bank retail interest rates, both in the short-run and the long-run. A full pass-through is said to take place when a movement in the policy interest rates/money market interest rates leads to a one-for-one change in commercial bank interest rates.

If the pass-through to bank interest rates demonstrates "stickiness", i.e., pass-through is sluggish and incomplete, the channels of the transmission mechanism of monetary policy that operate through bank rates will also be affected. Cottarelli and Kourelis (1994) have shown that the term "interest rate stickiness" has usually taken two distinct meanings. "First, it has been used to indicate that bank rates are relatively inelastic with respect to shifts in the demand for bank loans and deposits. Second, it has been used to indicate that, in the presence of a change of money market rates, bank rates change by a smaller amount in the short-run (short-run stickiness), and possible also in the long-run (long-run stickiness)." It is in the latter context the term "stickiness" is used in this paper.
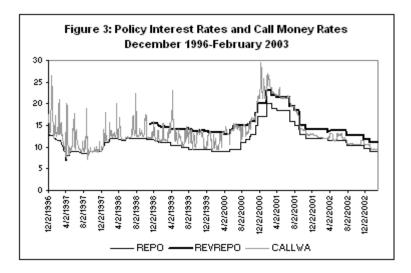
C. Interest Rate as a Policy Instrument in Sri Lanka

The Monetary Law Act No. 58 of 1949 has provided the CBSL an array of policy instruments which could be used in the conduct of monetary policy in Sri Lanka. These vary from market oriented policy instruments to non market oriented instruments and include the statutory reserve ratio (SRR) on commercial bank deposit liabilities, Bank rate, OMO, foreign exchange operations, refinance facilities, quantitative restrictions on credit, and ceilings on interest rates.

However, along with international trends in central banking, Sri Lanka too has witnessed a continuous shift from non market oriented policy instruments to market oriented ones. In this regard, the CBSL has increasingly been relying on interest rates as the instrument for conducting monetary policy in Sri Lanka.

The Central Bank's key monetary policy interest rates are the Repo rate, the Reverse Repo rate, and the Bank rate. The first two are closely linked to market rates, while the latter is more or less a non-market oriented indicative rate. The Repo rate is the rate at which commercial banks and primary dealers can invest their surplus funds in Government securities and Central Bank securities held by the CBSL, while the Reverse Repo rate is the rate at which commercial banks and primary dealers can obtain funds from the Central Bank by pledging their own holdings of Government securities to the Central Bank. The Bank rate is defined as the rate at which the Central Bank grants advances to commercial banks to meet their temporary liquidity requirements as the lender of last resort, but this rate has not been used since 1985.

The Repo and the Reverse Repo rate are expected to facilitate reducing excess volatility in the inter-bank overnight money market thereby providing stability to the money market. Meanwhile changes to these policy interest rates are the Central Bank's signaling mechanism to indicate the expected direction of interest rates in the market. With the adoption of the free floating exchange rate regime in January 2001, the CBSL has been allowed more

Figure 3: Policy Interest Rates and Call Money Rates
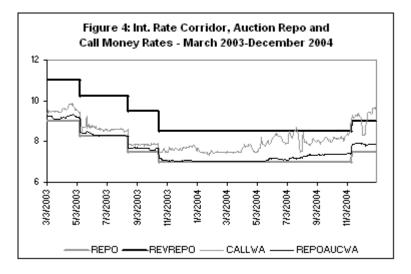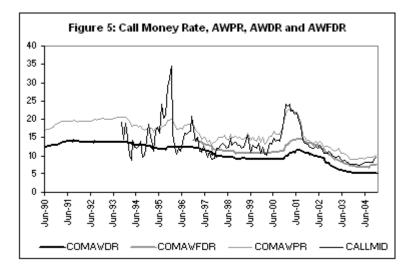December 1996-February 2003

freedom in using policy interest rates as the key monetary policy instrument in Sri Lanka. Figure 3 shows the behaviour of daily interest rates between December 1996 and February 2003 and highlights how interest rates in the call money market have stabilized following the floating of the exchange rate in early 2001.

Marking a major change in the manner in which the CBSL implements its monetary policy, the Bank switched to a more market based active open market operations (active OMO) framework with effects from 03 March 2003. Under this system, the Repo and the Reverse Repo rates form the corridor in which the overnight market operates, while participants in the money market are expected to play a more active role in setting the operational interest rate within the policy interest rate corridor. The weighted average rate at the daily auctions suggests that there is adequate liquidity in the money market if the rate is close to the Repo rate, while suggesting the existence of liquidity shortages if the rate is close to the Reverse Repo rate. Standing facilities are available to participants either at the Repo rate or Reverse Repo rate, depending on their liquidity conditions. Figure 4 shows the behaviour of the daily overnight money market interest rates since 03 March 2003 up to 31 December 2004.

By influencing money market interest rate at the short end of the market, the CBSL expects the interest rate adjustments to be reflected in commercial bank retail interest rates. Commercial bank prime lending rates and other lending rates as well as commercial bank deposit rates both on savings as well as term deposits are also expected to adjust. Figure 5 plots the behaviour of some commercial bank deposit and lending rates against the call money market rate between the period from June 1990 to December 2004.

In summary, changes to the key monetary policy variables, the Repo and the Reverse Repo rates, are initially expected to be reflected in the OMO rates and the call money market rates. This initial transmission from the policy interest rates to overnight money market rates is shaped by the efficiency of the financial market as well as the liquidity conditions of the money market. While a speedy and complete pass-through indicates the existence of an efficient money market, sluggish and imperfect adjustments indicate inefficiencies. Also,

Figure 4: Int. Rate Corridor, Auction Repo and Call Money Rates - March 2003-December 2004

Figure 5: Call Money Rate, AWPR, AWDR and AWFDR

resultant adjustments in retail lending and deposit rates of commercial banks are good indicators of the efficiency of the banking and financial system. Since all these factors affect the efficiency of the monetary transmission mechanism of the CBSL it is essential that a good understanding of this interest rate pass-through process is obtained so that timely monetary policy decisions could be made to meet the objective of economic and price stability.

II. Literature Review

Given the importance of the interest rate pass-through process to the conduct of monetary policy, several researchers have ventured to measure its speed and magnitude using time-series, cross sectional and panel data. Early models included analysing price rigidities under oligopolistic market models, while there has been a series of recent literature on interest rate pass-through processes of several economies using autoregressive distributed lag models, structural vector auto-regression models and error correction models. In this section, an attempt is made to review several of landmark research work on the subject. A summary of data and models used by these researchers is provided at the end of this chapter.

An early work on price rigidities in the banking industry could be found in Hannan and Berger (1991). They focused on the setting of deposit interest rates by banks and addressed the issue of asymmetry between upward and downward price changes using a multinomial logit estimation procedure. Their primary findings were that price rigidity is significantly greater in markets characterised by higher levels of concentration and that deposit rates are significantly more rigid when the stimulus for a change is upward rather than downward.

Lowe and Rohling (1992) summarized four theoretical explanations in addition to oligopolistic behaviour for loan rate stickiness. These theories are based on equilibrium credit rationing, switching costs, implicit risk sharing, and consumer irrationality. They also examined the degree of stickiness of Australian lending rates, and observed that there are significant differences in the degree of interest rate stickiness among different rates, even

after allowing for lags in adjustment. Lowe and Rohling concluded that although it is not possible to empirically discriminate between the different theories of loan rate stickiness, their results provide strong evidence for the switching cost explanation.

Research work by Cottarelli and Kourelis (1994) has provided the bases for several subsequent works by other researchers on interest rate stickiness. Cottarelli and Kourelis analysed the degree of lending rate stickiness in 31 industrial and developing countries by estimating simple dynamic models in order to provide a systematic measure of the different degree of lending rate stickiness across countries. They regressed the lending rate in each country against lagged values of money market and discount rates and measured the degree of lending rate stickiness by looking at the response of lending rates following a change in money market rates at different time lags by estimating impact, interim and long term multipliers. Cottarelli and Kourelis attributed the different degree of lending rate stickiness to structural features of the financial system, such as the existence of barriers to competition, the degree of development of financial markets, and the ownership structure of the banking system.

Borio and Fritz (1995) examined the relationship between the monetary policy rate, money market rate and the lending rate for a group of OECD countries. They observed that, in the short-run, some countries show a high degree of pass-through, while some others show a high degree of interest rate stickiness. However, in the long-run, the pass-through is more homogenous across countries and it gets closer to 1. They also found that changes in money market rates takes three months and two years to be completely transmitted to retail interest rates.

In 1999, Moazzami examined the short-run and long-run impacts of changes in money market rates on lending in Canada and the United States using an error-correction modeling framework, which distinguishes short term impacts from long-run or full equilibrium effects. Moazzami also specified an autoregressive distributed lag model to allow for the presence of lags in the adjustment of lending rates to changes in the money market rates

Winker (1999) combined model with credit rationing due to asymmetric information with a marginal cost pricing to bank behaviour to explain the adjustment of deposit and loan rates to changes of the money market rate. It was observed that the hypothesis that deposit and loan rates do not adapt immediately to changes in the money market rate cannot be rejected based on German monthly data.

Measuring the pass-through for several bank credit and deposit rates for each of the six largest countries in the euro area, Mojon (2000) assumed that there is full pass-through in the long-run and concentrated on estimating its size in the short term. His main findings were that retail rates respond sluggishly to changes in the money market rate, short-term rates generally respond faster than long-term rates, and there is asymmetry in the degree of pass-through, in particular, the pass-through to lending rates is larger when the money market rate increases than when it decreases, while the opposite is true for the deposit rates. Mojon showed that for both credit and deposit rates, the higher the volatility of the money market rate the lower the pass-through. Higher competition from other sources of finance or alternative forms of investment increases the pass-through from the money market rate to bank rates. According to Mojon, competition also reduces the banks' ability to smooth their interest rate margin across the interest rate cycle, thereby reducing the interest rate cycle

asymmetry of the pass-through.

Toolsema, Strum and de Haan (2001) examined how the pass-through of monetary policy measures in six EMU countries has evolved over time and whether there is convergence in monetary transmission. In doing so, they built up on Cottarelli and Kourelis model and concluded that major differences in pass-through exist between these countries, both in terms of initial as well as long-run responses to policy induced interest rate changes. They found no indication for convergence of monetary policy transmission among the six countries.

In 2001, Donnay and Degryse investigated the pass-through from the money market rate to several bank lending rates and the government bond rates for twelve European countries. They applied SVAR based on the Cholesky decomposition in conducting their analysis.

Heinemann and Schüler (2001) argued that national differences of the pass-through speed in the EU could be regarded as a retail-oriented indicator of financial integration. The speed of interest rate adjustments in the EU retail credit markets for different markets and countries is measured and results showed a considerable fragmentation of markets. They used simulations to show how much consumers in some countries could gain from a convergence of adjustment speed on the faster levels.

In 2002, Bredin, Fitzpatrick and O Reilly examined the extent to which changes in the money market interest rate are passed-through to a number of retail lending rates in Ireland. They also analysed the speed of adjustment of these lending rates with respect to changes in the money market rate. They found that there is no complete pass-through from the money market rate to lending rates and the speed of adjustment varies quite considerably across alternative lending rates. They also showed that there has been significant structural change in the relationship between the Irish money market rate and lending rates both in terms of pass-through and speed of adjustment over time.

Using evidence from the Chilean banking industry, Berstein and Fuentes concluded that there is some sluggishness of adjustments of the bank-lending rates to changes in policy rate. By using data at the bank level, they explored factors that influence the degree of delay in market interest rate responses to changes in the policy rate, and found that the size of the bank, type of customers and the loan risk level are important characteristics that determine the speed and size of the pass-through.

Weth (2002) analysed the relationships between German bank lending rates and both money market and capital market rates in the 1990s. This study revealed evidence of structural differences in the interest rate pass-through across German banks. Weth related the speed at which bank lending rates adjust to changes in market rates to a credit institution's size, its refinancing conditions and the extent of its business with non-banks. He concluded that by smoothing their rates, banks appear to be accepting temporary fluctuations in their loan mark-up, which, in turn, tend to retard monetary policy transmission via bank rates.

Examining the retail bank interest rate pass-through process in the euro area, de Bondt (2002) showed that the immediate pass-through of market interest rates to retail bank interest rates is incomplete, in line with previous cross country studies. The empirical results suggested a quicker retail interest rate pass-through process since the introduction of the Euro. Using an error correction model of the interest rate pass-through process based on a mar-

ginal cost pricing framework including switching and asymmetric information costs, he estimated that the proportion of a given market interest rate change that is passed-through within one month to be around 50 per cent and close to 100 per cent in the long term.

Mizen and Hofmann (2002) provided a theoretical and econometric framework for assessing the evidence of the assumption of complete pass-through using 14 years of monthly data for interest rates on deposit and mortgage products offered by UK banks and building societies. The method employed allows for asymmetries and non-linearities in adjustment and the results show that the speed of adjustment in retail rates depends on whether the perceived 'gap' between retail and base rates is widening or narrowing.

Research work conducted by Petro, McDermott and Tripe explored the relationship between the New Zealand official cash rate (OCR), money market interest rates and financial intermediaries' lending margins. They looked at the difference in the degree of pass-through before and after OCR implementation and the extent to which a change in money market rates is passed-through to banks' housing lending rates. They also observed that since the introduction of OCR, there has been a significant decline in the volatility of both underlying money market rates and margins.

Using Markov switching regime systems that allows for asymmetries and non-linearities in the parameters, Humala (2003) modelled the dynamic relationship between money market rate and different short term lending rates in the banking system of Argentina. He observed that under normal financial conditions short-run stickiness is higher for those rates on loans with higher credit risk.

Burgstaller (2003) examined dynamic responses of commercial credit rates to changes in key policy rates and money market rates using Austrian data from 1995 to 2002. He showed that the strength and speed of interest rate transmission depend on whether rates go up or down. However, with the establishment of EMU this asymmetry in interest rate transmission has partly declined and the speed of transmission and the relative importance of policy and money market rates for commercial credit rates too have been affected.

With the objective of testing whether Chile's pass-through is atypical Espinosa-Vega and Rebucci (2003) investigated empirically the pass-through of money market interest rates to retail banking interest rates in Chile, the US, Canada, Australia, New Zealand and five European countries. They estimated both the size and the speed of the pass-through from policy to retail banking rates, in the short-run (on impact, within a month) and in the long-run (in the steady state) for Chile They compared the results with a number of other countries and concluded that as in most countries considered in their study, Chile's measured pass-through is incomplete but does not appear atypical. They also found no significant evidence of asymmetry in Chile's pass-through across states of the interest rate or monetary policy cycle.

Kleimeier and Sander (2003) used a generalized empirical approach that allows for a variety of different specifications of the pass-through, including asymmetric adjustment, the role of interest rate expectations, in determining retail banking product pricing in the Eurozone. They showed that the pass-through is faster when monetary policy changes are correctly anticipated. However, this result is limited to the loan market and more pronounced for positive interest rate shocks, while particularly deposit rates are found to be rigid, suggesting an important role of competitive banking markets for the pass-through process.

In 2004, Tieman aimed to test the hypothesis that the interest rate pass-through from

Table 1 - Data and Techniques used
in Previous Research on the Interest Rate Pass-through Process

Researcher	Data Description	Analytical Tools Used
Hannan and Berger (1991)	The United States of America September 1983 -December 1986	Multinomial Logit Estimation
Lowe and Rohling (1992)	Australia January 1986- August 1991	Simple OLS Regression Analysis
Cottarelli and Kourelis (1994)	31 Industrial and Developing Countries (Including Sri Lanka) January 1980- June 1993	Distributed Lag Analysis
Borio and Fritz (1995)	12 OECD countries	Distributed Lag Analysis
Moazzami (1999)	Canada and the United States of America January 1969-December 1995	Distributed Lag Analysis Error Correction Analysis
Winker (1999)	Federal Republic of Germany January 1975-October 1989	Marginal Cost Pricing Model Co-integration and Error Correction Analysis
Mojon (2000)	Belgium, France, Germany, Italy, the Netherlands, Spain 1979-1998	Error Correction Analysis
Mahadeva and Thenuwara (1999/2000)	Sri Lanka Jan. 1990-December 1999	Co-integration and Error Correction Analysis General Method of Moments
Toolsema, Strum and de Haan (2001)	Belgium, France, Germany, Italy, the Netherlands, Spain January 1980-January 2000	Distributed Lag Analysis Error Correction Analysis
Donnay and Degryse (2001)	12 European Countries 1980-2000	Structural VAR Based on the Cholesky Decomposition
Heinemann and Schüler (2001)	EU Member Countries March 1995-October 2000	Error Correction Analysis
Bredin, Fitzpatrick, and O Reilly (2002)	Ireland January 1980-March 2001	Error Correction Analysis
Berstein and Fuentes	Chile 1996-2002	Imperfect Competition Model Quadratic Loss Function
Weth (2002)	Germany April 1993-December 2000	Distributed Lag Analysis Error Correction Analysis
De Bondt (2002)	EU Member Countries January 1996-May 2001	Marginal Cost Pricing Model Error Correction Analysis VAR
Mizen and Hofmann (2002)	The United Kingdom January 1986-July 1999	Distributed Lag Analysis Co-integration and Error Correction Analysis
Petro, McDermott and Tripe	New Zealand August 1994-July 2001	Co-integration Regime Change Tests
Humala (2003)	Argentina June 1993-December 2000	Co-integration and Error Correction Analysis Markov Switching VAR Linear VAR

<div align="center">**Table 1 (Contd.):**</div>

Researcher	Data Description	Analytical Tools Used
Burgstaller (2003)	Austria March 1995-December 2002	Structural VAR
Espinosa-Vega and Rebucci (2003)	Chile, the United States, Canada, Australia, New Zealand and Five European Countries April 1993-September 2002	Distributed Lag Analysis Error Correction Analysis
Kleimeier and Sander (2003)	Euro zone January 1999-May 2003	Co-integration VAR Threshold Autoregressive Model
Tieman (2004)	Romania, the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia January 1995-February 2004	Co-integration and Error Correction Analysis

policy to market rates plays a lesser role in Romania than in other transition economies in the region. Results for data series on newly issued loans suggest that market rates for new loans react to policy rate changes quite fast and in most cases almost one-to-one, and confirmed that transmission in Romania is similar to that of its neighbours. Analysis of the Romanian loans market for different time periods strongly suggested that the interest rate pass-through from policy to market rates has become more pronounced over time.

Having reviewed a selection of literature on the experience of interest rate pass-through in different countries, it is now appropriate to explore existing findings on interest rate pass-through in Sri Lanka.

Cottarelli and Kourelis (1994), in their analysis of interest rate pass-through in 31 countries, computed the 3 months, 6 months and long-run multipliers to be 0.22, 0.28, and 0.30, respectively as against average 3 months, 6 months and long-run multipliers of 0.64, 0.77 and 0.97, indicating extremely slow and incomplete pass-through both in the short-run and long-run in Sri Lanka.

To evaluate money market efficiency in Sri Lanka, Mahadeva and Thenuwara (1999/2000) employed several econometric tests, particularly one that was based on the co-integration properties of market interest rates and monetary policy rates. They were of the view that if markets are efficient the market rates and policy rates should be co-integrated implying that market rates respond to policy rates. Results indicated that call money rates are not co-integrated with any deposit rate, but the market rediscount rate is co-integrated with especially the shorter interest rates. Mahadeva and Thenuwara found that the pass-through coefficients were much lower than one and lower than those of other countries, indicating significant inefficiencies in the Sri Lankan money market "imposing serious drawbacks in the propagation of policy changes to the final target variable".

More recently, the International Monetary Fund (2004) quantified interest rate pass-through in analysing monetary transmission mechanism in Sri Lanka. They concluded that changes in policy rates appear to translate into changes in market-determined interest rates. Using simple OLS regressions and Treasury bill rates with maturities of 3, 6 and 12 months, they showed that changes are transmitted quickly throughout all maturities, with shorter

maturity rates responding the fastest.

In concluding this chapter, data and models used in research work highlighted so far in analysing the interest rate pass-through process are summarised in Table 1:

III. Data and Statistical/Econometric Tools Used

A. Description of Data

As indicated earlier, the objective of this paper is to analyse the interest rate pass-through process in Sri Lanka and test the speed and magnitude of the pass-through. In order to do so, several interest rate data series are used. However, there is no consistency between the periodicity of data as well as the available time periods for each series.

Daily data are used to address whether there is a one-to-one pass-through from policy interest rates to call money market rates or else, to assess at what rate a unit change in policy rates impact upon the call money market rates in the short-run and in the long-run. Described below are the daily interest rate data series used for this analysis. All interest rates are given in percentages.
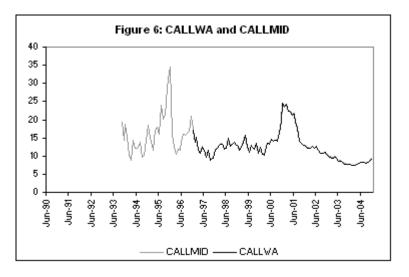
a) REPO – This is the CBSL policy interest rate which effectively regulates minimum rate in the overnight call money market. A daily data series is available since the introduction of the Repo facility on 04 October 1993. Up to 31 December 2004, the REPO series has 2,935 daily observations.

b) REVREPO – Just as the Repo rate regulates the minimum overnight call money market rate, the objective of introducing the Reverse Repo rate was to provide an upper bound for the overnight call money market rate. However, its effectiveness in doing so is limited by the availability of Government securities available with money market participants. The Reverse Repo facility was introduced on 09 November 1998 and up to 31 December 2004, the series contains 1,605 observations.

c) REPOAUCWA – With the introduction of more active OMO commencing 03 March 2003, OMO participants play a major role in setting the effective rate at the daily OMO auctions within the policy interest rate corridor. In view of excess liquidity in the money market during the entire period following the introduction of more active OMO, the CBSL has conducted only Repo auctions and no Reverse Repo auction. Therefore, this series contains weighted average rate at OMO Repo auctions and has 480 observations.

d) CALLWA – This is the weighted average Call Money Market rate. Although minimum and maximum call money market rates are available for a longer time horizon, CALLWA is available only from 02 December 1996. The series has 2,110 observations.

e) EFFECTIVERATE – The existence of several policy interest rates poses the serious problem of what policy interest rate should be used to analyse interest rate pass-through from policy rates to call money market rates. Although it was quite possible to have used dummy variables to determine what policy interest rate is the effective rate under each circumstance, an alternative, but arguably similar, method was used to compile a new series of effective interest rates. This was done as follows:

1) Daily excess liquidity estimates were used to determine whether the effective interest rate for that particular day was the Repo rate or the Reverse Repo rate. When there was excess liquidity the Repo rate was the effective rate, while when there was no excess liquidity or liquidity shortage Reverse Repo rate was considered the effective rate

2) For the period before the Reverse Repo facility was introduced, the Bank rate was used to fill in the gaps, although this may not be a plausible alternative given that the Bank rate was only an indicative rate since 1985.

3) Since the introduction of more active OMO on 03 March 2003, the weighted average Repo auction rate is taken as the effective rate.

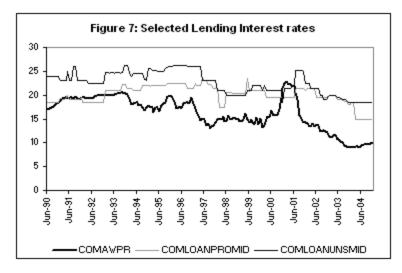The resultant daily data series was named EFFECTIVERATE.

Although daily data are used to analyse the interest rate pass-through from policy interest rates to call money market rate, such short periodicities are not available to many other interest rate variables. Therefore, to address whether there is a one-to-one pass-through from call money market rates to commercial bank retail interest rates (lending rates / deposit rates) or else, to examine at what rate a unit change in call money market rates impact upon the commercial bank retail interest rates in the short-run and in the long-run, as well as to assess whether there is an asymmetry of pass-through during different phases of an interest rate cycle the following monthly interest rate series were used. Unless otherwise specified, all series had 175 monthly observations commencing June 1990.

a) CALLWA – Monthly averages of daily weighted average call money market rate comprised this series. However, since daily weighted average call money market rates were available only from December 1996, this series had only 97 observations.

b) CALLMID – An attempt was made to elongate the data series on call money market rates by using the middle of the minimum and maximum daily call money market rates and then taking the monthly averages of these rates. The resultant series was named CALLMID and it was observed that this series was almost perfectly corre-
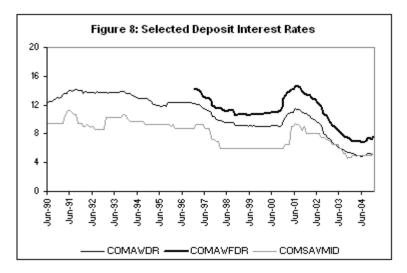

Figure 6: CALLWA and CALLMID

lated with CALLWA for the period they coincided. CALLMID was available from October 1993 and contained 133 observations.

c) COMAWPR – Average Weighted Prime Lending Rate (AWPR) is compiled weekly by the CBSL based on information provided by commercial banks regarding new lending to their prime customers. These loans are granted by commercial banks usually on a short term basis. Monthly averages of weekly AWPR are taken to form this series.

d) COMLOANPROMID – This is the middle rate of commercial bank lending secured by property mortgages. It could be assumed that this series mainly comprises interest rates on long term loans such as housing loans.

e) COMLOANUNSMID – This is the middle rate of commercial bank lending on an unsecured basis. High spread between minimum and maximum interest rates on unsecured lending reported by commercial banks suggests that this includes not only lending at prime rates but also high interest rates on credit facilities such as temporary overdrafts.

f) COMAWDR – The CBSL compiles Average Weighted Deposit rates (AWDR) on a

Figure 7: Selected Lending Interest rates

monthly basis based on data provided by commercial banks on their existing stock of interest bearing deposits.

g) COMAWFDR – Since December 1996, the CBSL has compiled a series named Average Weighted Fixed deposit Rate (AWFDR) based on data provided by commercial banks on their existing stock of all term deposits. This series has only 97 observations.

h) COMSAVMID – This is the middle rate offered on savings deposits of commercial banks.

i) UP – This is the dummy variable defined as 1 when the CBSL policy interest rates

Figure 8: Selected Deposit Interest Rates

increased during this period over the last period or when policy interest rates have remained unchanged during this period after the last change to policy interest rates was upward.

j)   DOWN – This is the dummy variable defined as 1 when the CBSL policy interest rates decreased during this period over the last period or when policy interest rates have remained unchanged during this period after the last change to policy interest rates was downward.

B. Description of Statistical/Econometric Tools Used

Several statistical methods and econometric tests were carried out to analyse the interest rate pass-through process in Sri Lanka. These methods and circumstances which warrant the use of such tests are explained below:

a)   Descriptive statistics – Descriptive statistics of all time series used are obtained in order to observe the nature of each series. This included mean, standard deviation, minimum and maximum.

b)   Correlation – Simple coefficients of correlation are used to derive to the extent of which interest rate series are correlated. Although this may be a good first indicator of the presence or the absence of interest rate pass-through, using contemporaneous series do not allow measuring any lag effects involved.

c)   Unit root tests – All time series are subject to stationarity tests prior to using these series in econometric analysis, in order to avoid spurious regressions. Unit root tests are carried out to test whether the series are level stationary (I(0)) or first difference stationary (I(1)). If a series is found to be I(1) then first differences may have to be used in analysing the relationships. Augmented Dickey-Fuller (ADF) tests are used to test for stationarity. Results of these tests were confirmed by Phillips-Perron tests. Although more sophisticated econometric procedures to test

for stationarity have been introduced, for instance, by Kwiatkowski, Phillips, Schmidt and Shin (KPSS) where the null hypothesis is stationarity, these latter methods were not used in the present analysis.

d) Causality tests – Causality tests introduced by Granger could be used to identify whether policy rates precede changes in money market rates or whether changes in money market rates prompt policy rate changes. Unexpected direction of causality may indicate serious deficiencies in the monetary policy transmission mechanism.

e) Distributed lag modelling – Distributed lag models are used to observe how the effect of a shock to exogenous variable is reflected on the endogenous variable over time. Two popular methods are the Koyck approach and the Almon approach. Koyck distributed lag model assumes that the effect declines geometrically as the lag lengthens, an assumption which may be too restrictive in some instances. Therefore, the polynomial distributed lag (PDL) approach introduced by Almon is used instead.

f) Co-integration – If two time series are found to be I(1), they may be tested for co-integration. Regression analysis using co-integrated time series are said to produce non-spurious results. Procedures suggested by Engel and Granger as well as Johansen are used to test for the existence of co-integrating relationships.

g) Error correction analysis – Given a co-integrated relationship, error correction models are used to analyse the short-term dynamics around a possible long-term equilibrium relationship between time series. Simple error correction models as suggested by Engel and Granger are used for this purpose.

h) Hypothesis tests – Simple hypothesis tests are carried out to verify whether the pass-through is asymmetric over an interest rate cycle, and between deposit rates and lending rates. Wald coefficient tests are used to impose and test restrictions under the null hypotheses.

IV. Analysis and Findings

In this chapter, the data described in the previous chanper are used to carry out the analysis of the interest rate pass-through process in Sri Lanka by employing the statistical and econometric methods explained earlier. The analysis is conducted in two stages. First, the pass-through from the CBSL policy interest rates to the call money market rates will be looked at. The pass-through process from call money market rates to commercial bank retail lending and deposit rates will be dealt with thereafter.

A. From Policy Rates to Money Market Rate

In analysing the interest rate pass-through from policy interest rates to money market rates, five daily data series have been used. Descriptive statistics of these series are given in Table 2.

Descriptive statistics show some early indications that CALLWA has, on average, remained between REPO and REVREPO, although with higher volatility. Lower mean and standard deviation of REPOAUCWA are due to the fact that this series is shorter than other series and only covers a low interest rate regime.

Table 2 - Descriptive Statistics Daily Interest Rates

Series	Period	Mean	Standard Deviation	Minimum	Maximum
REPO	10/04/1993-12/31/2004	11.3296	2.9983	7.0000	20.0000
REVREPO	11/09/1998-12/31/2004	13.3611	3.7346	8.5000	23.0000
REPOAUCWA	03/03/2003-12/31/2004	7.6274	0.6905	7.0100	9.3300
EFFECTIVERATE	12/02/1996-12/31/2004	11.3793	3.7929	7.0000	23.0000
CALLWA	12/02/1996-12/31/2004	12.3833	4.0642	7.2500	29.5400

As explained earlier, for several years, the CBSL's policy interest rates, i.e., the Repo rate and the Reverse Repo rate have been used as the key monetary policy variables, particularly, influencing the behaviour of the call money market rate. Therefore, a good starting point for this analysis is to test whether the CBSL has set the direction for the behaviour of call money market rates or whether the CBSL has followed the behaviour of call money market rates by changing policy interest rates after call money market rates are adjusted automatically to suit changing economic and financial conditions. To test these competing hypotheses, Granger causality tests were carried out.

Causality tests showed that there is unidirectional causality from REPO to CALLWA and also from REVREPO to CALLWA. There is no causality from CALLWA to either REPO or REVREPO. These results clearly indicate that the Repo rate and the Reverse Repo rate have provided direction to the behaviour of the overnight call money market rate.

Cross correlations are good indicators to measure the degree of pass-through between contemporaneous data. The correlation matrix given below shows that CALLWA is closely correlated with the CBSL policy rates as well as the EFFECTIVERATE series created by combining REPO,REVREPO and REPOAUCWA and liquidity conditions in the money market.

Table 3: Pair-wise Granger Causality Tests

Sample: 12/02/1996 12/31/2004

Lags: 10

Null Hypothesis:	Obs	F-Statistic	Probability
CALLWA does not Granger Cause REPO	2100	0.97864	0.45980
REPO does not Granger Cause CALLWA		11.0459	0.00000

Sample: 11/09/1996 12/31/2004

Lags: 10

Null Hypothesis:	Obs	F-Statistic	Probability
CALLWA does not Granger Cause REVREPO	1595	1.00337	0.43811
REVREPO does not Granger Cause CALLWA		10.8346	0.00000

Table 4 - Correlation Matrix for Daily Interest Rates
Maximum Sample: 12/02/1996-12/31/2004

	REPO	REVREPO	EFFECTIVERATE	CALLWA
REPO	1.0000	0.9608	0.9350	0.9034
REVREPO	0.9608	1.0000	0.9457	0.9488
EFFECTIVERATE	0.9350	0.9457	1.0000	0.9262
CALLWA	0.9034	0.9488	0.9262	1.0000

The final analysis of the interest rate pass-through from policy interest rates to money market rates is expected to be conducted using the two series CALLWA and EFFECTIVERATE. These series are then tested for stationarity in order to avoid spurious regressions. ADF tests showed that both CALLWA and EFFECTIVERATE are stationary, i.e., I(0), while Phillips-Perron tests confirmed this finding.

Table 5 - Unit Root Tests
Daily Interest Rates

Series	No. of Lags	Deterministic Components		ADF Test Statistic
		Constant	Trend	
EFFECTIVERATE (Level)	4	Significant	Insignificant	-3.6896*
CALLWA (Level)	4	Significant	Insignificant	-3.7236*

* Hypothesis of a unit root can be rejected at the 1 per cent level. The results were confirmed by Phillips-Perron tests, which used longer truncation lag lengths.

In order to quantify the size and speed of interest rate pass-through from EFFECTIVERATE to CALLWA, a polynomial distributed lag (PDL) model was fitted. Preliminary experiments with PDLs with long lags suggested that using only 10 lags is sufficient to capture the pass-through process from EFFECTIVERATE to CALLWA. Also, the model initially imposed no end constraints in order to allow the model itself to determine the shape of the polynomial. A second degree polynomial distributed lag model was found to be appropriate for the analysis. The estimated relationship could be written as:

$$CALLWA_t = \alpha + \beta_1 PDL01_t + \beta_2 PDL02_t + \beta_3 PDL03_t + \varepsilon_t$$

Where;

$$PDL01_t = \sum_{i=0}^{k} EFFECTIVERATE_{t-i}$$

$$PDL02_t = \sum_{i=0}^{k} i\, EFFECTIVERATE_{t-i}$$

$$PDL03_t = \sum_{i=0}^{k} i^2\, EFFECTIVERATE_{t-i}$$

where i is the length of the lag and k is the maximum length of the lag.

The results of the PDL model are given in Table 6:

Table 6 - Pass-through from Policy Rates to the Call Money Market Rate

Sample(adjusted): 12/02/1996 12/31/2004
Included observations: 2110 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	0.7315	0.0988	7.4027	0.0000
PDL01	0.0403	0.0101	3.9861	0.0001
PDL02	-0.0299	0.0024	-12.3909	0.0000
PDL03	0.0053	0.0010	5.2320	0.0000

Lag Distribution of EFFECTIVERATE	i	Coefficient	Std. Error	t-Statistic
. *|	0	0.3219	0.0194	16.6054
. * |	1	0.2444	0.0114	21.3855
. * |	2	0.1776	0.0074	24.1604
. * |	3	0.1212	0.0078	15.6088
. * |	4	0.0755	0.0094	8.0204
.* |	5	0.0403	0.0101	3.9861
.* |	6	0.0156	0.0094	1.6588
* |	7	0.0015	0.0078	0.1949
* |	8	-0.0020	0.0074	-0.2755
.* |	9	0.0050	0.0114	0.4361
.* |	10	0.0226	0.0194	1.1634
Sum of Lags		1.0235	0.0082	124.0930

The constant term and all three PDLs in the PDL equation are significant confirming that a second degree polynomial is an appropriate fit to model the relationship. The lag distribution of EFFECTIVERATE shows that EFFECTIVERATE is passed-through to CALLWA significantly within the first seven time periods (0-6) following a change to the EFFECTIVERATE. The sum of lags between i = 0 to 6 is 0.9965 indicating a 99.65 per cent pass-through from policy interest rates of the CBSL to the CALLWA within the first seven working days (including the day policy rates were changed). More than 50 per cent of the change is transmitted to the call money market rate on the first two days and the effect builds into the call money market rate over the next few days after an almost complete pass-through.

From this analysis, it can be concluded that the CBSL policy decisions are efficiently transmitted to the short end of the money market within a matter of days. Also, there is a complete pass-through from policy interest rates to the call money market rate. Therefore, there is no need to differentiate between a short-run pass-through and a long-run pass-through with regard to the interest rate transmission process from the CBSL policy interest rates to the overnight call money market.

B. From Money Market Rates to Retail Bank Interest Rates

Having established that there is a highly efficient interest rate pass-through process between the CBSL policy interest rates and the call money market rate, this section analyses

STAFF STUDIES - VOLUME 35, NUMBERS 1 & 2

the pass-through from the call money market rate to retail interest rates in the commercial banking sector, both on lending as well as on deposits. Monthly series of two representative rates from the call money market, three commercial bank lending rates and three commercial bank deposit rates are used for the analysis and relevant descriptive statistics are given in Table 7:

Table 7 - Descriptive Statistics
Monthly Interest Rates

Series	Period	Mean	Standard Deviation	Minimum	Maximum
CALLWA	1996/12-2004/12	12.3798	3.9210	7.4800	24.6200
CALLMID	1993/10-2004/12	13.4928	4.7980	7.5100	34.5600
COMAWPR	1990/06-2004/12	16.2546	3.5063	8.9400	22.8600
COMLOANPROMID	1990/06-2004/12	20.1218	1.9010	15.0000	23.5000
COMLOANUNSMID	1990/06-2004/12	22.5847	2.4281	18.5000	26.2500
COMAWDR	1990/06-2004/12	10.7418	2.7012	4.8400	14.1600
COMAWFDR	1996/12-2004/12	10.9527	2.2776	6.8200	14.7000
COMSAVMID	1990/06-2004/12	7.9616	1.8024	4.5500	11.2500

On average, all commercial bank lending rates are above both call money market rates confirming the existence of a mark-up, which is as high as 10 percentage points for unsecured lending (COMLOANUNSMID). On the other hand, deposit rates are lower than the call money market rates. Taken together, these factors confirm the high interest rate spread between lending and deposit rates that prevail in the Sri Lankan banking industry. Except for prime lending (COMAWPR), standard deviations of all other commercial bank rates are low, indicating that commercial banks, themselves, absorb a part of volatility in the money market; an early sign of low degree of pass-through between money market interest rates and retail interest rates.

Cross-correlations between monthly interest rate series resulted in some interesting findings. First, it was seen that CALLWA and the middle of the maximum and minimum rates of the call money market (CALLMID) were closely correlated showing that these series could be used interchangeably in our analysis. CALLMID was a longer time series, and could be used in this analysis as an excellent proxy for CALLWA. Second, COMAWPR also has a very high degree of correlation with call money market rates, while COAWDR and COMAWFDR also show high correlations with call market rates. Third, the lowest correlation with call market rates is with loans secures by immovable property (COMLOANPROMID), which are of a long-term nature. Finally, it could also be seen that all three deposit rates are closely correlated with each other.

Prior to engaging in performing econometric analyses, all variables were subjected to ADF Unit root tests to verify their time series properties. The results are given in Table 9.

None of the monthly interest rate series was found to be stationary on levels. Therefore, unit root tests were carried out on first differences. As indicated below, all first difference series were stationary at a very high level of significance, and both the constant and the trend were not significant in each series in carrying out unit root tests. It was concluded all series were I(1).

22   CENTRAL BANK OF SRI LANKA

Table 8 - Correlation Matrix for Monthly Interest Rates
Maximum Sample: June 1996-December 2004

	CALL WA	CALL MID	COM AWPR	COM LOAN PROMID	COM LOAN UNSMID	COM AWDR	COM AWFDR	COM SAVMID
CALLWA	1.0000	0.9994	0.9619	0.2801	0.3710	0.6360	0.7033	0.3900
CALLMID	0.9994	1.0000	0.7898	0.3644	0.4651	0.5371	0.7040	0.4307
COMAWPR	0.9619	0.7898	1.0000	0.3655	0.6888	0.8826	0.8131	0.7432
COMLOANPROMID	0.2801	0.3644	0.3655	1.0000	0.6531	0.4759	0.7159	0.4577
COMLOANUNSMID	0.3710	0.4651	0.6888	0.6531	1.0000	0.8282	0.8258	0.8368
COMAWDR	0.6360	0.5371	0.8826	0.4759	0.8282	1.0000	0.9726	0.9014
COMAWFDR	0.7033	0.7040	0.8131	0.7159	0.8258	0.9726	1.0000	0.8462
COMSAVMID	0.3900	0.4307	0.7432	0.4577	0.8368	0.9014	0.8462	1.0000

Table 9 - Unit Root Tests (Levels)
Monthly Interest Rates

Series	Lags	Constant	Trend	ADF Test Statistic
CALLWA	2	Insignificant	Insignificant	-0.9216
CALLMID	4	Significant	Insignificant	-2.7525
COMAWPR	4	Significant	Significant	-2.9961
COMLOANPROMID	4	Insignificant	Insignificant	-1.0903
COMLOANUNSMID	4	Significant	Significant	-2.3928
COMAWDR	4	Significant	Significant	-2.9544
COMAWFDR	2	Insignificant	Insignificant	-1.2103
COMSAVMID	4	Significant	Significant	-2.9768

* Hypothesis of a unit root can be rejected at the 1 per cent level.

** Hypothesis of a unit root can be rejected at the 5 per cent level.

Table 10 - Unit Root Tests (First Differences)
Monthly Interest Rates

Series	Lags	Constant	Trend	ADF Test Statistic
CALLWA	2	Insignificant	Insignificant	-5.1555*
CALLMID	4	Insignificant	Insignificant	-6.0604*
COMAWPR	4	Insignificant	Insignificant	-5.5559*
COMLOANPROMID	4	Insignificant	Insignificant	-6.8993*
COMLOANUNSMID	4	Insignificant	Insignificant	-6.5740*
COMAWDR	4	Insignificant	Insignificant	-3.0380*
COMAWFDR	2	Insignificant	Insignificant	-2.8441*
COMSAVMID	4	Insignificant	Insignificant	-5.0772*

* Hypothesis of a unit root can be rejected at the 1 per cent level.

** Hypothesis of a unit root can be rejected at the 5 per cent level.

Given that monthly interest rates were I(1), a series of simple linear regressions were carried out on first differences to assess the size and the significance of the interest rate pass-through from call money market rate to retail bank rates. The simple model used is as follows:

$$\Delta \text{ Retail Rate}_t = \alpha + \epsilon\beta_1 \Delta \text{ CALLWA}_t + \epsilon_t$$

Where Δ is the first difference operator.

Results of these regressions are summarized in Table 11.

Table 11 - Simple Linear Regressions

	No Lag		Sum of Coefficients(H0: $\epsilon\beta_1$=1)		
	α	β_1	Number of lags		
			3	6	9
Lending Rates					
COMAWPR		0.5132	0.7663	0.8057	0.7297
		(0.0329)	(0.000036)	0.006191)	(0.000696)
COMLOANPROMID		-0.1031	-0.1085	-0.0087	0.0649
		(0.0633)	(0.000000)	(0.000000)	(0.000007)
COMLOANUNSMID		-0.1691	0.0214	0.0563	0.1980
		(0.0533)	(0.000000)	(0.000000)	(0.000001)
Deposit Rates					
COMAWDR	-0.0703	0.0289	0.1324	0.1929	0.2595
	(0.0205)	(0.0147)	(0.000000)	(0.000000)	(0.000000)
COMAWFDR	-0.0646	0.0525	0.2020	0.2794	0.3753
	(0.0272)	(0.0194)	(0.000000)	(0.000000)	(0.000000)
COMSAVMID	-0.0339	0.0140	0.0607	0.2342	0.2386
	(0.0390)	(0.0279)	(0.000000)	(0.000000)	(0.000000)

Note: Standard errors appear in parentheses below the coefficient estimates for α and β_1, while probability values for H0: $\epsilon\beta_1$=1 are given in parentheses below the sum of lagged coefficients.

Regression results showed that with regard to lending rates, the degree of interest rate pass-through from call market rates was quite high for prime lending rates (COMAWPR). While 50 per cent of a percentage change in call money market rates is felt on AWPR immediately, the accumulated pass-through increases continuously until around 6 months after a change. However, in the case of loans secured by property, the coefficients do not even have the expected sign until after a lag of 9 months. Even at 9 months, sum of coefficients stands at 0.06 indicating that interest rates on long term loans are extremely rigid and the level of pass-through is very low. Interest rates on unsecured loans are also quite rigid and after a lag of 10 months, only 20 per cent of a percentage change in call money rates is reflected in the changes in rates on unsecured loans. In the case of deposit rates, the degree of pass-through is quite low initially, but increases within 9 months to around 20-40 per cent of the change. The tests carried out to test the hypothesis that $\epsilon\beta_1$= 1, show that the degree of pass-through is incomplete in all cases even after a lag of 9 months.

Given that all interest rate series used in this analysis are I(1), it is appropriate to test whether the linear relationships between these variables are co-integrated. This is done using the methodology suggested by Engel and Granger. The test involves running regressions of the type,

$$\text{Retail Rate}_t = \alpha + \beta\,\text{CALLMID}_t + \varepsilon_t$$

to obtain the co-integrating vectors

$$\varepsilon_t = (\text{Retail Rate}_t - \alpha - \beta\,\text{CALLMID}_t)$$

and use the ADF test on the residual series ε_t. However, since estimated β_t are based on the estimated co-integrating parameter â, using the ADF critical significance values to test whether the residual series are stationary is not appropriate. Instead, critical values computed by Engel and Granger are used, and therefore, the appropriate test is known as the Augmented Engel-Granger (AEG) test. Results of the regressions and relevant AEG test statistics are shown in Table 12.

Table 12 - Testing for Co-integration
Results of Engel-Granger Tests

	α	β	AEG Test Statistic
Lending Rates			
COMAWPR	7.6290	0.5715	-2.9677*
	(0.5508)	(0.0385)	
COMLOANPROMID	18.2985	0.1543	-2.9355*
	(0.4894)	(0.0342)	
COMLOANUNSMID	18.8307	0.2551	-3.3021*
	(0.6026)	(0.0421)	
Deposit Rates			
COMAWDR	6.1152	0.2803	-3.3292*
	(0.5465)	(0.0382)	
COMAWFDR	5.8334	0.4122	-1.6235***
	(0.5549)	(0.0426)	
COMSAVMID	5.3967	0.1517	-2.3237**
	(0.3945)	(0.0276)	

Notes: Standard errors appear in parentheses below the coefficient estimates.
* Hypothesis of a unit root can be rejected at the 1 per cent level.
** Hypothesis of a unit root can be rejected at the 5 per cent level.
***Hypothesis of a unit root can be rejected at the 10 per cent level.

The results show that all relationships are co-integrated (although at different levels of significance). These regressions are said to represent the long-run relationships and the estimated β represent the long-run pass-through from CALLMID to commercial bank retail rates. Accordingly the long-run pass-through from call money market rates to prime lending rates is about 57 per cent, while rates on long term loans secured by property (COMLOANPROMID) and interest rates on savings deposits (COMSAVMID), show the lowest levels of long-run pass-through.

The existence of co-integrated relationships between call money market rates and retail interest rates is confirmed by the results of the Johansen's co-integration tests shown in Table 13.

Table 13 - Results of the Johansen's Co-integration Tests

Test assumption: Linear deterministic trend in the data
Series: COMAWPR CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.166867	26.19938	15.41	20.04	None **
0.014323	1.918713	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Test assumption: Linear deterministic trend in the data
Series: COMLOANPROMID CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.113690	17.56604	15.41	20.04	None *
0.011322	1.514449	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Test assumption: Linear deterministic trend in the data
Series: COMLOANUNSMID CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.160955	25.83521	15.41	20.04	None **
0.018584	2.494929	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Test assumption: Linear deterministic trend in the data
Series: COMAWDR CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.230690	35.26773	15.41	20.04	None **
0.002906	0.387019	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Test assumption: Linear deterministic trend in the data
Series: COMAWFDR CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.275670	33.69420	15.41	20.04	None **
0.031655	3.055895	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Test assumption: Linear deterministic trend in the data
Series: COMSAVMID CALLMID
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.191156	30.91426	15.41	20.04	None **
0.020084	2.698419	3.76	6.65	At most 1

 *(**) denotes rejection of the hypothesis at 5%(1%) significance level
 L.R. test indicates 1 co-integrating equation(s) at 5% significance level

Having shown that there are long-run equilibrium relationships between each set of variables, i.e., the relationships are co-integrated, the next step is to analyse the short-run behaviour of the variables using the error correction mechanism (ECM) suggested by Engel and Granger. ECM is where the short-run disequilibria shown by the error terms (also known as equilibrium errors) obtained from Engel-Granger tests for co-integration are used to tie the short-run behaviour of dependent variables to their long-run values. The following ECM equation is used to continue the analysis.

$$\Delta\,(\text{Retail Rate}_t) = \alpha + \beta_1\,\Delta\,(\text{CALLMID}_t) + \beta_2\,\varepsilon_{t-1} + u_t$$

where Δ is the first difference operator, u_t is the random error term and $\varepsilon_{t-1} =$ Retail Rate$_{t-1}$ - α - β CALLMID$_{t-1}$ (i.e., the one period lagged value of the error from the co-integrating regressions derived above). ECM equations state that changes in retail rates depend on the changes in CALLMID as well as on the equilibrium error terms. If the error term is zero, the model is in equilibrium.

Table 14 - Error Correction Mechanism (ECM) Regressions

	α	β_1	β_2	AdjR^2
Lending Rates				
COMAWPR		0.1775	-0.0914	0.3558
		(0.0208)	(0.0266)	0.3558
COMLOANPROMID		-0.0173	-0.0768	0.0281
		(0.0239)	(0.0350)	0.0281
COMLOANUNSMID		-0.0123	-0.0778	0.0544
		(0.0226)	(0.0263)	0.0544
Deposit Rates				
COMAWDR	-0.0623	0.0090	-0.0212	0.0525
	(0.0157)	(0.0059)	(0.0076)	
COMAWFDR	-0.0635	0.0463	-0.0799	0.2765
	(0.0239)	(0.0173)	(0.0149)	
COMSAVMID		0.0056	-0.0563	0.0466
		(0.0104)	(0.0184)	

Note: Standard errors appear in parentheses below the coefficient estimates.

Estimated coefficients β_1 could be interpreted as short-run adjustments. Similar to the findings earlier in this section, the ECM equations also suggest a sluggish pass-through from call money market rates to commercial bank retail interest rates. Rates on loans to prime customers show the highest short-run pass-through of 0.18 per cent, while various deposit rates show very slow adjustments. Also, low R^2 values suggest that several other factors affect the interest rate pass-through process.

Some researchers have found that in certain countries when policy interest rates are rising, retail lending rates respond quickly but deposit rates remain sluggish, while the opposite is true when policy interest rates are declining. Similar test using Sri Lankan data were carried out to check whether this is true for Sri Lanka as well. The model used is:

$$\Delta \text{Retail Rate}_t = \alpha + \beta_1 \Delta \text{UP} + \beta_2 \Delta \text{DOWN} + \varepsilon_t$$

where Δ is the first difference operator, UP is a dummy variable (1 when the Policy interest Rate increases) multiplied by CALLWA, and DOWN is a dummy variable (1 when the policy rate decreases) multiplied by CALLWA (See data description in Chapter 3). The results from these regressions are provided in Table 15.

Table 15 - Tests of Symmetrical Responses

	α	β_1	β_2	Sig. LevelH0: $\hat{a}_1 = \hat{a}_2$
Lending Rates				
COMAWPR		0.5074 (0.0337)	0.5165 (0.0332)	0.4097
COMLOANPROMID		-0.0940 (0.0649)	-0.1083 (0.0639)	0.5012
COMLOANUNSMID		-0.1853 (0.0542)	-0.1598 (0.0534)	0.1528
Deposit Rates				
COMAWDR	-0.0701 (0.0206)	0.0278 (0.0151)	0.0295 (0.0149)	0.7246
COMAWFDR	-0.0640 (0.0273)	0.0498 (0.0199)	0.0541 (0.0196)	0.5091
COMSAVMID		0.0104 (0.0284)	0.0183 (0.0280)	0.3985

Note: Standard errors appear in parentheses below the coefficient estimates.

The results show that estimated values for β_1 are marginally lower than β_2, suggesting that interest rates are more flexible downward. Lowe and Rohling, who tested for asymmetry of pass-through using Australian data also found a similar relationship. However, in none of the cases, the hypothesis that retail interest rates respond symmetrically could be rejected. Therefore, it can be concluded that there is no evidence that in Sri Lanka, commercial bank retail interest rates respond asymmetrically during different phases of the interest rate cycle.

In summary, it can be concluded that the pass-through from call money market rates to both lending rates as well as deposit interest rates of commercial banks are sluggish and incomplete. The only exception is perhaps the rates on lending to prime customers, which show a faster and closer pass-through. However, it must be noted that COMAWDR and COMAWFDR are stock variables, while COMAWPR is a flow variable, which, by definition, captures adjustments in the money market rates faster. Also, there is no evidence to conclude that commercial bank retail interest rates react differently to increases and decreases of money market interest rates.

V. Conclusion

Findings in section IV indicate that although there is a rapid and almost complete pass-through from the Central Bank policy interest rates to call money market rates, the pass-through from call money market rates to commercial bank retail interest rates is sluggish and incomplete. The sluggish and incomplete pass-through poses a challenge to the Central Bank as it hinders the achievement of its monetary policy objectives as desired.

Studies have suggested several possible reasons for sluggish adjustments in commercial bank retail interest rates. These include the lack of competition in the financial system, collusive behaviour of banks, adverse selection and moral hazard problems, menu costs of commercial banks, switching costs to customers, inelasticity of demand for bank services, risk sharing behaviour, consumer irrationality, and the high proportion of fixed-rate loans and deposits. These reasons are possibly inter-related and also could be competing. This aspect, however, is beyond the scope of the present study, but contains future research opportunities for testing the validity of each of these arguments in the Sri Lankan context.

Potential research related to the present study includes analysing the term structure of interest rates and broadening the study to cover the developments in the Treasury bill and Treasury bond markets. An in-depth study into modelling the monetary transmission mechanism in Sri Lanka analysing each of the relevant transmission channels is yet to be undertaken.

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