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Monetary Policy and Yield Curve Dynamics in an Emerging Market: Sri Lankan Perspectives

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Abstract

The monetary policy targets the very short end of the yield curve although real economic activity is largely dependent upon the medium to long- term market interest rates. Conventional wisdom is that decrease in the monetary policy target rate leads to an immediate decrease in market interest rates, and an increase in bond prices; yet evidence for this view is elusive. Therefore, the question of how do the monetary policy actions translate across the yield curve remain at the forefront of many recent policy debates. Bringing the foundations of Expectation Hypothesis (EH) and empirical analysis of Sri Lanka money market and government bond daily yield rates for the period 2000 to 2009 through the application of Ordinary Least Squares (OLS) and Vector Error Correction Model (VECM), explains that monetary policy impact monotonically decreases over the yield curve at the short-end and become segmented toward medium to long-term of the yield curve. The impact appears to be waning at a faster pace at times of financial and economic uncertainties compared against stable economic period. This invites policy attention on the part of monetary policy effectiveness, structural impediments and market confidence in Sri Lanka.

Keywords: Monetary policy; Expectation hypothesis; Segmented market hypothesis; Yield curve and term structure of interest rates

JEL classifications: E64; E66; E68; G1

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1. Introduction

The recent US subprime mortgage market[3] led world economic and financial market fallout and subsequent unprecedented policy response by authorities to resurrect the world economic order has given impetus to study the effectiveness of policy actions tried in both advanced and emerging market economies. Among the policy choices, the monetary policy (MP) took precedence and became increasingly important in emerging market economies against the application of fiscal stimulus which was constrained by overstretched budgetary conditions (International Monetary Fund; 2009a, pp. xii-xvii). Central banks reacted quickly with exceptionally large interest rate cuts as well as unconventional measures to inject liquidity, sustain credit and induce market confidence. Given these developments the effectiveness of MP measures during the periods of financial and economic stress by its influence on the yield curve or term structure of interest rates (TSIR) has been at the centre of recent academic debate (Bates & Vaugirard, 2009, pp. 149-153; Mishkin, 2009, pp. 1-2; Obstfeld, 2009 ; Calomiris, 2008, pp. 55-63)[4].

From another perspective, the assessment of effectiveness of recent aggressive MP measures, leading central banks are still not conclusive in their assessments. For instance, Federal Open Market Committee (FOMC) of the Federal Reserve Board of Governors' (FRB), the central bank of US (also known as the Fed), in their October 2008 and September 2009 policy reviews states that the effectiveness of the MP measures in resurrecting the effected economies and more importantly to build the financial market and economic agents confidence are yet to be realized and also explains that most of the policy measures

[3] A financial crisis that arose in the US mortgage market in mid 2007 after a sharp increase in mortgage foreclosures, mainly subprime, collapsed numerous mortgage lenders and hedge funds. The meltdown spilled over into the global credit market as risk premiums increased rapidly and capital liquidity was reduced. The sharp increase in foreclosures and the problems in the subprime mortgage market were largely blamed on loose lending practices, low interest rates, a housing bubble and excessive risk taking by lenders and investors.

[4] Citations are in the descending order of date followed by the alphabet.

introduced in the post subprime period are experimental and unprecedented in nature. In addition, many scholarly works (Oda & Ueda, 2005; Thornton, 2004; Kuttner, 2001; Balduzzi, Bertola, Foresi & Klapper, 1998, Buttiglione, Giovane & Tristani, 1998; Rudebush, 1995) investigated the time-series properties of the yield curve and in particular how medium- and longer-term interest rates react to changes in the short-term interest rate target set by the monetary policy authority. Further, many empirical work (Estrella & Mishkin, 1996[5]; Bernanke & Blinder, 1992; Mishkin, 1990) use the slope of the yield curve as an indicator of the stance of the MP and the health of the economy. These studies, coupled with increasingly important role of yield curve dynamics in post subprime monetary policy discussions invites further contributions to the literature.

In conventional economic theory monetary policy actions are reflective in market interest rates. The conventional view rests on three principles[6]. First, the fact that monetary policy target instrument is often the overnight policy interest rate. Second, the changes in overnight policy interest rate is determined by considering the overall direction of the economy and based on information monetary policy authority posits at time of revision of the monetary policy stance. And third, the market determination of medium to long-term interest rates are a function of expected level of overnight policy interest rates over the relevant time horizon. Therefore, market participants expect MP actions to reflect in the market interest rates.

Bindseil (2004, p. 33) states that since the late 1990s, the dominant approach of monetary policy implementation is the steering of interest rates where the MP transmission starts with

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[5] Slope of the yield curve as a reliable predictor of economic activity.

[6] See Cook & Hahn (1989, pp. 331-332) for more details.

steering of short-term market interest rates. The snap-shot of interest rates is the yield curve[7] or TSIR. Although the monetary policy authority targets the short-term interest rate, it is evident that real economic activities are guided by medium to long-term market interest rates (Bindseil, 2004, p. 38 & pp. 77-79; Thornton, 2004, p. 21 & p. 35). Smets & Tsatsaronis (1997) state that real economic activities in the form of consumption and investment typically depends on medium to long-term interest rates. Also, there are many MP episodes of advanced economies that the MP aims at the structure of orderly medium to long-term market interest rates[8]. Therefore, the effectiveness of MP is dependent on whether it can impart any influence on medium to long-term interest rates. In other words, MP should be able to affect the entire maturities of the yield curve, irrespective of whether it is short-term or medium to long-term, in order to achieve its desired target of influencing the real economic activity or resurrecting the economic order.

Analyzing the MP impact across the yield curve from an emerging market perspective, the paper studies the Sri Lankan case and defines the time horizon across a heterogeneous period defined on the basis of economic stability against the homogeneous time horizon in the majority of existing literature.

The foundation of MP impact on yield curve is well explained providing that the yield curve or the TSIR is adequately explained by the expectation hypothesis (EH). According to the EH, long-term rates are an average of current short-term rates and expected short-term rates across the time to maturity. Given this scenario, monetary policy authorities could impact

[7] The yield curve enables economists to capture the overall movement of interest rates. The yield curve reflects the investor's expectation of interest rates by plotting yields to maturity of similar financial instruments as a function of maturity.

[8] The introduction of "Quantitative Targeting (easing) Monetary Policy" regime in March 2001 by the Bank of Japan was aimed at facilitating the orderliness in short to medium to long-term interest rate structure in the economy.

the medium to long-term rates by adjusting current short-term rates and alter the market expectations about the expected future short-term rates.

There are two strand of literature that investigated the MP impact on yield curve. The first is mainly concerned with the dynamics of the EH[9]. The second concentrated on quantifying the MP impact on the yield curve.

The studies on quantifying the MP impact on yield curve used mainly the event study analyses (Thornton, 2000; Rudebush, 1995; Cook & Hahn, 1989) or the time series context (Oda & Ueda, 2005; Thornton, 2004; Drakos, 2001; Kuttner, 2001; Balduzzi, Bertola, Foresi & Klapper, 1998; Buttiglione, Giovane & Tristani, 1998). These studies concluded that the MP impact exists across the yield curve and interestingly the impact wanes across as the time to maturity increases. In certain instances, findings supports no impact of MP as the yield curve approaches the long-term. Also, empirical work extends a fractured support for the EH.

The majority of these studies deal exclusively with advanced economies with developed financial markets and across a homogeneous time horizon. However, the post subprime world economic and financial markets suggests the requirement to analyze the MP impact on yield curves across the emerging market economies and across time horizons identified for economic stability and times of economic uncertainty.

Therefore, the paper proposes to study the effectiveness of MP separated for economic horizons of stability and instability by analyzing an emerging market case, Sri Lanka. The

[9] The concept has roots to the early and mid 20th century and derived from observing the way people commonly discuss choices between purchasing a long or short-term bond as an investments. The more recent empirical work follows the idea that long-term nominal interest rates depend on expectations of future short-term interest rates (Campbell and Shiller, 1991; Cox, Ingersoll & Ross, 1985).

Central Bank (CBSL)[10], monetary authority of Sri Lanka, aims at maintaining economic and price stability and maintaining financial system stability as its core objectives with a view to encouraging and promoting the development of the productive resources of Sri Lanka. In pursuing these broader objectives, CBSL has the mandate to practice either rule based or discretionary monetary policies[11]. Therefore, studying the Sri Lanka case will provide insights into the role of MP in resurrecting the economic order in the development process in an emerging market perspective.

In a specific sense, the paper will investigate the MP impact in Sri Lanka to address the following hypotheses.

- Does the MP, changes in MP, impact the yield curve or TSIR significantly?
- Has the MP impact similar across the yield curve or the impact monotonically decrease over the term to maturity? Does the impact explain the EH?
- Is the MP impact on yield curve similar in nature across heterogeneous economic environments?

Estimating the above hypotheses will enable assessment of MP effectiveness in Sri Lanka under normal economic circumstances and at times of economic uncertainty. Also the study

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[10] The Central Bank of Ceylon was established by the Monetary Law Act (MLA) No.58 of 1949 and commenced operations on August 28, 1950. It was renamed the Central Bank of Sri Lanka in 1985. The original objectives of the Central bank were streamlined into present context in 2002 by an amendment to the original MLA.

[11] The rule based monetary policy is the commitment to follow a “policy rule” instead of picking the appropriate policy at its discretion. The basic intuition under a rule is the credible commitment to a sequence of policy decisions that would bring about the best long-run outcome. Under discretion, the monetary policy would satisfy some short-run objective and thus forming expectations about policy decisions would not be straight forward. Inflation target may be considered as a rule and a policy of low inflation over the medium to long-term could be considered discretionary. However, in recent times, differentiating between types of monetary policy regimes become increasingly harder.

will contribute to the literature to analyze the MP impact on yield curve of a financial market of different depth and maturity.

The findings appear to describe the MP impact exist quantitatively across the yield curve but statistical significance become increasingly remote as the time to maturity moves towards medium to long-term market interest rates in Sri Lanka. Analyzed for heterogeneous time horizon when economic instability dominate, the MP impact appears to wane at a faster pace and segmented in nature against the monotonically decreasing impact seen in advanced economies. Also, the evidence for EH is fractured and inconclusive in Sri Lanka.

The paper will be organized as follows. Section 2 will explain the standard model (methodology) employed and the model employed under a stochastic environment followed by a brief introduction to the application of time series data in the study. Section 3 will discuss the empirical results and the section 4 will briefly work out the conclusion.

2. The Model

2.1. Methodology of monetary policy impact on yield curve

The base of the test of significance or impact of monetary policy on yield curve or term structure of interest rates comes from the EH. The empirical work on monetary policy impact on yield curve or term structure of interest rates employs the standard type of regression model used by many scholars (Drakos, 2001, pp. 246-247; Haldane & Read, 2000, pp. 20-21; Buttiglione, Giovane & Tristani, 1998; Rudebusch, 1995, pp. 247-251; Cook & Hahn, 1989, p. 340).

$$\Delta R_{i,t} = a_i + \beta_{1,i}\Delta R_{0,t} + \varepsilon_t \text{ ------ } (1)$$

The regression model of the equation (1), bivariate time series model, explains that β as the response of the change in particular market interest rate *i*, let say 91 day maturity Treasury bill ($\Delta R_{i,t}$), to the change in monetary policy instrument (interest rate), in this instance ΔR_0 . The Δ will act as difference operator of the time series. The ε_t is the disturbance term.

The foundation of the regression model of equation (1) is derived from the expectation hypothesis. Walsh (2003, pp. 489-90) states that under the expectation theory of the term structure, the *n*-period interest rate equals an average of the current short-term rate and future short-term rate over the *n*-period horizon.

$$(1+i_{n,t})^n = \prod_{i=0}^{n-1} (1+i_{t+1}) ------(2)$$

Accordingly, if $i_{n,t}$ is the nominal yield to maturity at time t of an *n*-period discount bond, while i_t is the one-period rate, the expectation hypothesis in the absence of uncertainty could be written in the form of equation (2)[12]. The equation state that the holding period yield on the *n*-period bond is equal to the yield from holding a sequence of one-period bonds.

Walsh (2003, p. 489) further explains that by log linearising, the equation (2) will be approximated into the following form.

$$i_{n,t} = \tfrac{1}{n}\prod_{i=0}^{n-1} i_{t+i} ------(3)$$

Since an *n*-period bond becomes an *n*-1 period bond after one period, the equation (3) could also be written into equation (4) and further simplified into equation (5).

[12] The equation can be extended to accommodate any risk premium including time-varying risk premium.

$$(1+i_{n,t})^{n} = (1+i_{t})(1+i_{n-1,t+1})^{n-1} ------(4)$$

$$i_{n,t} = (\tfrac{1}{n})i_{t} + (\tfrac{n-1}{n})i_{n-1,t+1} ------(5)$$

Although, these equations will not hold exactly under the conditions of uncertainty, it will be sufficient to illustrate the impact of monetary policy on yield curve or term structure of interest rates across two periods.

By taking $I_t \equiv i_{2,t}$ as the two-period interest rate (or the long-term interest rate) and E_t as the market expectation at time *t*, the yield curve or term structure of interest rate equation could be re-written and approximated as equation (6) and (7).

$$(1+I_{t})^{2} = (1+i_{t})(1+E_{t}i_{t+1}) ------(6)$$

$$I_{t} = \tfrac{1}{2}(i_{t} + E_{t}i_{t+1}) ------(7)$$

The implication of this relationship for monetary policy is that the current structure of interest rates will depend on current short-term interest rates and on market expectations of future short-term interest rates. Therefore, it is normal and rational to expect the long-term interest rate based on the expectation of future monetary policy actions when short-term interest rate being the monetary policy target instrument.

Subtracting i_t from both sides of equation (7), one could derive a direct and empirically testable equation (8) to test the monetary policy implications on yield curve or term structure of interest rates.

$$I_t - i_t = \tfrac{1}{2}(E_t i_{t+1} - i_t) - - - - - (8)$$

This rationale has been employed in equation (1) as a mechanism of monetary transmission with changes to the "one period" interest rate by the monetary policy authority. Based on the model explained in equation (1), the previous studies, by assuming stationary relationship, estimated the impact of monetary policy variable among contemporaneous market interest rates by applying *Ordinary Least Squares (OLS)* approach. The application of OLS is reasonable and simple in order to analyze the impact of change in monetary policy variable on change in market interest rates.

The study proposes to apply a variant of equation (1) to directly test the empirical application of monetary policy impact on yield curve or term structure of interest rates.

$$\Delta R_{i,t} = a_i + \beta_{1,i}\Delta R_{0,t} + \beta_{2,i}\Delta R_{0,t-1} + \beta_{3,i}\Delta R_{0,t+1} + \Gamma\Delta R_{i,t-1} + \varepsilon_t - - - - - (9)$$

Accordingly, the equation (9)[13] will be empirically tested where the lag ($\Delta R_{0,t-1}$) and the lead ($\Delta R_{0,t+1}$) of the monetary policy instrument (ΔR_0) is applied to capture the anticipation of monetary policy action and contemporaneous reaction if otherwise not captured by the data, respectively. Also, the lag depended variable ($\Gamma\Delta R_{i,t-1}$) is estimated to address any residual autocorrelation and the impact of 'recent event' bias, otherwise not captured by the data.

2.2. Methodology under a stochastic environment

[13] Recent work on MP impact across the yield curve (Oda & Ueda, 2005; Drakos, 2002 & 2001) uses the variant instead of the basic equation to separate out the lag and lead effect of monetary policy instrument.

The methodology applied by the equation (1) and its variant equation (9) are informative and empirically methodological to infer monetary policy impact on yield curve or TSIR. However, when empirically estimating the change in monetary policy instrument's impact on market interest rates (yield curve), differencing will not take into account the long-term pattern or the relationship exhibit by the monetary policy instrument (often overnight policy interest rate) and market interest rates. In other words, although level differencing achieves stationarity in the empirical work, if the long time series information involves non-stationarity at levels, it would not be optimal to restrict the empirical work to the model explained by equation (1) and its variant equation (9). Therefore, inferring the monetary policy impact on yield curve or TSIR by taking difference operator would be sub-optimal and not reflect the true long-term relationship embedded in the history of policy and market interest rates concerned. These concerns have been addressed by taking into account long-term information embedded in variables at levels. The model explained below will address the dynamic co-movement of variables.

According to the expectation hypothesis, to exert any impact on market interest rates by the monetary policy instrument, a dynamic co-movement among market interest rates and to have a parallel shift in market interest rates, a one to one relationship between policy interest rate and market interest rate of concern should exist. This condition is nothing but any pair of interest rates should exhibit co-integration and the co-integration vector should be symmetric (1, -1) in coefficients (Drakos, 2001, pp. 250-252). Therefore, the impact of monetary policy, assume overnight policy interest rate, on the yield curve will be investigated within a co-integrated system.

In this context, to empirically test the stochastic trend of the market interest rates with the monetary policy instrument

a) any linear combination in the form of $(R_{o,t} + \beta_i R_{i,t})$ will be tested for stationarity.

We know that, in the context of expectation hypothesis, the co-integration between monetary policy instrument, overnight policy interest rate $(R_{o,t})$, and the market interest rate $(R_{i,t})$ will be analyzed by the statistical significance of β_i .

Also, to test the expectation hypothesis for a certain segment of the yield curve

b) the co-integration vector (1, -1), symmetry hypothesis, will be tested.

Not rejecting the hypothesis that the co-integration vector (1, -1) among combination of interest rates establishes the proportionate or parallel impact of the monetary policy variable on the yield curve. If the co-integration vector (1, -1) is rejected, then the impact of monetary policy action on market interest rates will be examined by monotonically decreasing pattern of the parameter value β_i across the time to maturity on the yield curve.

Drakos (2001) test the co-integration between monetary policy instrument, overnight policy interest rate $(R_{o,t})$, and the market interest rate $(R_{i,t})$ by applying the Johansen procedure (Johansen, 1992, pp. 313-316). The Johansen procedure starts with applying *n*-dimensional vector of non-stationary variable *X*, which potentially forms a co-integrating set.

The standard model applied by many scholars (Thornton, 2004; Drakos, 2001; Haldane & Read, 2000) to test for co-integrating vectors between monetary policy instrument, overnight policy interest rate $(R_{o,t})$, and the market interest rate $(R_{i,t})$, follow the Vector Autoregressive (VAR) representation of the unrestricted system with error *u* is

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + ... + A_k X_{t-k} + u_t ------(10)$$

where $u_t \approx N(0, \Sigma)$ and

$X_t \approx (n \times 1)$, $A_i \approx (n \times n)$ are matrix parameters.

The equation (10) could be re-formulated into a Vector Error Correction Model (VECM) in the following form (equation [11]) to test the $\prod$, which determines the co-integration vectors between the monetary policy instrument, overnight policy interest rate $(R_{o,t})$, and market interest rates $(R_{i,t})$.

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + ... + \Gamma_{k-1} \Delta X_{t-k-1} - \Pi X_{t-k} + u_t ------(11)$$

where $\Gamma_i = -(I - A_1 - ... - A_i)$

$i = 1,2,...., k-1$ and

$\prod = -(I - A_1 - .... - A_k)$.

Based on the rank of matrix $\prod$, if it is zero the matrix is null and that implies the non existence of co-integration among combination of interest rates. If the column rank is non zero, stationary linear combination between the monetary policy instrument, overnight policy interest rate $(R_{o,t})$, and the market interest rate $(R_{i,t})$ correspond to the co-integration vectors and signify the co-movement among interest rates. The Johansen likelihood ratio (LR) tests, to test the rank of $\prod$, in the form of *trace test* and *maximum* *eigenvalue test* will be presented for empirical results. The normalized co-integration vectors will be analyzed for proportionate or parallel shift in market interest rates.

The standard model applied on the basis of equation (1) and its variants equation (9) and the model under a stochastic environment on the basis of equation (11) will enable to test the hypothesis (1) and (2).

- Hypothesis 1- does the monetary policy, changes in monetary policy, impact the yield curve or term structure of interest rates significantly?

Parameter values of β_i will be tested for contemporaneous impact on market interest rates $\boldsymbol{R}_{i,t}$. The statistical significance of β_i, under the equation (14), will be used for analyzing the co-integration.

- Hypothesis 2- has the monetary policy impact similar across the yield curve or TSIR or the impact monotonically decrease over the term to maturity

Again β_i parameter values for different market interest rates $\boldsymbol{R}_{i,t}$ will be tested. The normalized co-integration vector (1, -1) will be used to examine the pattern of monetary policy impact over the time to maturity. The normalized co-integration vector (1, -1) across the yield curve will provide evidence for proportionate or parallel shift in yield curve to monetary policy actions.

2.3. Application of the methodology under different economic environments

Apart from the hypothesis (1) and (2), the hypothesis (3), the monetary policy impact on yield curve or term structure of interest rates under *stable and unstable economic environments* (heterogeneous environment) will require testing the standard model of equation (1) and its variant equation (9) and the model under a stochastic environment on the basis of equation (11) separated for different economic environments.

The study proposes to use the market oriented mechanism in defining periods of economic stability and instability. On broader terms stable and unstable economic periods are recognized by the deviation of comparable market interest rates from the monetary policy target interest rate. Often, monetary policy target interest rate is the overnight policy interest rate which is compared with comparable overnight market interest rate across the full time horizon of 10 year period starting from year 2000 to year 2009.

2.3.1. The emerging market case, Sri Lanka

In the emerging market case, Sri Lanka, the MP operates within an interest rate corridor with an upper and lower bound, reverse repurchase rate (upper bound) and repurchase rate (lower bound)[14]. The MP operational corridor is determined by a meeting of the members of the Monetary Board[15], apex policy making committee, of the CBSL.

[14] Repo is the sale of government securities (or central bank securities) by the central bank or the rate at which counterparty financial institutions park their excess funds with the central bank with the agreement to buy them back at a pre determined date at a pre determined price (at official Repo rate). Reverse Repo is purchase of government securities by central bank with the agreement to sell them back at a pre determined date at a pre determined price (at official Reverse Repo rate) or at the rate at which counterparty financial institutions borrow their fund shortages with the central bank. The Official rates are set for overnight transactions.

[15] The CBSL has a unique legal structure in which the CBSL is not an incorporated body. In terms of the Monetary Law Act, the corporate status is conferred on the Monetary Board, which is vested with all powers, functions and duties. As the governing body, the Monetary Board is responsible for making all policy decisions related to the management, operation and administration of the CBSL. The Monetary Board consists of four members, the Governor, the Secretary to the Ministry of Finance (ex-officio) and two non-executive members. The Governor is the Chairman of the Monetary Board and also functions as the Chief Executive Officer of the Central Bank. The Governor and the non-executive Board members are appointed by the President, on the recommendation of the Minister of Finance. The approval of the Constitutional Council is

Timing of the monetary policy reviews are announced at the beginning of the year with CBSL keeping the discretion to make announcements outside the announcement plan, if necessary. The deviation of the overnight money market interest rate, weighted average call money rate (WACM) from the monetary policy interest rate corridor will be used as the base for identifying stable and unstable economic periods in Sri Lanka (equation 12). When the market interest rate reports a deviation from the monetary policy interest rate corridor, the CBSL acts through the Open Market Operations (OMO) to resurrect the orderliness in the overnight market interest rate. This is similar to FRB guidance in OMO to bring back the orderliness in US money market (Cook & Hahn, 1989, pp. 333-337). Thus the identification of periods of economic heterogeneity by an interest rate departure rule is itself a contribution of the study[16].

$$R_{1,t} - R_{o(repo),t} \prec 0.00, unstable$$
$$R_{1,t} - R_{o(rev.repo),t} \succ 0.00, unstable -\!-\!-\!-\!-\!- (12)$$

Accordingly, at times where the overnight market interest rate $R_{i,t}$, WACM, trade outside the monetary policy operating instrument $R_{o,t}$, policy corridor, the unstable economic period is identified. In other words, the overnight market interest rate $R_{i,t}$, WACM, falls below the lower bound of the MP corridor, repurchase rate, or trade above the MP corridor, reverse repurchase rate, that period is considered as the unstable economic period in Sri Lanka over the time horizon of the study. Figure 1 depicts the definition of equation (12) to

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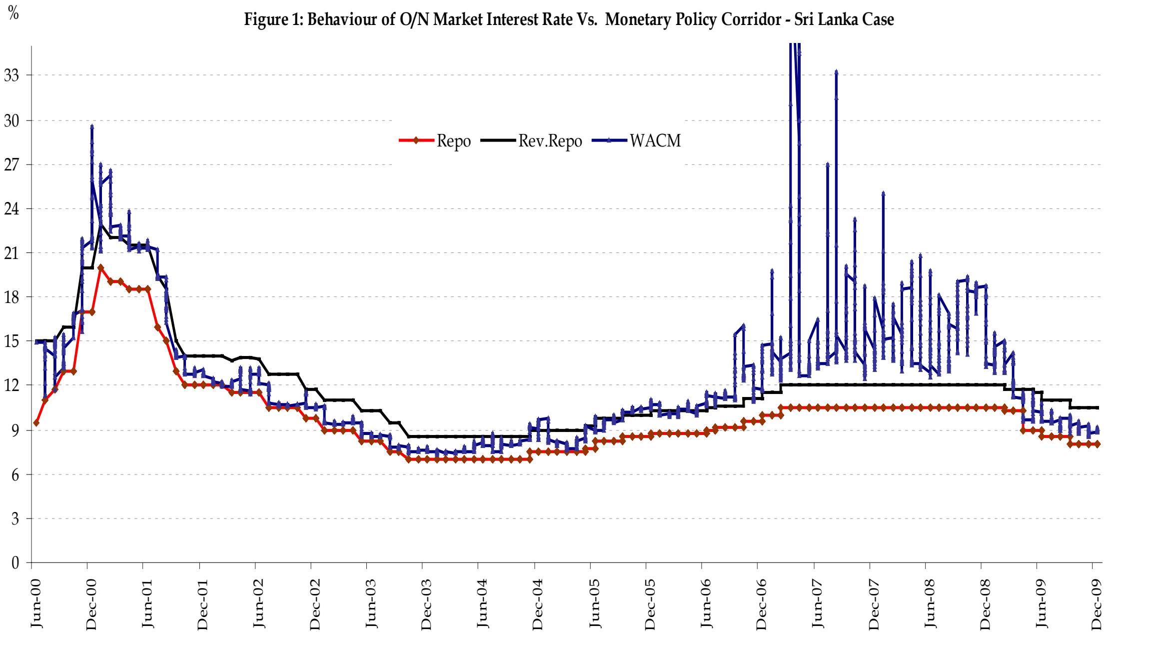
also required for the appointment of the non-executive Board members. The term of office of the Governor and the non -executive Board members is six (6) years.

[16] The periods of economic instability is usually recognized by an announcement by a policy authority or by an independent organization. For instance, National Bureau of Economic Research (NBER) of US define a recession in terms of significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales.

recognize periods of economic stability and instability where the period of instability is clearly visible from the departure of WACM from the monetary policy corridor.

Figure 1: Behaviour of O/N Market Interest Rate Vs. Monetary Policy Corridor - Sri Lanka Case



Source: Own calculation by using CBSL macroeconomic data portal.

The methodology identified by equation (12) will enable recognition of stable and unstable economic periods. Such an approach will facilitate testing the hypothesis 3, the MP impact on yield curve under different economic environments, by following the standard model and the model analyzed under a stochastic environment.

The data employed in the study are time series data from Sri Lanka. The monetary policy target instrument, policy corridor in the case of Sri Lanka, repurchase rate (repo) and reverse repurchase rate (reverse repo) data are collected from the CBSL. The overnight interest rate, one-week and one-month interest rates are collected from the Sri Lanka Inter Bank Offered Rates (SLIBOR), online data reporting system of the CBSL reported by the counter party financial institutions (mainly licensed commercial banks). The Treasury bill rates are used for 91 day (3 month), 182 day (6 month) and 364 day (1 year) maturities. The long-term interest rates represent 2, 3 and 5 year Treasury bonds. Both Treasury bill and Treasury bond interest rates are reported by the primary dealer data reporting systems with the Public Debt Department (PDD) of the CBSL.

The frequency of the data is daily. In cases where daily data is not available or not captured the appropriate method of norm to spread them throughout the period on a daily basis is employed. For instance the daily yield rates (interest rates) of Treasury bonds are not regular during the unstable period. In such instances, the last traded Treasury bond daily interest rate is continued till such time data become available.

The overnight interest rate, one-week and one-month interest rates, and Treasury bill interest rates are for the period starting end June 2000 to the end year 2009. The Treasury bond interest rates are for the period beginning August 2000 to the end year 2009. The data gaps in year 2000 are due the formal implementation of the primary dealer data reporting system at the PDD starting August 2000. The time horizon of the study is approximately a decade from mid 2000 to end 2009 where Sri Lanka experienced different economic episodes due to both domestic and international economic developments.

3. Estimates of the monetary policy impact across the market interest rates

Estimates of the standard model by the application of equation (1), bivariate time series model, and by its variant equation (9), assuming a stationary relationship between variations in market interest rates as a function of MP instrument, repurchase and reverse repurchase rates, including its lag and lead under stable and unstable economic conditions are reported in Table 1 and 2, respectively. The OLS approach is used for estimation of the equation (9), a differenced equation, takes care of diagnostics in the form of unit roots to address the stationarity concern of the time series data.

$$\Delta R_{i,t} = a_i + \beta_{1,i}\Delta R_{0,t} + \beta_{2,i}\Delta R_{0,t-1} + \beta_{3,i}\Delta R_{0,t+1} + \Gamma\Delta R_{i,t-1} + \varepsilon_t -\!-\!-\!-\!-\!-(9)$$

The Table 1 presents the estimation results of the equation (9) for the stable economic condition. As the CBSL follows a policy corridor, at times of economic stability the MP instrument which guide the market interest rates is the “floor” interest rate of the policy corridor, repurchase rate.

Accordingly, at times of stable economic conditions, the MP impact on market interest rates (yield curve) separated for repurchase rate alone , estimated by β_1 , in Sri Lanka over the time horizon of 2000-2009 does not reflect the monotonically decreasing pattern over the time to maturity. Also, the β_1 does not appear statistically or quantitatively significant. In mature financial markets, MP impact on yield curve shows monotonically decreasing pattern over the time to maturity and parameter values show statistical and quantitative significance (Oda and Ueda; 2005, pp. 15-18; Drakos; 2001, pp. 248-250; Kuttner; 2001, p. 526; Cook and Hahn, 1989, 340-345). However, once both lag and lead parameter values accommodated with the repurchase rate, $\beta_1 + \beta_2 + \beta_3$, MP exert a reasonable quantitative impact and monotonically decreasing pattern emerges with few kinks across the market interest rates. Apart from money market and Treasury bill maturities, few Treasury bond maturities respond quantitatively significant proportions with kinks across the MP impact curve. These findings are in accordance, in approximation, with central banking and stylized facts where MP remains conservative at times of economic stability but differentiated in the form of segmented impact across the yield curve in the case of Sri Lanka compared with mature financial markets.

Table 1: Monetary Policy Impact Across Market Interest Rates-
Sri Lanka Case Under Stable Economic Condition

Maturity/ Parameter Values	β_1	β_2	β_3	β_4	α	Observations
O/N	-0.02	-0.06	0.02	-0.01	-0.02*	1321
	(0.24)	(0.19)	(0.13)	(0.12)	(0.01)	
Weekly	0.05	0.09	0.05	-0.01	-0.01**	1321
	(0.17)	(0.13)	(0.05)	(0.10)	(0.01)	
Monthly	0.13	0.08	0.03	0.05	-0.01**	1321
	(0.10)	(0.10)	(0.03)	(0.05)	(0.00)	
Quarterly	0.01	0.00	0.09	0.00	-0.01***	1321
	(0.01)	(0.00)	(0.06)	(0.02)	(0.00)	
Semi Annual	0.01	0.00	0.09	0.01	-0.01***	1321
	(0.01)	(0.00)	(0.07)	(0.03)	(0.00)	
Annual	0.03	0.00	0.07	-0.01**	-0.01***	1321
	(0.02)	(0.00)	(0.08)	(0.00)	(0.00)	
2 Year	0.00	0.00	0.01	0.00	-0.012*	1297
	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	
3 Year	0.00	0.01	0.04	-0.004*	-0.012*	1297
	(0.00)	(0.01)	(0.04)	(0.00)	(0.01)	
5 Year	0.02	0.00	0.19	-0.01	0.00	1297
	(0.01)	(0.00)	(0.18)	(0.01)	(0.01)	

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 2 presents the estimation results of the equation (9) for the unstable economic condition. As the CBSL follows a policy corridor, at times of economic instability the MP instrument which guide the market interest rates is the “cap” interest rate of the policy corridor, reverse repurchase rate.

Table 2: Monetary Policy Impact Across Market Interest Rates-
Sri Lanka Case Under Unstable Economic Condition

Maturity/ Parameter Values	β_1	β_2	β_3	β_4	α	Observations
O/N	0.05	0.24	0.44	0.21*	0.01	975
	(0.12)	(0.15)	(0.37)	(0.11)	(0.05)	
Weekly	0.11*	0.06	0.27	0.19	0.01	975
	(0.06)	(0.09)	(0.27)	(0.16)	(0.03)	
Monthly	0.24***	-0.16**	0.16	0.21	0.01	975

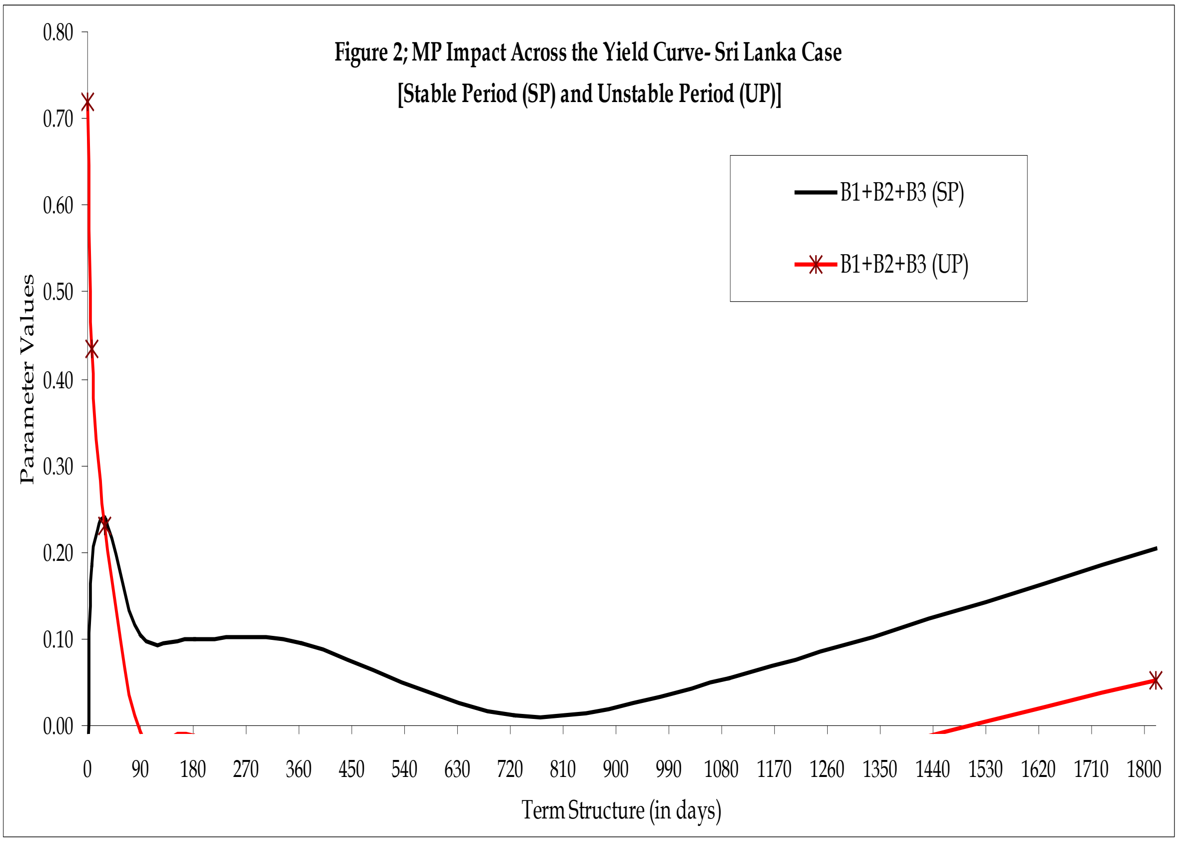
	(0.04)	(0.08)	(0.17)	(0.15)	(0.01)	
Quaterly	0.01	0.01	-0.02	-0.23***	0.02	975
	(0.01)	(0.02)	(0.02)	(0.05)	(0.02)	
Semi Annual	0.00	0.00	-0.02	-0.01**	0.01***	975
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	
Annual	0.01	0.00	-0.11	-0.009**	0.02***	975
	(0.00)	(0.00)	(0.08)	(0.00)	(0.00)	
2 Year	0.06	0.00	-0.10	-0.02	0.01	975
	(0.06)	(0.00)	(0.08)	(0.02)	(0.01)	
3 Year	-0.02	0.01	-0.05	0.00	0.02*	975
	(0.03)	(0.01)	(0.05)	(0.00)	(0.01)	
5 Year	0.03	0.03	0.00	0.02	0.01	975
	(0.03)	(0.03)	(0.00)	(0.10)	(0.01)	

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Accordingly, at times of unstable economic conditions, the MP impact on market interest rates (yield curve) separated for reverse repurchase rate alone, estimated by β_1 , becomes more significant in both quantitative and statistical considerations compared with stable economic period in Sri Lanka. The incorporation of both lag and lead parameter values with reverse repurchase rate, $\beta_1 + \beta_2 + \beta_3$, MP exert a quantitatively significant impact across the market interest rates at the shorter end of the yield curve and speedily waning towards Treasury bill maturities compared against a stable economic period. Also the patterns of impact resemble a monotonically decreasing pattern although the MP impact becomes insignificant beyond 91 day Treasury bill maturities with few segmented impacts reappearing in Treasury bond market interest rates. Analyzing the impact of lag and lead parameters, during the unstable period, the impact of the lead parameter (β_3) becomes quantitatively significant across market interest rates. This is supportive of the market expectation of policy direction or the guidance of future path of interest rates by the central bank at times of unstable economic conditions.

The interpretation of MP impact across the yield curve depends upon the assumption that the changes to the monetary policy targeted instrument cause the changes in market interest rates and not the reverse. In fact it is empirically right that changes in the market interest rates are often followed by the changes in overnight policy interest rates and any factoring of expectations are captured by the lead variable in the regression.

Figure 2 exhibits the MP impact across the yield curve in the parameter values/ term structure (time to maturity) space. The MP impact curve clearly shows the considerably higher impact at the shorter end of the yield curve during the unstable period and wane out at a faster pace by 91 day Treasury bill maturity whereas during the stable period MP impact remain low but steady across short-term money market interest rates and Treasury bill interest rates with few segmented impacts reappear on benchmark Treasury bond maturities of market preference.



Estimates of the stochastic environment address the concern of co-integration. Although the standard model achieves stationarity concern of the time series data by applying differenced equations, the analysis would be suboptimal if the long-term patterns of interest rates data are ignored. Therefore, empirical estimate of the change in MP instrument's impact on market interest rates (yield curve or TSIR) needs to take into account the long-term pattern or the relationships exhibit by the interest rates data at levels. For instance, the figure 3 shows the co-movement of market interest rates in Sri Lanka over the period of this study. It is evident from the figure 3 that the market interest rates exhibit a co-movement.

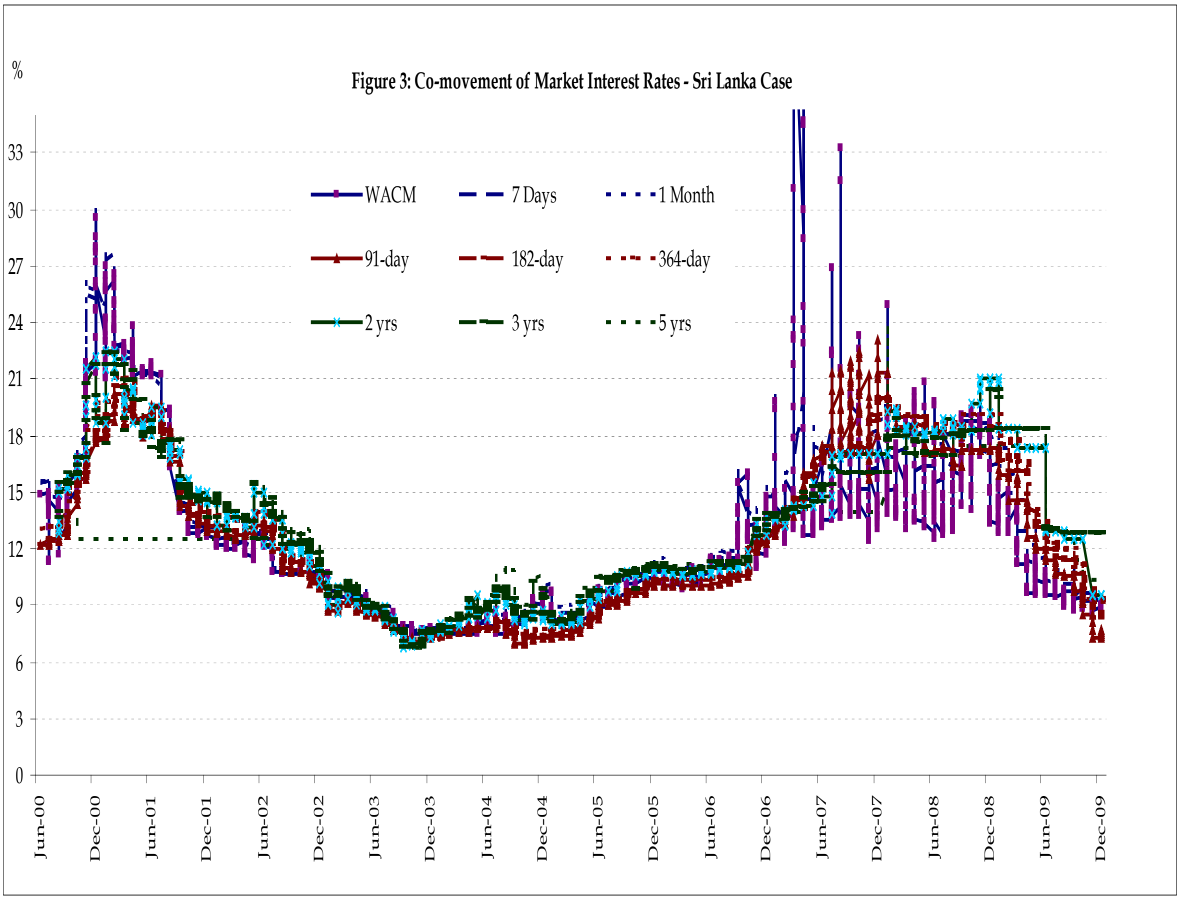


Figure 3: Co-movement of Market Interest Rates - Sri Lanka Case

Source: Own calculation by using CBSL macroeconomic data portal.

The estimation of the stochastic time series data over a period of a decade will be adequate to cover long-run relationships between MP target instruments and market interest rates. Also, the existence of co-integration between interest rates is a pre-requisite under the validity of EH to have MP impact across the market interest rates. In other words, this explains the stationarity condition of any pair of interest rates with the MP target interest rate. This condition is tested by applying the equation (11).

The estimated results based on Johansen test procedure for the stable economic period are presented in the Table 3.

Table 3: Johansen Bivariate Co-integration Output-
Sri Lanka Case Under Stable Economic Condition

Maturity	Null	Unrestricted Co-integration Rank Test (Trace)		Unrestricted Co-integration Rank Test (Maximum Eigenvalue Trace)		Observations
		Trace Statistics	Critical Value	Max-Eigen Statistics	Critical Value	
O/N	None*	51.87926	12.32090	51.36085	11.22480	1295
	At most 1	0.518401	4.129906	0.518401	4.129906	
Weekly	None*	35.50111	12.32090	34.95437	11.22480	1295
	At most 1	0.546743	4.129906	0.546743	4.129906	
Monthly	None*	24.57531	12.32090	23.99598	11.22480	1295
	At most 1	0.579323	4.129906	0.579323	4.129906	
Quarterly	None*	25.53805	12.32090	25.03184	11.22480	1295
	At most 1	0.506211	4.129906	0.506211	4.129906	
Semi Annual	None*	19.42037	12.32090	18.86892	11.22480	1295
	At most 1	0.551454	4.129906	0.551454	4.129906	
Annual	None*	16.85916	12.32090	16.28878	11.22480	1295
	At most 1	0.570386	4.129906	0.570386	4.129906	
2 Year	None	11.77372	12.32090	11.00594	11.22480	1295
	At most 1	0.767782	4.129906	0.767782	4.129906	
3 Year	None	7.937719	12.32090	7.254323	11.22480	1295
	At most 1	0.683396	4.129906	0.683396	4.129906	
5 Year	None	5.698458	12.32090	4.990199	11.22480	1295
	At most 1	0.708259	4.129906	0.708259	4.129906	

The estimation does not include intercept or trend.
* denotes rejection of the null hypothesis (rank= 0) at the 0.05 level

The none condition (rank=0) is rejected in majority of interest rate pairs except in Treasury bond interest rates supporting co-integration between MP interest rate, $R_{o,t}$, and the market interest rates, $R_{i,t}$, under the stable economic period. The existence of co-integration implies that the MP impacts the market interest rates in line with hypothesis (1) both statistically and quantitatively. The hypothesis (2) also tested by applying normalised co-integration vectors to see the quantitative impact of MP across the market interest rates. The estimated results of normalised co-integration vectors for the stable economic period are presented in the Table 4.

Table 4: Normalised Co-integration Vectors-
Sri Lanka Case Under Stable Economic Condition

Maturity	Co-integration Vector (1-B)	Standard Errors
O/N	(1, -0.90422)	(0.00694)
Weekly	(1, -0.873831)	(0.00900)
Monthly	(1, -0.858932)	(0.01238)
Quaterly	(1, -0.923465)	(0.01628)
Semi Annual	(1, -0.904006)	(0.02244)
Annual	(1, -0.885147)	(0.02517)
2 Year	(1, -0.839284)	(0.03699)
3 Year	(1, -0.81265)	(0.05126)
5 Year	(1, -0.868806)	(0.09580)

According to normalised co-integration vectors, symmetry condition (1, -1) is not satisfied supporting breakdown of EH. Another interesting observation is the point estimates of MP impact on market interest rates. The estimated MP impact, though not unity, shows closet to unity at shorter end of the yield curve and remains fairly stable across overnight money market and 6 month (semi annual) Treasury bill maturity. The estimated MP impact declines as the yield curve approach Treasury bond maturities with a skew at 5 year Treasury bond. The patterns of MP impact analyzed resemble similarity to the case of standard model estimated under the equation (9).

How about the MP impact across market interest rates at times of unstable economic conditions under the stochastic environment? The estimates are summarized in Table 5.

Table 5: Johansen Bivariate Co-integration Output-
Sri Lanka Case Under Unstable Economic Condition

Maturity	Null	Unrestricted Co-integration Rank Test (Trace)		Unrestricted Co-integration Rank Test (Maximum Eigenvalue Trace)		Observations
		Trace Statistics	Critical Value	Max-Eigen Statistics	Critical Value	
O/N	None*	59.52780	12.32090	58.64751	11.22480	970
	At most 1	0.880293	4.129906	0.880293	4.129906	
Weekly	None*	27.67645	12.32090	26.84813	11.22480	970
	At most 1	0.828322	4.129906	0.828322	4.129906	
Monthly	None	10.08492	12.32090	9.534126	11.22480	970
	At most 1	0.550792	4.129906	0.550792	4.129906	
Quaterly	None	4.362020	12.32090	4.361973	11.22480	970
	At most 1	4.65E-05	4.129906	4.65E-05	4.129906	
Semi Annual	None	2.836728	12.32090	2.828191	11.22480	970
	At most 1	0.008537	4.129906	0.008537	4.129906	
Annual	None	3.181850	12.32090	3.149393	11.22480	970
	At most 1	0.032457	4.129906	0.032457	4.129906	
2 Year	None	4.281725	12.32090	4.279143	11.22480	970
	At most 1	0.002582	4.129906	0.002582	4.129906	
3 Year	None	5.056681	12.32090	5.055793	11.22480	970
	At most 1	0.000888	4.129906	0.000888	4.129906	
5 Year	None	4.401409	12.32090	4.392611	11.22480	970
	At most 1	0.008798	4.129906	0.008798	4.129906	

The estimation does not include intercept or trend.
* denotes rejection of the null hypothesis (rank= 0) at the 0.05 level

The none condition (rank=0) is not dismissed in majority of interest rate pairs except in the very shorter end of the yield curve. This supports the co-integration between MP interest rate, $R_{o,t}$, and the market interest rates, $R_{i,t}$, at the very shorter end of the yield curve at times of unstable economic conditions and the co-integration among interest rate pairs weaken at a faster pace there onwards across the yield curve. In fact, the co-integration appears only up to less than one month maturity in the market interest rates. The existence of no co-integration implies that the MP impact has considerably weakened when tested for hypothesis (1). The hypothesis (2) also tested by applying normalised co-integration vectors to see the quantitative impact of MP across the market interest rates. The estimated results of normalised co-integration vectors for the unstable economic period are presented in the Table 6.

Table 6: Normalised Co-integration Vectors-
Sri Lanka Case Under Unstable Economic Condition

Maturity	Co-integration Vector (1-B)	Standard errors
O/N	(1, -0.840959)	(0.01824)
Weekly	(1, -0.78666)	(0.02384)
Monthly	(1, -0.742867)	(0.03914)
Quaterly	(1, -0.694521)	(0.10959)
Semi Annual	(1, -0.707871)	(0.12831)
Annual	(1, -0.713717)	(0.11429)
2 Year	(1, -0.743746)	(0.08367)
3 Year	(1, -0.770696)	(0.07089)
5 Year	(1, -0.825789)	(0.13302)

According to normalised co-integration vectors, symmetry condition (1, -1) is not satisfied supporting weaker EH. The estimated MP impact is farther away from unity compared with stable economic period. The point estimates also appear to weaken at a faster pace across maturities with few segmented points of benchmark maturities on the yield curve.

6. Conclusion

The study explored a number of questions of MP impact on yield curve or TSIR across stable and unstable economic environments in an emerging market, Sri Lanka, perspective. In specific sense, the study explored the impact of overnight MP target interest rate on medium to long-term market interest rates from an outside the standard -deep, liquid and matured financial market- market perspective and studied the impact at different economic horizons.

The empirical evidence for Sri Lanka suggests that MP impacts the whole spectrum of maturities but impact weakens as the time to maturity increases under both the standard model and under the stochastic environment. Also, the MP impact weakens across the length (maturity) but becomes significant towards very short-term of the yield curve at times of unstable economic condition defined in terms of behavior of market interest rates. Another interesting finding is the existence of preferred market maturities in Sri Lanka showing segmented impact of the MP against the standard pattern of impact seen in advanced financial markets. When tested for parallel shifts in the yield curve for MP changes (EH), MP impacts the yield curve to shift but not in parallel. The high magnitude impact at the short-end of the yield curve does not support the primacy of EH in explaining the MP impact across market interest rates tested under standard form and through analysis of co-integration in Sri Lanka. The study does not attempt to de-strand the sources which make MP impact to weaken across the maturity and at times of economic instability. Indirect identification suggests structural weaknesses in financial market and MP transmission mechanism.

The findings differ in terms of magnitude of the MP impact across the yield curve at stable and unstable economic periods, monotonically decreasing pattern of the impact and existence of preferred maturities which makes MP impact to be segmented across the yield curve compared with advanced financial markets.

Regarding the MP options, as policy considerations, the study enables rethinking the existing modus operandi of the MP and favor addressing concerns of resurrecting economic activities, in particular at times of economic uncertainty, by exploring segmented market hypothesis and preferred habitat hypothesis of yield curve behavior. The segmented MP impact across the yield curve observed support series of preference zones; in terms of maturity this could be aligned into the policy direction by policy authorities' participation in the market or by cushioning uncertainty among market participants. The preferred habitat view also could be explored by adequately compensating market participants to position them across maturities instead of sharp swings in risk premium across term structure which makes investors flock around short end of the yield curve.

References:

Aazim, Mohamed Z. M. (2009). Japan's Debt Volcano and its Structural Weaknesses. *Political Economy Journal of India, 18* (3 & 4), 65-76.

Balduzzi, P., Bertola, F., Silverio & Klapper, L. (1998). Interest Rate Targeting and the Dynamics of Short Term Rates. *Journal of Money, Credit and Banking, 30,* 26-50.

Bates, S. & Vaugirard, V. (September 2009). Monetary Transmission Channels around the Subprime Crisis: The US Experience. *Global Economy & Finance Journal, 2* (2), 138-156.

Bernanke, B., & Blinder, A. (1992). The Federal Funds Rate and Channels of Monetary Transmission. *American Economic Review, 82* (4), 901-921.

Bindseil, U. (2004). *Monetary Policy Implementation: Theory, Past and Present.* New York: Oxford University Press.

Board of Governors of the Federal Reserve System (FRB), Federal Open Market Committee (FOMC). (September 2009). . *Minutes,* .

Buttiglione, L., Giovane, Del, Q. & Tristani, O. (1998). *Monetary Policy Actions and the Term Structure of Interest Rates: A Cross-Country Analysis.* : In: Angeloni, I., Rovelli, R. (Eds.) Macmillan Press.

Campbell, J.Y. & Shiller, R.J. (May 1991). Yield Spreads and Interest Rate Movements: A Bird's Eye View. *Review of Economic Studies*, *58* (3), 495-514.

Calomiris, C. (2008). The Subprime Crisis: What's Old, What's New, and What's Next?. *Federal Reserve of Kansas City Colloquium on "Maintaining financial stability in a changing financial system"*, Jackson Hole, Wyoming, 21-22 August.

Central Bank of Sri Lanka (a), *Annual Report*, Various Issues, Colombo: CBSL Press.

Central Bank of Sri Lanka (b), *Review of External Sector Developments*, Various Press Releases, Colombo.

Cook, T. & Hahn, T. (1989). The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s. *Journal of Monetary Economics*, *24* 331-351.

Cox, J.C., Ingersol, J.E. & Ross, S.A. (Mar. 1985). A Theory of the Term Structure of Interest Rates. *Econometrica*, *53* (2), 385-407.

Drakos, K. (2002). A Daily View of the Term Structure Dynamics: Some International Evidence. *De Economist*, *150* (1), 41-52.

Drakos, K. (2001). Monetary Policy and the Yield Curve in an Emerging Market: the Greek Case. *Emerging Markets Review, 2* (2001), 244-262.

Duma, N. (2008). Pass-Through of External Shocks to Inflation in Sri Lanka. *International Monetary Fund Working Paper, 08* (78).

Estrella, A. & Mishkin, F. (1996). The Yield Curve as a Predictor of U.S. Recessions. *Current Issues in Economic and Finance*, Federal Reserve Bank of New York, *2* (7).

Federal Reserve Board of Governors' (2009), Minutes, Federal Open Market Committee, September.

Federal Reserve Board of Governors' (2008), Minutes, Federal Open Market Committee, October.

Fitch Rating Agency (2009), Rating Outlook –Sri Lanka. *www.fitchratings.com*

Haldane, A. & Read, V. (2000). Monetary Policy Surprises and Yield Curve. *Bank of England Working Paper, 106* .

Hardouvelis, G. (1994). The Term Structure Spread and Future Changes in Long and Short Rates in the G7 Countries. *Journal of Monetary Economics, 22* 255-283.

Hsu, C. & Kugler, P. (1997). The Revival of the Expectations Hypothesis of the US Term Structure of Interest Rates. *Economic Letters, 55* 115-120.

International Monetary Fund (2009a), World Economic Outlook, April. www.imf.org

International Monetary Fund (2009b), World Economic Outlook, October. www.imf.org

Johansen, S. (1992). Testing Weak Exogeneity and the order of Co-integration in UK Money Demand Data. *Journal of Policy Modelling*, *14* 313-334.

Jondeau, E. & Ricart, R. (1999). The Expectations Hypothesis of the Term Structure: Tests on US, German, French and UK Euro-rates. *Journal of International Money and Finance, 18* 725-750.

Karunasena, A. G. (2005). Development of Government Bond Market with Special Reference to Developing a Yield curve: Experience of Sri Lanka. *Staff Studies*, Central Bank of Sri Lanka, *35* (1 & 2), 93-106.

Kuttner, K. (2001). Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. *Journal of Monetary Economics, 47* 523-544.

Mishkin, F. S. (2009). Is Monetary Policy Effective during Financial Crises?. *National Bureau of Economic Research Working Paper*, (14678).

Mishkin, F. S. (1990). The information in longer maturity term structure about future inflation. *Quarterly Journal of Economics, 105* 815-828.

Obstfeld, M. (2009). Lenders of Last Resort in a Globalized World. *International Conference, Institute for Monetary and Economic Studies*, Bank of Japan, Tokyo, May 27-28.

Oda, N. & Ueda, K. (2005). The Effects of Bank of Japan's Zero Interest Rate Commitment and Quantitative Monetary Easing on the Yield Curve: A Macro Finance-Approach. *Bank of Japan Working Paper Series, 05-E-6.*

Rudebusch, G. (1995). Federal Reserve Interest Rate Targeting, Rational Expectations and the Term Structure. *Journal of Monetary Economics, 35* 245-274.

Sinclair, P. (2005). *The Transmission of Monetary Policy through Interest Rates: Policy Rate Effects on other Interest Rates, Asset Prices, Consumption and Investment.* In Mahadeva, Lavan and Sinclair (Eds.), How Monetary Policy Works (pp.5-49): Oxon: Routledge.

Smets, F. & Tsatsaronis, K. (1997). Why does the Yield Curve Predict Economic Activity? Dissecting the Evidence for Germany and the United States. *Bank for International Settlements Working Paper, 49*.

Taylor, J. B. (2009). The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong. *National Bureau of Economic Research Working Paper,* (14631).

The Standard & Poor's Rating Services (2009), Sovereign Rating Review-Sri Lanka. www.standardandpoors.com

Thornton, D. L. (2004). Testing the Expectation Hypothesis: Some New Evidence for Japan . *Federal Reserve Bank of St. Louis Review, 86* (5), 21-39., September/October.

Thornton, D. L. (2000). Lifting the Veil of Secrecy from Monetary Policy: Evidence from the Fed's Early Discount Rate Policy . *Journal Money Credit Banking, 32* (2), 155-167.

Walsh, E. C. (2003). *Monetary Theory and Policy, Second Edition.* : Massachusetts Institute of Technology.