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For all correspondence about the Staff Studies Journal, please contact:

Director of Economic Research
Central Bank of Sri Lanka
30, Janadhipathi Mawatha
Colombo 01, Sri Lanka
Email: directorerd@cbsl.lk

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Investigating Factors Affecting the Target Level of Inflation: The Case of Sri Lanka[1]

P.K.G. Harischandra, S. Jegajeevan, L.R.C. Pathberiya, M.M.J.D. Maheepala, K.D. Pathirage, H.K.D.S.M. Perera

Abstract

Sri Lanka formally adopted a Flexible Inflation Targeting (FIT) monetary policy framework in 2020. Along with this transition, the target level of inflation has become a focal point for implementing FIT. This policy paper discusses several considerations when selecting a target for inflation in the context of Sri Lanka, such as the choice between headline and core inflation and the choice of the price index. It undertakes several descriptive and empirical analyses to arrive at the possible numerical value(s) of the target (or range). The results of these analyses suggest a point target for the Colombo Consumer Price Index (CCPI)-based year-on-year headline inflation at 5 per cent, with a margin of ±2 percentage points to be suitable for Sri Lanka for considering operationalisation of FIT under the Central Bank of Sri Lanka Act No. 16 of 2023 (CBA).[2] This exercise should be repeated periodically to assess whether the inflation target under the Monetary Policy Framework Agreement needs to be revised, especially as economic conditions continue to evolve.

Keywords: *Flexible Inflation Targeting, Headline Inflation, Monetary Policy Framework*

JEL Classification: *E31, E52, E58, E63*

[1] This analysis was originally conducted in September 2023 with the primary objective of identifying the most appropriate inflation measure and target parameters for Sri Lanka under the Flexible Inflation Targeting (FIT) framework. The study aimed to support the Central Bank of Sri Lanka in preparing its proposal to the Government for setting the initial inflation target, as required for the signing of the first Monetary Policy Framework Agreement (MPFA) under the Central Bank of Sri Lanka Act, No. 16 of 2023 (CBA). The technical analyses contained herein reflect the assessments of the authors, and they do not necessarily indicate the views of the Central Bank of Sri Lanka.

[2] In line with these suggestions, the Monetary Policy Framework Agreement (MPFA) signed between the Minister of Finance and the Central Bank of Sri Lanka on 03 October 2023 mandates the Central Bank to maintain quarterly headline inflation, as measured by the CCPI, at a rate of 5 per cent. If the Central Bank fails to meet the inflation target of 5 per cent by a margin of ±2 percentage points, as set out in the MPFA, for two consecutive quarters, the Monetary Policy Board of the Central Bank should submit a report to the Parliament through the Minister of Finance.

1. Introduction

Central banks across the globe are responsible for executing monetary policy with varied degrees of independence to maintain low and stable inflation. They use a variety of monetary policy frameworks to achieve their goal of price stability, using the policy tools at their disposal. Sri Lanka's monetary policy framework has evolved dramatically since its initial currency board setup before the establishment of the Central Bank of Sri Lanka in 1950 (Weerasinghe, 2018). Sri Lanka predominantly had a fixed exchange rate regime from 1950 to 1977, initially pegging the value of the Sri Lankan rupee to the British pound and later to the US dollar. During this period, there was no need for a particular monetary anchor to control inflation because domestic and foreign inflation were closely related. Following the abandonment of the fixed exchange rate regime in 1977, and with the adoption of a managed floating exchange rate regime, interest rates and monetary aggregates became more important. Thus, Sri Lanka implemented a monetary aggregate targeting framework for monetary policy in the early 1980s. Nevertheless, with the increasing volatility in the money multiplier and money velocity, along with the weakening of the correlation and causation between money supply and inflation, the effectiveness of the monetary target as a nominal anchor became uncertain. This also led the Central Bank's communication strategy to become quite intricate, prompting the need to explore a more suitable monetary policy framework. In the early 2000s, the Central Bank commenced a monetary policy modernisation process, while engaging in research and analysis on the new framework. As an interim arrangement, the Central Bank implemented monetary policy within an enhanced monetary policy framework that features both monetary targeting and Flexible Inflation Targeting (FIT) since 2015. In parallel, the preparatory work concerning the adoption of FIT, mainly legislative amendments, capacity building on modelling and forecasting, and internal process improvements, continued.

In 2020, the Central Bank officially adopted the FIT framework for conducting monetary policy. This framework's primary objective was to maintain inflation within the range of 4-6 per cent, over the medium term, while also facilitating the realisation of the economy's full potential. Yet, the FIT framework had not been formally recognised and agreed upon with the then Government and necessary legal provisions for the fulfilment of the key prerequisites of the FIT framework were not enacted. However, with the enactment of the Central Bank of Sri Lanka Act, No. 16 of 2023 (CBA), in September 2023, FIT was statutorily recognised as the monetary policy framework in Sri Lanka (Section 11 of the CBA). Moreover, Section 26(5) of the CBA mandates that the Central Bank submit a report to the Parliament through the Minister of Finance, if the Central Bank fails to meet the inflation target by a specified margin for two consecutive quarters. This report must outline the reasons for the failure to achieve the inflation target, the remedial actions proposed to be taken by the Central Bank, and an estimate of the time period within which the inflation target shall be achieved.

An explicit inflation target would provide more specificity to the price stability objective, enhancing transparency and accountability for monetary policy. The Central Bank needs to be aware of the current rate of inflation and its projected path to decide on appropriate policy actions to achieve the price stability objective in line with the operationalisation of the FIT framework. Inflation refers to the increase in the general price level of an economy. It is commonly measured using indicators, such as the Consumer Price Index (CPI), the Gross Domestic Product (GDP) deflator, and the Producer Price Index (PPI), among others. In Sri Lanka, the generally accepted method of measuring inflation by the Central Bank and most economic stakeholders is to consider the year-on-year change of the CPI, compiled by the

Department of Census and Statistics (DCS). The DCS compiles two consumer price indices, namely, the Colombo Consumer Price Index (CCPI) and the National Consumer Price Index (NCPI). The NCPI captures island-wide price movements, whereas the CCPI captures price movements in the urban areas of the Colombo district. The weights of the items included in the baskets of these indices vary, reflecting the consumption patterns of the respective consumer groups. The change in overall CPI is generally considered as headline inflation. In contrast, core inflation measures the underlying inflation by excluding highly volatile items in the CPI basket (such as volatile food and energy sub-categories).

When there are multiple indices that can be used to measure changes in price levels, choosing one index for monetary policy considerations becomes a challenge. When choosing such an index as a target, it is important to consider factors such as how accurately the index captures the cost of living, its volatility, predictability, persistence, correlation with inflation expectations, timeliness of data releases, and index continuity. Accordingly, when it comes to deciding on an inflation target in the Sri Lankan context, several important parameters need to be considered, including:

I. the choice between headline inflation vs core inflation,
II. the choice of the price index (CCPI vs NCPI),
III. the numerical inflation target (point vs a range target),
IV. specific considerations when measuring deviations from the inflation target, and
V. the time period during which inflation is expected to reach the target in response to policy actions.

This paper presents the important considerations that were taken into account when deciding on the inflation target, as established in the first Monetary Policy Framework Agreement (MPFA), signed between the Central Bank and the Minister of Finance on 03 October 2023.[3] Section 2 provides some background on various contributions in the literature relevant to the discussion of a target level of inflation, while Section 3 illustrates selected details of the statistical methodologies utilised. Meanwhile, each of the above-discussed parameters is discussed in Section 4, and Section 5 provides concluding remarks.

2. Related Literature and Theoretical Underpinnings

The effectiveness of Inflation Targeting (IT) policies depends significantly on a country's prevailing economic conditions and institutional framework. Therefore, it is important to periodically review research to better understand the complexities of IT and its implications for macroeconomic stability and growth. In the context of Sri Lanka, earlier studies have proposed various inflation targets. Jayamaha *et al.*, (2002) suggest a 7 per cent target with a band of ±1.5 percentage points (pp) and a minimum two-year target horizon. Perera (2010) recommends a 10 per cent target range with a wider band based on the historical experiences. The author also emphasised the use of core inflation, excluding administered prices, seasonal food price fluctuations, terms of trade effects, and indirect taxes, as a more stable measure in the early stages of IT adoption. Once credibility is established, the author proposed transitioning to headline inflation, which is more visible and better aligned with public expectations.

[3] The MPFA is available for public access via the Extraordinary Gazette No. 2352/20.

Nevertheless, since 2009, in the post-war period, Sri Lanka experienced a period of single-digit inflation, along with an improved monetary policy framework. The average inflation of the aforementioned period is around 5 per cent. In 2019, an initial assessment by the Central Bank of Sri Lanka has concluded that "headline inflation based on an urban consumer price index, targeting mid-single digit level inflation with a reasonably wide tolerance band over a target horizon of 2-3 years, which is jointly decided by both the Government and the Central Bank would be appropriate for Sri Lanka" (Central Bank of Sri Lanka, 2019). Given the evolving economic landscape and the changes in past recommendations, further research is essential to determine an inflation target that reflects current realities. Especially under the FIT framework, the endeavour is to stabilise inflation around the targeted levels while supporting economic growth towards its potential. Therefore, the selection of an appropriate inflation target can be technically determined by assessing the correlation between economic growth and inflation across various inflation thresholds. Numerous research papers explore both theoretical and empirical inquiries regarding the connection between inflation and economic growth. For Sri Lanka, De Silva (2017) and Cooray (2013) identify 9 per cent and 7.4-9.6 per cent range as the inflation thresholds that maximise the per capita GDP growth, respectively. However, these findings need to be revisited due to the introduction of rebased series of consumer price indices and GDP for the subsequent period, and the recent shifts in inflation and growth dynamics. When the question of deciding a target level of inflation is considered, it is imperative to provide due consideration of the most recent behaviour of macro variables. Therefore, updated research is crucial to reassess the inflation threshold and guide the setting of a suitable inflation target.

When the theoretical underpinnings of the relationship between real economic growth and inflation are considered, classical economic theory suggests that inflation is largely a monetary phenomenon. The Quantity Theory of Money and monetarist views suggest that sustained growth cannot occur from monetary activities, but it is rather a result of real factors, i.e., improvements in capital accumulation, increased and efficient allocation of labour, and productivity enhancements. This is the quintessential idea behind the famous statement by Milton Friedman, "*inflation is always and everywhere a monetary phenomenon*" (Friedman, 1970). As per these views, inflation harms growth mainly through distortions such as reducing purchasing power, increasing uncertainty and discouraging long-term investments. Accordingly, policy focus should be to stabilise prices in order to reduce uncertainty and misallocations that depress investment and productivity. Moreover, rational expectations literature suggests that any short-term inflation surprise to spur growth would be short-lived and would lead to higher inflation over the long run. This is explained by the concepts of the *time-inconsistency problem* and *inflation bias*, which mean that when economic agents are rational, they would internalise the possibility of policymakers opting for a short policy easing, i.e., a short inflationary episode, to promote growth when inflation expectations are anchored, leading to de-anchoring of expectations to a higher level over the long run (Kydland and Prescott, 1977; Barro and Gordon, 1983).

On the other hand, Keynesian economic theory suggests that the relationship between economic growth and inflation can vary depending on the specific economic conditions and time frames considered. According to Keynesians, in the short term, the Aggregate Supply (AS) curve slopes upward, signifying that stimulating the demand side of the economy impacts both prices and output. In the short run, Keynesians suggest that there may be a positive relationship between inflation and economic growth. An increase in aggregate demand in the short run, caused by factors such as increased government spending or consumer spending, can result in both higher output (economic growth) and higher prices (inflation).

This is because when demand rises, businesses may respond by expanding production and hiring more workers, driving economic growth. However, if the economy is already operating at or is near its full employment capacity, further increases in demand may result in higher prices rather than increased output. Meanwhile, in the long run, the AS curve becomes vertical. The policy implication of the vertical AS curve is that demand-side policy no longer increases the level of output but only the level of prices. Accordingly, Keynesian theory also converges with the classical thought of long-run monetary neutrality.

Empirically, the relationship between growth and inflation seems to be non-linear. Low to moderate inflation appears consistent with growth, but there seems to be a threshold level of inflation, beyond which growth drops with inflation. Past contributions estimate such threshold levels to be around 2-3 per cent for developed economies, while for developing economies, they are found to be larger, at even 10-20 per cent levels (López-Villavicencio and Mignon, 2011; Kremer, Bick and Nautz, 2013; Eggoh and Khan, 2014). As illustrated earlier in this section with specific examples for Sri Lanka, specific country studies offer varying levels of estimates of these threshold inflation levels. As another country-specific example, different authors find evidence of this threshold level to be around 6-7 per cent in the case of India (see, among others, Ahluwalia (2011), Mohanty *et al.*, (2011), Mohaddes and Raissi (2016), and Rangarajan (2020)).

The past decade has given rise to another perspective on the discussion on possible inflation targets. When neutral real interest rates are at low levels, as observed over the past decade or so in many developed countries, a low inflation target can limit the policy space of central banks to revive the economy. This has given rise to a debate on whether a slightly higher target could provide some increased policy space for central banks. However, it has been noted that increasing an already established target, specifically long-established ones in many developed countries, may not be an easy task (Apel, Armelius and Claussen, 2017). This dialogue becomes even more complicated when considering the fact that policy tools, such as quantitative easing and forward guidance, that were traditionally deemed unconventional, have now become commonplace in many central banks, developed and emerging economies alike. Even though this concern is mainly focused on developed economies that have faced persistently low real interest rates, the takeaways are equally relevant for emerging markets. The lower bound of the policy rate, which is usually zero or close to zero in developed economies, often comes into the picture in this discussion. However, in the case of developing economies, the effective lower bound of the policy rate may be well above zero, due to a multitude of reasons, such as higher inflation expectations, exchange rate vulnerabilities and high risk premia, underdeveloped financial markets and low financial literacy, external debt pressures, higher non-performing loans and financial stability concerns, relatively higher growth potential leading to higher neutral rates, and challenges with respect institutional credibility. Accordingly, the need for sufficient policy space is an equally valid consideration for emerging markets as well when deciding on a target level of inflation.

3. Methodology

In the process of determining a numerical inflation target, historical data and other countries' experiences, both past and present, can be examined. Literature reveals differences between the recommended inflation targets for developing countries and advanced economies. In the case of

advanced economies, there is consensus that an inflation rate within the 1 to 3 per cent range is associated with price stability. Conversely, there is less guidance in the literature on the optimal level of inflation in developing and emerging countries, but the optimal level of inflation in these countries is likely to be higher than in advanced economies due to the Balassa-Samuelson Effect (Hammond, 2012). The Balassa-Samuelson Effect explains the difference in productivity growth in tradable and non-tradable sectors, resulting in higher inflation targets in these countries. Taking inherent measurement problems also into consideration, Škreb (1998) suggests that for emerging and transitioning economies, an inflation rate falling between 4 to 5 per cent to be treated as price stability. When exploring the related literature, the majority of academic papers examine the interplay between GDP growth and inflation, while weighing the feasibility of a target that does not have adverse effects on consumers. Some evidence could be found using technical analyses under several methodologies to determine an appropriate numerical value as an inflation target. Hence, a hybrid approach, combining descriptive analysis that considers historical data trends and the application of time series models, has been used for this purpose (more details are provided in Section 4). Specifically, we use the well-known threshold regression model that has been previously used in Sri Lankan studies as well, as seen in Cooray (2013) and De Silva (2017). With regard to data, inflation and economic growth data have been sourced from the DCS, while the remaining data have been obtained from the Central Bank.

In time series analysis, a threshold model is a statistical framework that characterises how a time series variable behaves under different regimes or states, each defined by a specific threshold or critical value. The fundamental concept behind a threshold model is that the relationship between variables or the statistical characteristics of time series data can undergo sudden or non-linear changes when a particular threshold condition is met. Such models are employed when there is a belief that the data exhibits distinct behaviours before and after surpassing a specific threshold value. Two separate threshold models are considered in this paper, viz., a threshold regression model and a Threshold Vector Auto-Regression (TVAR).

With regard to the threshold regression, following established economic theory and empirical findings of contributions such as Khan and Senhadji (2001), Bhatta (2015), Mosikari and Eita (2018) and Dholakia *et al.*, (2021), the following growth model is employed,

$$\Delta Y = \alpha + \beta_1 \pi + \beta_2 * D.(\pi - \pi^*) + \Theta X + \varepsilon, \tag{1}$$

where ΔY is the GDP growth rate. π is the rate of inflation, $\pi^*$is the threshold rate of inflation, X represents other exogenous variables, and ε is $iid(0, \sigma^2)$. D is a Dummy variable such that $D = 0$ when $\pi \leq \pi^*$and $D = 1$ when $\pi > \pi^*$.

Furthermore, we expand this analysis via a TVAR as well in order to derive further evidence on the inflation threshold limit. We estimate the following three-regime TVAR model as elucidated by Aleem and Lahiani (2014), intending to identify two threshold limits for inflation:

$$\begin{aligned} y_t &= \alpha_1 + A_1(L)y_t + \varepsilon_{1t} \quad if \quad \pi_t \leq \pi_1\,, \\ y_t &= \alpha_2 + A_2(L)y_t + \varepsilon_{2t} \quad if \quad \pi_1 \leq \pi_t \leq \pi_2, \\ y_t &= \alpha_3 + A_3(L)y_t + \varepsilon_{3t} \quad if \quad \pi_t \geq \pi_2, \end{aligned} \tag{2}$$

where y_t is the vector of variables, π_t is the threshold variable and π_1 and π_2 are the threshold values. Lag polynomial $A_i(L)$ is order p and can be represented as $A_{ij}(L) = A_{i1}L + A_{i2}L^2 + \cdots + A_{ip}L^p$, where $i = 1,2$ and 3, and $j = 1,2, \ldots, p$.

Spline regression, a non-parametric statistical method employed in time series analysis, is utilised to model and scrutinise time-dependent data. It is especially valuable when the relationship between variables exhibits intricate, non-linear patterns over time. This technique entails fitting piecewise polynomial functions to the time series data, with these polynomial segments, known as 'splines,' seamlessly connected to form a more flexible and precise representation of the relationship between the variables. Spline regression typically employs low-degree polynomials, such as linear or cubic, within each segment to model the data. In the present analysis, we use cubic smoothing splines, where the degree of smoothness is selected so that the root-mean square error (RMSE) of out-of-sample predictions is minimised, based on evaluating several sub-samples of the full data set. This method produces a smoothed curve that captures the relationship between the two variables of the given sample data set. Unlike standard frequentist regression techniques, this approach does not assume a predefined data-generating process. We repeat the process for quarterly and annual data separately.

4. The Choice of Inflation Target

This section discusses each parameter considered when choosing an appropriate inflation target.

4.1. The Choice Between Headline and Core Inflation

Headline inflation represents the total expenditure in the consumer price index; therefore, it is more representative of the overall behaviour of prices. Core inflation is derived by excluding volatile items such as food, energy, and transport components from the overall consumer price basket to gauge underlying inflation in the economy. Many inflation-targeting countries use headline inflation as their target (Table 01), primarily because it is easy to communicate to the public and serves as a more effective anchor for inflation expectations. While core inflation is less volatile and more responsive to monetary policy, headline inflation is more widely recognised by the public, who play a key role in shaping inflation expectations. Moreover, in emerging and developing economies, the consumption baskets have a sizeable weight on food items. Since a large portion of that is eliminated in arriving at the core inflation, it lacks credibility among the public. Empirical evidence also suggests that headline inflation is more suitable as a target index than core inflation, as it has a stronger relationship with inflation expectations influenced by sensible linkages with wages and social security payments. In the case of Sri Lanka also, the outcomes of the Inflation Expectations Survey confirm that inflation expectations are more aligned with headline inflation than core inflation. It is noteworthy that while some central banks initially adopted core inflation as their inflation target, many have since transitioned to headline inflation as the key target of monetary policy. For example, the Bank of Thailand selected core inflation as its inflation target when it introduced inflation targeting in 2000, but it shifted to headline inflation in 2015 to enhance communication with the public and to strengthen the effectiveness of monetary policy in anchoring long-term inflation expectations. In light of such experiences, it is suggested that headline inflation be

considered the targeted index for monetary policy. Nevertheless, core inflation remains an important indicator and should continue to be closely monitored in the formulation of monetary policy decisions.

Table 01: Inflation Metrics of Selected Economies[a]

	Country	Date Adopted	Target Measure	Initial Target	Current Target	Target Type	Average Target[b]	
							Initial	Current
Developed Countries	**Australia**	Early 1990s	Headline	2.00% - 3.00%	2.00% - 3.00%	Range	**3.1%**	**2.2%**
	Canada	1991	Headline	2.00% +/- 1.0 pp	2.00% +/- 1.0 pp	P+T		
	Czech Republic	1998	Headline	5.50-6.50%	2.00% +/- 1.0 pp	P+T		
	Euro Area	1999	Headline	Below 2.00%	2.00%	P		
	Hungary	2001	Headline	7.00%	3.00% +/- 1 pp	P+T		
	Japan	2013	Headline	2.00%	2.00%	p		
	New Zealand	1990	Headline	0.00-2.00%	2.00% +/- 1.0 pp	P+T		
	United Kingdom	1992	Headline	1.00-4.00%	2.00%	P		
Emerging Economies	**Brazil**	1999	Headline	8.00% +/- 2.0 pp	3.00% +/- 1.5 pp	P+T	**4.5%**	**3.3%**
	Chile	1999	Headline	3.00%+/-1.0 pp	3.00%+/-1.0 pp	P+T		
	Georgia	2009	Headline	3.00%	3.00%	P		
	India	2016	Headline	4.00% +/- 2 pp	4.00% +/- 2 pp	P+T		
	Indonesia	2005	Headline	6.0% +/- 1 pp	2.5% +/- 1 pp	P+T		
	Mongolia	2007	Headline	5.00%	6.00% +/- 2.0 pp	P+T		
	Philippines	2002	Headline	4.5-5.5%	2.00%-4.00%	P+T		
	Thailand	2000	Headline[c]	1.00% - 3.00%	1.00% - 3.00%	Range		

Source: Respective Central Banks

(a) The midpoint of each target, including ranges, was considered when calculating the average.
(b) Thailand shifted to target headline inflation from core inflation in 2015.
P: Point, T: Tolerance band, pp: percentage points

4.2. The Choice of the Price Index: NCPI and CCPI

When considering other measures that can be used to measure inflation, such as the GDP deflator, producer price indices, etc., using a consumer price index is advised because of its relevance to the general price levels in the market. Moreover, availability with a higher frequency, a long-established regular publishing calendar, and familiarity among most economic stakeholders also support consideration of a price index, rather than, say, an indicator like GDP deflator.

The DCS compiles two consumer price indices, the NCPI and the CCPI, which differ primarily in their geographical coverage. The NCPI covers the entire island, whereas the CCPI covers urban areas in the Colombo district.

Table 02: CCPI Vs. NCPI

Characteristic	CCPI (2021=100)	NCPI (2021=100)
Geographical Coverage	Urban areas of the Colombo district	All provinces in Sri Lanka
Target Household Units	All households in urban areas of the Colombo district	All households in each province
Average Size of the Household Unit	3.8	3.7
Average Monthly Consumption Expenditure in the Base Period	Rs. 91,880.34	Rs. 50,728.60
Value of One Index Point	Rs. 918.80	Rs. 507.29
Total Number of Items	426	485
Percentage of Total Weight		
i. Food	26.23	39.22
ii. Non-Food	73.77	60.78
Date of Release	Last working day of each month	Released with a time lag of 21 days
Price Collection Centres	10	03 price collecting outlets in each District town for each item

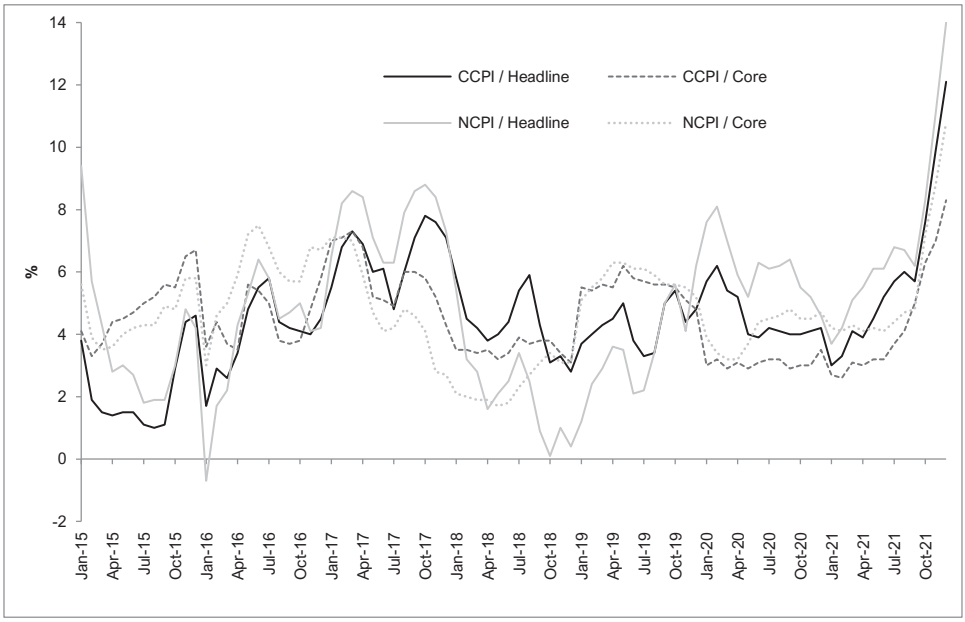
Source: Department of Census and Statistics

Apart from the geographical coverage, the share of food items and the consumption of domestically sourced commodities are other key diverging factors between the NCPI and the CCPI. The share of food items in the NCPI is larger than that of the CCPI. At the same time, the consumer expenditure and behaviour patterns at the national level could be relatively more biased towards domestically sourced items. On the other hand, when compared to their rural counterparts, urban consumers spend relatively more on non-food categories. Further, the NCPI may not adequately cover market price movements, as the rural households tend to substitute market-based products with products produced by themselves. Therefore, an urban price index, such as the CCPI, could better reflect overall changes in market prices. Meanwhile, the CCPI represents inflation dynamics in urban areas in Colombo, and therefore, it could be more indicative of overall economic conditions, given the fact that economic activity is also largely concentrated in urban areas in Colombo. Moreover, the CCPI has a longer time series commencing from January 1953 on different base years, compared to the NCPI, which commenced in January 2014. Therefore, expenditure patterns could be better examined with the CCPI, and the relatively longer sample makes economic analyses and forecasts more accurate. This is a key consideration when selecting an index for monetary policy purposes, given the considerable importance of projections in a FIT framework.

Further, since the NCPI places a greater emphasis on the food basket (around 40 per cent), it is more vulnerable to supply shocks and less responsive to monetary policy. The NCPI broadly follows the trend observed in the CCPI, but is relatively more volatile, reflecting the movements of transitory supply conditions. Hence, the controllability of the measure is somewhat lower compared to the CCPI. Moreover, as the NCPI is released with a time lag of 21 days, it would have implications for the forecasting process during the monetary policy cycles. Inflation expectations, as measured by the Central

Bank's Inflation Expectations Survey, are perceived to be largely driven by realised inflation, thus reflecting an adaptive expectations formation. Nevertheless, the correlation between inflation expectations and realised inflation also seems to be higher for the CCPI than for the NCPI.

Figure 01: Year-on-Year Inflation (2015-2021)[a]



Source: Department of Census and Statistics

(a) The chart starts from 2015 since the year-on-year changes of NCPI become available only after this period. Data after 2021 is not displayed to better highlight the dynamics of inflation during normal times. Inflation dynamics changed drastically since the onset of the historic economic crisis in 2022 and the aftermath, with sharp disinflation and subsequent deflation. Including these data points would lead to counterintuitive inferences. Data from the 2013=100 base year series are used for this analysis.

Table 03: Average Year-on-Year Inflation and its Volatility During 2015-2021[a]

	CCPI / Headline	CCPI / Core	NCPI / Headline	NCPI / Core
Average Inflation (%)	4.6	4.5	4.9	4.7
Standard Deviation (%)	1.9	1.3	2.6	1.6

Sources: Department of Census and Statistics, Central Bank Staff Calculations

(a) Data during 2015-2021 are considered to enable comparison between the NCPI and the CCPI, where the former commenced only from 2014 onwards, and to exclude the extraordinary inflation episode during 2022-2023. Data from the 2013=100 base year series are used in this analysis.

Table 04: Correlation[(a)] Between Inflation Expectations[(b)] and Realised Inflation (2016-2021)

	Current Month (1 Month Ahead) Expectation	3 Months Ahead Expectation	6 Months Ahead Expectation	12 Months Ahead Expectation
CCPI / Headline	0.81	0.55	0.52	0.25
NCPI / Headline	0.72	0.50	0.48	0.19

Sources: Department of Census and Statistics, Central Bank of Sri Lanka

(a) Correlations are calculated with expected inflation of the corporate sector and corresponding realised year-on-year inflation (2013=100) at the given time horizon.
(b) As measured in the Inflation Expectations Survey conducted by the Statistics Department.

Therefore, given its low volatility and less susceptibility to supply factors, the availability of data for a longer period, and shorter publication lag, the CCPI may be more suitable than the NCPI as the targeted measure of inflation for monetary policy purposes.

Nevertheless, as the economy progresses, regional disparities may lessen, enhancing the relevance of the NCPI due to its broader geographical coverage. Further, with time, the predictability of the NCPI could improve with more data availability and reduced publication lag. At such a stage of development, the Central Bank could reconsider revisiting the use of the NCPI as a potential target for monetary policy.

4.3. The Choice of the Target: "Range" Vs. "Point with Tolerance margin" Vs. "Point"

The inflation target can be defined in several ways (a range target, a point target with tolerance margin, or a point target). Compared to a range target, a point target with a tolerance margin could imply a firm commitment to achieving the targeted level of inflation. This can improve the credibility of the respective central bank and enable better anchoring of inflation expectations. As a result, many inflation-targeting central banks use either a point target or a point target with a tolerance margin (Table 01). For a developing country, a point target without a tolerance margin may also be less desirable, as headline inflation is usually subject to transitory supply shocks, which can lead inflation to deviate from the target frequently. If an adequate tolerance band is not considered, possible frequent 'target misses' could undermine central bank credibility and, in turn, affect the anchoring of inflation expectations.

Specifically for the case of Sri Lanka, the CBA requires the Central Bank to submit a report to the Parliament if it fails to meet the inflation target by a margin specified under the Monetary Policy Framework Agreement. This provision affirms the importance of adopting a point target accompanied by an acceptable tolerance margin in the CBA. Accordingly, a point target, with a defined tolerance margin to measure the breach of the target, is recommended for Sri Lanka, in contrast to the range target (4-6%), considered prior to the enactment of the CBA.

4.4. The Numerical Value of the Inflation Target

The appropriate level of the inflation target for a country depends on various factors, including the country's economic conditions, policy objectives, and institutional framework. Key considerations in determining an inflation target include the country's overall economic goals, need for policy flexibility, historical and institutional context, inflation expectations, real interest rate trends, international trade and

competitiveness, structural characteristics of the economy, and the need for the target to evolve and adapt over time.

In countries where inflation is particularly sensitive to external, as well as domestic shocks, it may be appropriate to adopt a slightly higher inflation target than those typically set by developed countries. This approach can help establish a credible inflation target that accounts for heightened uncertainty and variability caused by these external factors. A relatively high inflation target provides greater policy flexibility, allowing the central bank more 'room to manoeuvre' in response to sudden fluctuations in exchange rates, commodity prices, other global developments and supply-side volatilities. If a country sets an inflation target that it consistently meets, it builds credibility with the public, businesses, and financial markets, fostering better long-term planning and reducing uncertainty. However, it is essential to strike a careful balance between flexibility and credibility when determining the appropriate level of the inflation target.

For most developed countries, it is common practice to adopt a small positive value as the inflation target. As illustrated in Table 01, developed countries typically set lower inflation targets than developing countries. Based on the statistics published by the World Bank, average annual inflation during 1982-2022 in low- and middle-income countries is more than double that of high-income countries. Similarly, inflation volatility in low- and middle-income countries is nearly twice as high as that of high-income countries (Table 05). Although one could expect inflation volatility to reduce with the adoption of inflation targeting, the higher volatility of inflation in developing nations could also be due to structural characteristics, such as a higher share of food items in the consumer basket, exchange rate volatility, higher susceptibility to oil and commodity price shocks, etc. Knight (2007) highlights the challenges in producing reliable inflation forecasts in emerging economies, which include unpredictable exchange movements, large economic and financial shocks, lack of long time series and the presence of structural changes in the time series estimation. These challenges translate into more forecast errors and inflation target misses. Accordingly, these factors contribute to developing and emerging market countries choosing a relatively higher target than developed countries.

Table 05: Inflation During 1982-2022:
High-Income vs. Low & Middle-Income Countries

	Average Annual Inflation (%)	Standard Deviation of Annual Inflation (%)
High-Income Countries	3.2	1.9
Low-& Middle-Income Countries	7.1	3.7

Source: Authors' Compilation Based on World Bank Data

Measurement errors are also another consideration when deciding the inflation target. Discrepancies between measured inflation and inflation perceived by the public, arising from issues such as low representativeness of the consumer basket and sampling weaknesses, can hinder anchoring of inflation expectations. Since such measurement errors are difficult to eliminate entirely, setting a modest positive inflation target can serve as a buffer against unintended deflation episodes.

Various technical analyses provide valuable insights that should be considered when determining the appropriate inflation target. In the case of Sri Lanka, the following evidence can be considered using technical analyses under several methodologies.

4.4.1. Threshold Inflation Regression

Threshold regression refers to a type of regression analysis that involves modelling a relationship between variables that vary based on certain threshold conditions. It is important to note that threshold regression can be complex and relies on the assumption that the relationship changes at the specified threshold. The choice of the threshold variable and the functional form of the model will significantly impact the results. This approach offers a more data-driven method for establishing an inflation target, considering the interplay between inflation and other key economic indicators at various levels, which could be valuable for countries with inflation-targeting regimes. The regression equation utilised in the analysis, which was described in a generic form in equation *(1),* can be expanded as follows.

$$\Delta Y = \alpha_1 + \beta_1 \pi + \beta_2 * D_i(\pi - \pi^*) + \beta_3 BD + \beta_4 CA + \beta_5 GM2 + \varepsilon \quad (3)$$

In this regression model, if inflation falls below a predefined inflation threshold, the associated dummy variable (D) takes a value of zero, resulting in a relationship between inflation and GDP growth characterised solely by the coefficient of inflation (β_1). However, when inflation exceeds the threshold, the effect of inflation on growth is a combination of the inflation coefficient and the dummy coefficient, summed together$(\beta_1 + \beta_2)$.

According to Hayat and Kalirajan (2009), when conducting regressions with various threshold values, the objective is to identify the threshold value at which a significant structural break occurs, often characterised by a high R-squared value or the lowest sum of squared residuals. Moreover, it is essential that the combined sum of regression coefficients for the inflation variable and the dummy variable is positive and they are both statistically significant to establish it as the threshold level of inflation.

Table 06: Variables Considered

Variables	Definition
GGDP	$\Delta Y =$ Real GDP Growth
INF	$\pi =$ Inflation
BD	Budget Deficit (as % of GDP)
CA	External Current Account Balance (as % of GDP)
GM2	Broad Money Growth

Source: Authors

Dummy variables are defined as,

$$D_i = \begin{cases} 1, & INF > k_i \\ 0, & INF \leq k_i \end{cases} \quad (4)$$

where,

$$k_1 = 3, \quad k_2 = 4, \quad k_3 = 5, \quad k_4 = 6, \quad k_5 = 7, \quad k_6 = 8, \quad k_7 = 9, \quad k_8 = 10.$$

Table 07: Results of the threshold regressions (Dependent variable: Real GDP Growth)

k_i	Variables	Coefficient	Std. Error	t-statistics	Prob.	R-squared	SSR
3.0	C	3.6113	0.9562	3.7768	0.0004	0.2944	275.8
	INF	0.4167	0.3604	1.1565	0.2519		
	GM2	0.1041	0.0344	3.0229	0.0036		
	BD	0.4512	0.1256	3.5914	0.0006		
	CA	-0.3658	0.1141	-3.2068	0.0021		
	D1_DEFF1	-0.3871	0.3821	-1.0130	0.3150		
4.0	C	3.7929	0.8770	4.3247	0.0001	0.2922	276.6
	INF	0.2753	0.2475	1.1123	0.2703		
	GM2	0.1033	0.0345	2.9963	0.0039		
	BD	0.4488	0.1257	3.5699	0.0007		
	CA	-0.3691	0.1141	-3.2350	0.0019		
	D2_DEFF2	-0.2484	0.2730	-0.9097	0.3664		
5.0	C	3.5856	0.8337	4.3007	0.0001	0.3077	270.5
	INF	0.3336	0.1933	1.7258	0.0893		
	GM2	0.1028	0.0341	3.0153	0.0037		
	BD	0.4577	0.1244	3.6803	0.0005		
	CA	-0.3562	0.1133	-3.1439	0.0025		
	D3_DEFF3	-0.3275	0.2179	-1.5032	0.1378		
6.0	C	3.5910	0.7997	4.4906	0.0000	0.3151	267.7
	INF	0.2920	0.1486	1.9649	0.0538		
	GM2	0.1021	0.0339	3.0097	0.0038		
	BD	0.4503	0.1231	3.6570	0.0005		
	CA	-0.3641	0.1123	-3.2427	0.0019		
	D4_DEFF4	-0.3099	0.1800	-1.7211	0.0901		
7.0	C	3.6525	0.7878	4.6361	0.0000	0.3136	268.3
	INF	0.2462	0.1272	1.9365	0.0573		
	GM2	0.1013	0.0340	2.9795	0.0041		
	BD	0.4424	0.1230	3.5953	0.0006		
	CA	-0.3605	0.1125	-3.2037	0.0021		
	D5_DEFF5	-0.2735	0.1631	-1.6772	0.0985		

8.0	C	3.7237	0.7725	4.8206	0.0000	0.3124	268.7
	INF	0.2148	0.1125	1.9095	0.0608		
	GM2	0.1012	0.0340	2.9744	0.0042		
	BD	0.4426	0.1232	3.5940	0.0006		
	CA	-0.3632	0.1125	-3.2275	0.0020		
	D6_DEFF6	-0.2538	0.1544	-1.6437	0.1052		
9.0	C	4.0447	0.7529	5.3723	0.0000	0.2914	276.9
	INF	0.1204	0.0942	1.2775	0.2061		
	GM2	0.1043	0.0345	3.0222	0.0036		
	BD	0.4496	0.1260	3.5685	0.0007		
	CA	-0.3830	0.1146	-3.3415	0.0014		
	D7_DEFF7	-0.1242	0.1430	-0.8690	0.3882		
10.0	C	3.8761	0.7482	5.1805	0.0000	0.3074	270.7
	INF	0.1617	0.0915	1.7676	0.0820		
	GM2	0.1004	0.0342	2.9355	0.0046		
	BD	0.4432	0.1236	3.5849	0.0007		
	CA	-0.3744	0.1128	-3.3200	0.0015		
	D8_DEFF8	-0.2204	0.1476	-1.4936	0.1403		

Source: Authors' Estimates

Based on the findings described above, the determination of the threshold value takes into consideration the highest R-squared, the lowest sum of squared residuals (SSR), and the combined sum of regression coefficients for both the inflation and dummy variables. This analysis indicates that, using historical data as a reference, the optimal inflation threshold for the target level is approximately 6 per cent.

4.4.2. Analysis Using the TVAR Model

The second threshold model used is the TVAR model with three regimes. This model examines the dynamic interactions among the output gap (GDP), inflation (Inf), interest rates (Int), and the budget deficit (BD). The inflation rate is considered the threshold variable in the model. Accordingly, the vector of variables is defined as follows:

$$y_t = [Inflation \quad Output\ gap \quad Budget\ Deficit \quad Interest\ Rate] \tag{5}$$

The optimal lag order of 2 is selected by using the Akaike Information Criterion (AIC). However, the two threshold values, 6.5 and 7.7, are estimated endogenously as model outputs using R software. The following three equations indicate the results of the TVAR model with the inflation rate as a threshold variable.

Low inflation regime (<6.5%)

$$Output\ Gap_t = -0.8516 + 0.7992^{***}.Output\ Gap_{t-1} + 0.0555.Inflation_{t-1} + 0.6617.Interest\ Rate_{t-1} - 0.0289.Budget\ Deficit_{t-1} - 0.1038.Output\ Gap_{t-2} + 0.1426.Inflation_{t-2} - 0.6765.Interest\ Rate_{t-2} + 0.1145.Budget\ Deficit_{t-2}$$

Middle inflation regime (6.5–7.7%)

$$Output\ Gap_t = -32.3316^{**} + 1.3885^{**}.Output\ Gap_{t-1} + 4.3076^{**}.Inflation_{t-1} + 1.6654.Interest\ Rate_{t-1} + 0.6750^{*}.Budget\ Deficit_{t-1} - 0.8169.Output\ Gap_{t-2} + 1.0052^{*}.Inflation_{t-2} - 3.5187^{*}.Interest\ Rate_{t-2} + 0.9836^{*}.Budget\ Deficit_{t-2}$$

High inflation regime (>7.7%)

$$Output\ Gap_t = 0.2280 + 0.9834^{*}.Output\ Gap_{t-1} + 0.0317.Inflation_{t-1} + 0.0272.Interest\ Rate_{t-1} + 0.0218.Budget\ Deficit_{t-1} - 0.5195.Output\ Gap_{t-2} - 0.1813.Inflation_{t-2} + 0.0813.Interest\ Rate_{t-2} + 0.0184.Budget\ Deficit_{t-2}$$

$*\ significant\ at\ \alpha = 0.05 \qquad **\ significant\ at\ \alpha = 0.01 \qquad **\ significant\ at\ \alpha = 0.001$

TVAR estimation identifies two significant inflation thresholds at 6.5 per cent and 7.7 per cent, which divide the sample into three regimes of inflation and output gap dynamics.[4] In the low-inflation regime, where inflation is below 6.5 per cent, the output gap is primarily determined by its own persistence, while the effect of inflation is weak and insignificant, indicating that low inflation has little impact on the output gap. In the middle regime, when inflation is between 6.5 per cent and 7.7 per cent, the relationship between output gap and inflation strengthens considerably as inflation exerts a large and positive effect on the output gap, suggesting that moderate inflation supports demand conditions and enables the economy to operate closer to potential.[5] In the high-inflation regime, where inflation is above 7.7 per cent, inflation remains highly persistent[6], but its effect on the output gap diminishes, implying that higher inflation does not translate into sustained improvements in economic activity and may exacerbate macroeconomic imbalances. These findings provide further evidence to support the conjecture that moderate levels of inflation around the levels suggested by the middle regime supports preserving macroeconomic stability.

[4] Based on the sample data, in most cases when inflation is low, the economy seems to have operated below full capacity, while at moderate levels of inflation, economic performance seems to have remained close to the full capacity levels.

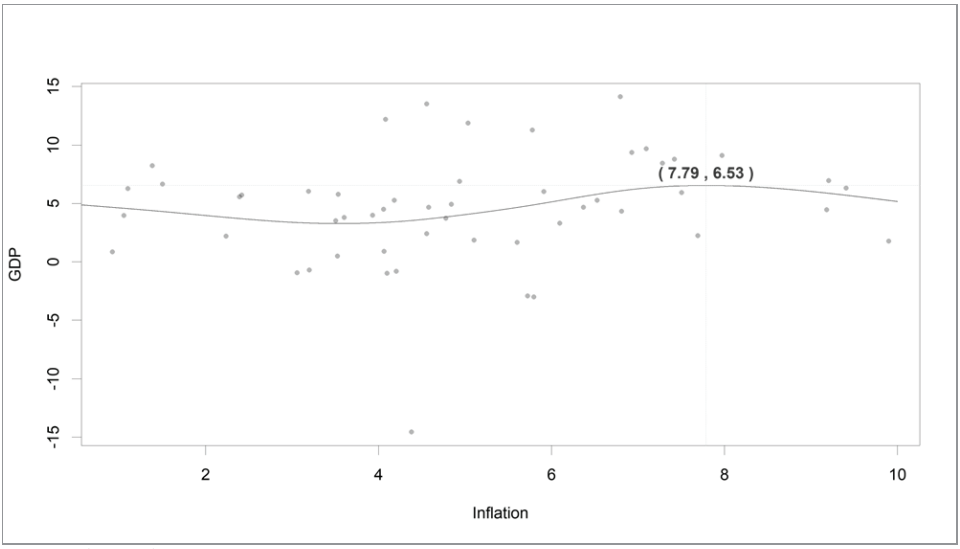
[5] Note that in this scenario, the intercept on the output gap equation is a statistically significant, large, negative value. Accordingly, ceteris paribus, the positive statistically significant relationship with inflation can be interpreted as better support for closing the output gap.

[6] The coefficient of the lagged inflation term in the inflation equation of the TVAR model is significant and relatively high.

4.4.3. Spline Regression

The following graphs illustrate the non-linear relationship between GDP and inflation through spline regression using R software.

Figure 02: GDP Growth Vs. Inflation Using Spline Regression (Quarterly Data Since 2009-21)

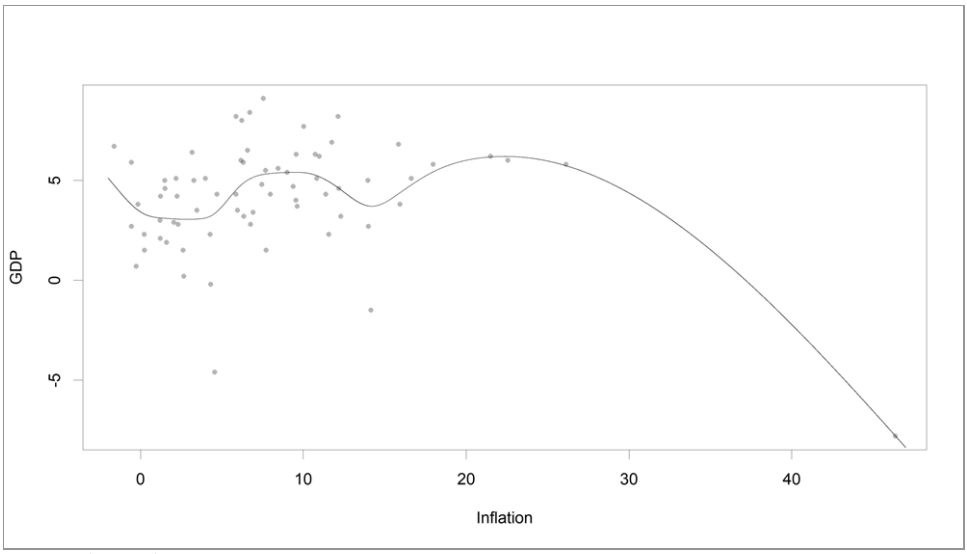


Source: Authors' Estimates

Based on the findings from the spline regression analysis, it becomes evident that optimal growth occurs when inflation is close to 7 per cent. Beyond this threshold, a consistent reduction in GDP growth is noticeable. Furthermore, the connection between inflation and GDP growth remains positive when inflation is below 7 per cent. Notably, the impact of inflation on growth is particularly pronounced within the range of around 4 to 7 per cent inflation, thus highlighting a potential for increased manoeuvrability. It suggests that GDP growth has an increasing relationship with inflation when inflation is around 4-7 per cent.

When extending the analysis over a more extended period, using annual data since 1953, similar trends emerge. When inflation remains in the single-digit range and specifically below approximately 7 per cent, it demonstrates a strong response of GDP growth. In contrast, when inflation lies between around 7-12 per cent, inflation exhibits a weaker connection with GDP, responding with less intensity. Consequently, during this timeframe, policymakers may find it relatively manageable to stabilise growth near its potential level. Notably, optimal GDP growth tends to align with an inflation rate around the 7 per cent range. The analyses also suggest that the relationship between inflation and GDP growth has another local maximum when inflation is about 23 per cent. However, this case could not be considered, given the lower number of observations in this region under specific economic conditions.

Figure 03: GDP Growth Vs. Inflation Using Spline Regression (Annual Data Since 1953)



Source: Authors' Estimates

Taking these factors into account, it can be concluded that the optimal inflation range lies approximately between 4 and 7 per cent.

4.4.4. Historical Relationships

When the behaviour of output gap and inflation is considered, the negative output gap, calculated based on a Hodrick Prescot (HP) filter, tends to close when inflation is around 4-7 per cent. During the period, where inflation remained within single-digit levels during 2009-2021, average inflation was around 5 per cent, while the standard deviation was about 2 per cent.[7]

Monetary policy conducted by a central bank primarily influences the money supply, interest rates, and credit conditions in an economy. Its main objective is typically to maintain price stability (low and stable inflation) and thereby support sustainable economic growth. However, the direct impact of monetary policy on long-term economic growth (the growth of an economy's potential output) is limited. It can influence short-term economic fluctuations, but its effect on the underlying potential growth rate of an economy is more indirect.

The output gap measures the difference between actual output and potential output in an economy. Policymakers are often more interested in the output gap because it provides insights into the immediate health of the economy and the presence of economic slack or overheating. Policymakers often focus on short-term fluctuations (business cycles) in the output gap. These fluctuations can have significant implications for employment, inflation, and overall economic stability. Monetary policy tools, such as interest rate adjustments, can be used to smoothen out these short-term fluctuations, stabilising the economy and reducing the amplitude

[7] During the same period, the average quarterly year-on-year growth rate is about 4 per cent and its standard deviation is about 5 per cent.

of the business cycle. Hence, the level of inflation that is consistent with a smaller amplitude of output gap can be considered more desirable as a target level of inflation.

Table 09: Average Output Gap at Different Levels of Inflation

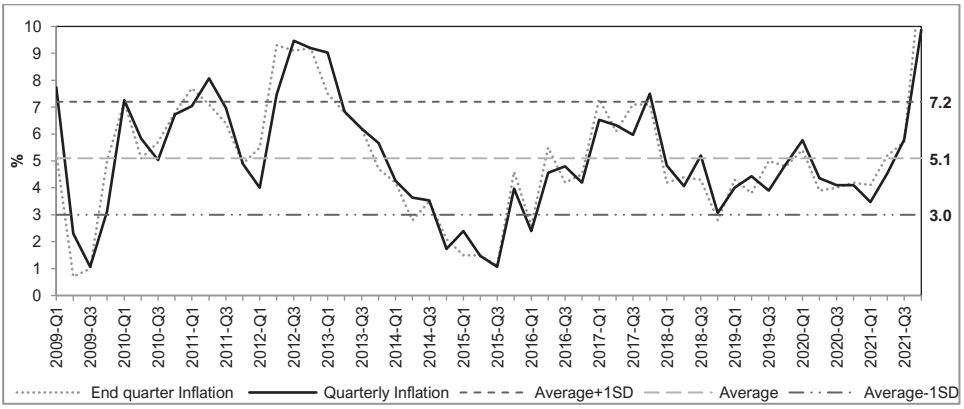
Y-o-Y Inflation Level (%, Log Difference)	Less than or equal to 1	More than 1, but less than or equal to 3	More than 3, but less than or equal to 5	More than 5, but less than or equal to 7	More than 7, but less than or equal to 9	More than 9, but less than or equal to 11	More than 11, but less than or equal to 13	More than 13, but less than or equal to 15	More than 15
Average Output Gap (%, Log Difference)	-0.49	-0.83	0.13	0.17	0.54	0.83	0.18	1.55	0.56
Standard Deviation of Output Gap (%, Log Difference)	0.29	1.56	2.85	2.32	2.04	2.07	0.97	0.06	2.55
No. of Observations	3	9	28	15	12	4	5	2	11

Note: Data used in this analysis are based on the Quarterly Projection Model of the Central Bank.

Source: Prepared by the Authors based on data from the Department of Census and Statistics

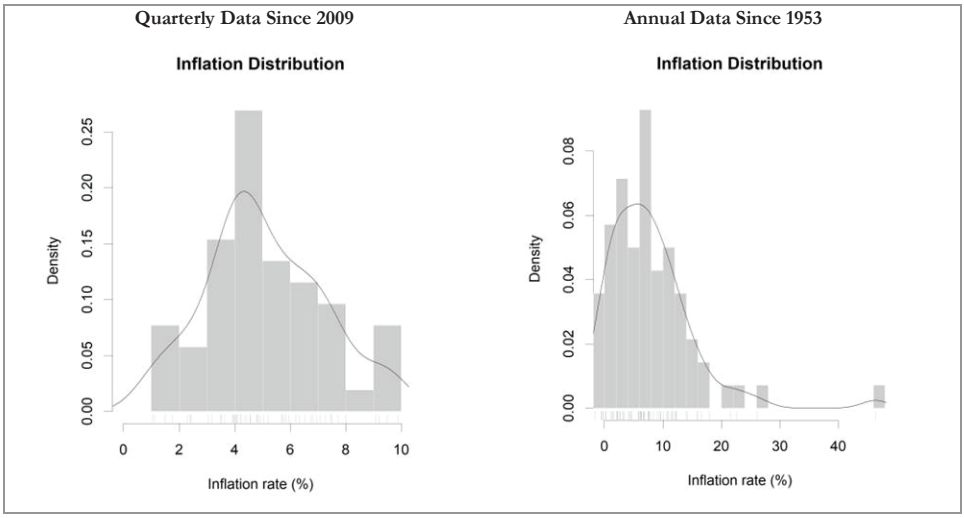
The above observations suggest that the output gap, on average, is smallest when inflation is around 3-7 per cent. Moreover, it also suggests that the output gap, on average, tends to take comparatively more extreme values when inflation is outside this region. Accordingly, inflation hovering around 3-7 per cent is consistent with a lower amplitude of the business cycle, i.e., a more stable level of economic activity. This observation does not suggest any causation but only offers a simple characteristic observation of inflation and output dynamics in the economy. Nevertheless, it still suggests that too high or too low inflation from a mid-single-digit level is accompanied by a more extreme level of the business cycle.

Figure 04: Quarterly Inflation based on the CCPI



Source: Prepared by the Authors based on data from the Department of Census and Statistics

Figure 05: Distribution of Inflation



Source: Prepared by the Authors based on data from the Department of Census and Statistics

Note: The thick line in each of the histograms displays the kernel density, estimated using R software, assuming a Gaussian kernel. The kernel density can be thought of as a way of transforming the discrete distribution given in the histogram into a smoothed continuous distribution.

When selecting a target, careful consideration of historical data patterns is essential. During the single-digit inflation era (2009-2021), the average inflation rate was 5.1 per cent, with an observed standard deviation of 2.1 per cent. These distributional characteristics can be visualised using histograms and kernel densities as given in Figure 05. Given this historical pattern, it is prudent to set a 5 per cent target with a tolerance margin of ±2 percentage points.

Considering empirical evidence and the need to facilitate sufficient policy space to affect real economic conditions, a point inflation target of 5 per cent, with a margin of ±2 percentage points, may be appropriate for the Sri Lankan economy. This target aligns with the country's unique circumstances, promoting stability, credibility, and sustainable growth in the face of various economic challenges. This recommended target enables compliance with the CBA while strengthening the ability to anchor inflation expectations.

Moreover, having a margin of about two percentage points, which broadly aligns with the observed standard deviation, provides some space for inflation to deviate due to factors that may be difficult to control with monetary policy. This is particularly important, given that Sri Lanka, being a small island, is prone to frequent weather shocks and susceptible to global commodity price fluctuations.

4.5. Specific Considerations When Measuring Deviations from the Target

The CBA requires the Monetary Policy Board of the Central Bank to submit a report to Parliament if the inflation target is breached for two consecutive quarters. For this purpose, it is proposed that inflation be monitored using quarterly average inflation with a margin of ±2 percentage points. Quarterly average

inflation, calculated as the simple average of three monthly year-on-year inflation, is suggested to be considered for this purpose. Compared to other calculation methodologies,[8] this method is proposed due to its simplicity, leading to a higher level of transparency.

4.6. The Time Horizon During which Inflation is Expected to Reach the Target, in Response to Policy Actions

The inflation target horizon is the time period during which inflation is expected to return to its target following economic shocks. Determining an appropriate target horizon requires consideration of several factors, including the behaviour of inflation expectations, the transmission lag of monetary policy (i.e., the time it takes for monetary policy actions to affect the real economy), and the economy's responsiveness to exchange rate fluctuations. Although each of these factors is subject to considerable uncertainty, they are critical in assessing how quickly inflation can return to its desired level. Further, the nature and persistence of economic shocks play a significant role in shaping the adjustment path of inflation. These dynamics are likely to evolve as the economy undergoes structural transformations.

Considering the statistical relationships among short-term interest rates, real output and inflation, based on empirical evidence from previous research and the semi-structural model employed officially, as well as the vulnerability of the Sri Lankan economy to supply shocks and external shocks, a medium-term target horizon of around 2 years is deemed appropriate for Sri Lanka.

5. Conclusion

This study examined various parameters of inflation measures to arrive at recommendations for the most appropriate target for Sri Lanka under the FIT framework. Both qualitative and quantitative analyses were carried out to determine the suitable target for inflation and the allowable deviation band that would constitute a target miss under the CBA. The objective of this policy research is to facilitate the Central Bank in proposing an inflation target for the consideration of the Government, as required for signing the first Monetary Policy Framework Agreement (MPFA) under the CBA. The key findings are summarised below.

Given its comprehensibility to the public, its reflection of total expenditure in the consumer basket, thus being closely representative of overall price developments and effectiveness of anchoring inflation expectations, headline inflation is recommended over core inflation as the target measure for monetary policy purposes. Among available indices, the CCPI is preferred over the NCPI, due to lower volatility, lower susceptibility to supply factors, availability of data for a longer period and shorter publication lag. Empirical evidence, along with the need for adequate policy room to influence real economic conditions, supports a point inflation target of 5 per cent, with a margin of ± 2 percentage points to measure the deviation of inflation from its target at this stage of the implementation of FIT. This recommended

[8] See, for example, the method of calculating quarterly inflation as per the Monetary Policy Consultation Clause (MPCC) in the Extended Fund Facility (EFF) programme of the International Monetary Fund (IMF), where a slightly different averaging is used. These methodologies produce approximately similar values when price changes are relatively small. However, in periods where price changes are substantial, the differences between the averages widen.

target aligns with the requirements of the CBA and enhances the ability to anchor inflation expectations.[9] A medium-term target horizon of approximately two years is appropriate for Sri Lanka. Nevertheless, these findings are contingent on prevailing economic conditions, which may evolve due to external and domestic shocks and structural changes. Therefore, it is essential to periodically revisit these analyses and strengthen them with further analytical tools to ensure the continued relevance and effectiveness of the inflation target.

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[9] In line with these recommendations, the current MPFA mandates the Central Bank to maintain quarterly headline inflation, as measured by the CCPI, at a rate of 5 per cent. If the Central Bank fails to meet the inflation target of 5 per cent by a margin of ±2 percentage points, as set out in the MPFA, for two consecutive quarters, the Monetary Policy Board of the Central Bank should submit a report to the Parliament through the Minister of Finance.

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Implementing the Mandatory Code of Corporate Governance for Licensed Commercial Banks in Sri Lanka

Jayod Danthanarayana [1] [2]

Abstract

Corporate governance standards have evolved over the past three decades in response to numerous corporate scandals. Many fragilities in financial institutions observed across the world could be traced back to failures in corporate governance practices. In Sri Lanka, several domestic financial institutions barely demonstrated resilience to severe corporate governance malpractices during 2007–08. As such, the Central Bank of Sri Lanka (Central Bank) introduced a mandatory corporate governance code for Licensed Commercial Banks (LCBs) in December 2007, to enhance overall stability in the banking sector. The objective of the study is to examine the level of compliance demonstrated by LCBs with the provisions of the Central Banks's mandatory code of corporate governance during the first year of its implementation. This study sheds light on the readiness, preparedness and willingness of banks in implementing these directions in the first year of adoption and attempts to enrich the literature on corporate governance practices of domestic LCBs. The study has been confined to domestic LCBs and is based on secondary data gathered through their annual reports. These reports were analysed using a checklist which was developed based on five assessment criteria identified in the conceptual model of the study. This model further conceptualises the principal-agent relationship between key stakeholders of an LCB and its directors. A score has been assigned to each principle and a composite score has been devised to assess the overall level of compliance. The findings reveal that domestic LCBs on average reported a commendable level of compliance in the first year of implementation. The study also reveals the challenges that prevailed during the first year of implementing the mandatory code of corporate governance.

Key words: *Corporate Governance, Principal-Agent Problem, Licensed Commercial Banks*

[1] The author currently serves as a Deputy Director of the Macroprudential Surveillance Department of the Central Bank of Sri Lanka. Corresponding email: jayod@cbsl.lk

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1 Introduction

The concept of governance has its own roots in the early era of human civilisation. With the formation of the society, mankind required a governing body to assure conformity with social values, norms, and beliefs while abstaining from undesirable conduct. Governance is a concept that synchronises human expectations, delegation of power, and verification of performance (Olsen, 2015). Governance may take place in any system or, organisation of any size ranging from a single member to entire community. Corporate governance in a broad sense is viewed as ethical responsibility and moral duty (Arjoon, 2005) by the agent to its principals. Generally, corporate governance refers to the structures and processes for the direction and control of companies. Its scope extends to the relationships among the management, board of directors, controlling shareholders, minority shareholders, and other stakeholders. The shareholders delegate decision making rights to the board/managers to act in the principal's best interests. This separation of ownership from control implies a loss of effective control by shareholders over managerial decisions and may lead to adverse selection (Marks, 2000). Corporate governance practices attempt to align the personal incentives of the board/management with those of shareholders (Davies, 2000). A board endorses the organisation's strategy, develops directional policy, appoints, supervises and remunerates the senior executives and ensures accountability of the organisation to its owners and authorities. Key elements of good corporate governance principles include honesty, trust, integrity, openness, performance orientation, responsibility and accountability, mutual respect, and commitment to the organisation (Biswas, 2023). In this context, it is important to assess how directors and management develop a model of governance that aligns with the values of the corporate participants and then evaluate the model periodically for its effectiveness. Further, corporate governance is not a one-time exercise but rather an ongoing process (IFC and US Department of Commerce, 2004).

Organisations adopt corporate governance practices due to numerous benefits. Corporate governance stimulates the performance and operational efficiencies of companies (Heenetigala, 2011). Improvements in a company's governance practices enhance accountability, thereby minimising the risk of fraud or self-dealing by its officers. Accountable behaviour, combined with effective risk management and internal controls, can bring potential problems to the forefront before a full-blown scandal (Bubilek, 2017). Effective corporate governance practices can enhance the access to capital markets and facilitate mobilising of funds (Morales, Mahendra and Widyastuti, 2012). Well-governed firms are perceived as investor friendly, providing greater confidence in their ability to generate returns while upholding shareholder rights. Further, investors are willing to pay a premium for the shares of well governed companies. Effective corporate governance lowers the cost of capital and raises the value of the company (Zhu, 2014). When a company exercises satisfactory internal controls and when shareholder rights are adequately protected, its cost of equity and debt capital may naturally decrease. Further, effective implementation of corporate governance improves the corporate reputation and goodwill which would reflect positively on share prices of the company (Siddiqui *et al.,*2023).

Good corporate governance is essential for the health and sustainability of an organisation, irrespective of size, sector, and legal form. Effective corporate governance in sectors such as financial intermediaries, pension funds, and insurance companies is crucial for the wellbeing of society and the stability of the broader economy. Amongst these institutions, Licensed Commercial Banks (LCBs) play a pivotal role in Sri Lanka. It accounted for 48.6% of financial assets in the domestic financial system in 2007 amounting Rs.2.1 Tn of assets (CBSL (2007a)) (54.6% and Rs. 18.1 Tn in December 2023 (CBSL, 2023). An LCB pursues economic activities which affects the public welfare to an unusual degree as it touches almost every phase of a country's economic life (CBSL, 2007b). Hence, banks are exposed to a wide array of stakeholder groups in an economy. Failure of LCBs would affect the transmission of monetary policy, financial intermediation, gross national investments and payment system of the country, which are essential for smooth performance of an economy. Thus, failure of a bank could endanger the stability and confidence in the financial system and economic wellbeing of the public. A banking crisis would impose an enormous cost to the economy in terms of loss in output and fiscal cost of restructuring failed financial institutions. Moreover, poor corporate governance may lead to loss of market confidence in the bank's ability to

manage its assets, which may in turn trigger a liquidity crisis (Basel Committee on Bank Supervision, 2006). In view of foregoing, attributes of corporate governance principles for banks are more important to the society and economy at large.

In light of the above, it is clear that a sound banking system is essential for promoting healthy and sustainable economic development. Therefore, strengthening corporate governance for LCBs would undoubtedly shield the public against mismanagement, bank failures and loss of confidence in the banking system. The board of directors holds the primary responsibility for ensuring sound corporate governance within an organisation.

1.1 Research Issue

In Sri Lanka, when the Central Bank was established in 1950, the financial sector was still in its infancy, consisting of only a few commercial banks, most of which operated as branches of foreign institutions (Karunasena, 1996). During the early years of post-independence, the Central Bank and Government introduced measures to promote the development of the financial system (Karunasena, 1996). The financial system dispersed within the country during 1950 -1976 with the opening of bank branches particularly in rural areas, and the sector expanded notably in terms of total assets and bank accounts (CBSL, 1990a). With the economic reforms and deregulations introduced in 1977, the financial system further expanded in volume, complexity and sophistication (Seelanatha, 2009; CBSL, 1990a). Nevertheless, a number of issues emerged within the financial system during the period from 1977 to 1988 due to deterioration in conditions of some banks and finance companies. These challenges reflected contemporary critical issues of the time such as poor quality of management, excessive risk taking and debt recovery difficulties (CBSL, 1990a). Several finance companies failed during 1986 - 88, prompting the Central Bank to intervene to restore confidence in the system (Premaratne, 2011; Siriwardana, 2014; CBSL, 1990b; and CBSL, 1991). Many finance companies were family-run businesses, with practices more akin to moneylenders, and only a few were willing to comply with Central Bank regulations (CBSL, 1990a). In this backdrop, the Banking Act No. 30 of 1988 and Finance Companies Act No. 78 of 1988 were introduced. Numerous regulatory measures were taken under these Acts to limit the finance business to viable finance companies (CBSL, 1991; CBSL, 1992). In the early 2000s, the license of a small licensed specialised bank was cancelled due unsound, improper and imprudent practices and mismanagement, resulting in a significantly high Non-Performing Loan (NPL) ratio, which impeded its ability to engage in the financial intermediations (CBSL, 2002). In late 2008, a systemically important bank experienced a financial distress leading to a deposit run, triggered by the contagion effect from the collapse of one of its subsidiaries, an unregulated financial institution (Premaratne, 2011). The Central Bank restored market confidence in the bank by, among other measures, appointing a state-owned systemically important bank to manage its operations (CBSL, 2008a). Moreover, the financial sector experienced distress during 2008-09 due to a loss of public confidence in shadow banks, some of which were either unregulated or less regulated (Premaratne, 2011). Although the distress was confined to a few institutions, lapses by directors and management that led to poor governance were identified as common reasons for the issues (Premaratne, 2011) Despite the insignificant and negligible market share of these distressed entities, the publicity surrounding them caused a significant uproar in both the financial market and the broader economy (Siriwardana, 2014). By 2013, a few of these distressed entities were undergoing restructuring when the Central Bank implemented a Consolidation Plan for the Financial Sector in 2013/14 (Siriwardana, 2014). The initiative aimed to "build a strong, dynamic, and internationally competitive financial sector with cross-border linkages and a significant overseas presence" (CBSL, 2013). Importantly, one of the key synergies envisioned in the consolidation plans was to instil good governance in regulated financial institutions (Siriwardana, 2014). Further, a Consolidation Masterplan for Licensed Finance Companies (LFC) /Specialised Lasing Companies (SLC) sector was launched in 2020 by the Central Bank, with the view of downsizing the number of LFCs/SLCs operating in Sri Lanka and establish resilient and well performing LFCs in the medium term.

These financial scandals had repeatedly reminded Sri Lanka of the acute shortcoming in corporate governance practices and urged the need for regulation. These scandals had partially contributed negatively on capital

markets, investor confidence, foreign direct investments and societal expectations at large. Therefore, effective implementation of sound corporate governance principles for the banking sector would be a necessity for health and soundness of the financial system (BIS, 2015). Amongst regulated financial institutes, Licensed Banks are regarded as the apex of the financial system (CBSL, n.d.; ADB, 2023; and Kurincheedaran, 2015). As such, corporate governance for LCBs is a significant proposition to be dealt with.

In December 2007, the Central Bank introduced the first ever management framework for corporate governance of Licensed Banks, the Banking Act Direction No 11 of 2007, in order to enhance overall stability in the banking sector (CBSL, 2007b). This was an initial yet bold decision in order to protect depositors and stockholders while empowering bank directors and officers to manage the affairs of the bank more effectively and diligently. Compliance with this direction was mandated to commence from 1 January 2008 (first time adoption) and all LCBs were required to comply with these provisions in full by or before January 1, 2009.

LCBs are bound to abide by the aforesaid directions. However, individual LCBs have adopted varied corporate governance disclosure practices due to differences in leadership, levels of commitment, organisational culture, and attitudes. It is envisaged by this report to examine the level of compliance of domestic LCBs with the provisions of the Central Bank's mandatory code of corporate governance **in the first year of its implementation** and to identify salient characteristics of their governance practices. The study essentially shed light on the readiness, preparedness and willingness of banks in implementing the corporate governance directions of the Central Bank ***in the first year of its implementation*** and attempts to enrich the literature on corporate governance practices of banks during the formative stages of its implementation. There have been several subsequent circulars revising specific sections of the original corporate governance code. Given the limited research on corporate governance practices in the banking sector, this study aims to make a significant contribution to the corporate governance literature in Sri Lanka.

Domestic LCBs had demonstrated its adherence to the disclosure requirements on the codes on corporate governance issued by the Colombo Stock Exchange (CSE), the Central Bank, the Institute of Chartered Accountants (ICASL) and Securities and Exchange Commission (SEC) of Sri Lanka. Nevertheless, the scope of this study was limited to corporate governance principles stipulated by the Central Bank in 2007 ***and subsequent amendments during 2008***. The Banking Act Directions of the Central Bank applicable to the study are;

1. Banking Act Direction No.11 of 2007: Corporate Governance for LCBs in Sri Lanka (CBSL, 2007b)
2. Banking Act Direction No. 5 of 2008: *Amendments t*o Directions on Corporate Governance for LCBs in Sri Lanka (CBSL, 2008b)
3. Banking Act Direction No. 7 of 2008: *Amendments* to Directions on Corporate Governance for LCBs in Sri Lanka (CBSL, 2008c)

The Banking Act Direction No. 11 of 2007 was issued on 26 December 2007 requiring banks to commence compliance with the mandatory code from 01 January 2008. A transitional arrangement had been availed for banks to fully comply with the direction by or before 01 January 2009, except where extended compliance dates had been provided. The annual reports for the year ending 31 December 2008 were the first available annual report since the implementation of the aforesaid directions, which were used to examine the level of compliance *in the first year of implementation* of the mandatory code of Corporate Governance of the Central Bank[3].

[3] The Central Bank issued a new comprehensive Corporate Governance Direction for Licensed Banks in October 2024, which will take effect in January 2025.
https://www.cbsl.gov.lk/sites/default/files/cbslweb_documents/laws/cdg/Banking_Act_Directions_No_5_of_2024.pdf The new Direction aims to further strengthen the corporate governance practices of banks. The first annual report publications under the new corporate governance code will only be available for the financial year ending in December 2025.

2 Literature Review

2.1 Theoretical Perspectives of Corporate Governance

Corporate governance is a set of processes, customs, policies, laws, and institutions affecting the way a corporation is directed, administered or controlled. It includes the relationships among many stakeholders and the goals for which the corporation is governed (Shourvarzi and Beinabaj, 2011). Schmidt (2003) defined corporate governance as a range of mechanisms and arrangements that shape the way in which key decisions are made in (large) corporations. Larcker *et al.* (2004) denoted corporate governance as a set of mechanisms that influence the decisions made by managers when there is a separation of ownership and control. This separation of ownership and control can be viewed as an agency relationship. The governance of an organisation is entrusted to boards of directors and key management personnel by the shareholders – the principals in this relationship. As such, an important theme of corporate governance is to balance the interests (Schoenmaker and Shramade, 2023) and ensure accountability through mechanisms that try to reduce or eliminate the principal-agent problem (Gersen and Stephenson, 2014).

Literature in relation to the agency relationship identifies it as a contract under which one or more persons (the principal(s)) engage another person, the agent, to perform some service on their behalf which involves delegating some decision-making authority to the agent (Jensen and Meckling, 1976). The article argues that if both parties are utility maximisers, there is a good reason to believe that the agent will not always act in the best interests of the principal. This therefore leads to a principal-agent problem. The principal can limit principal-agent problem by establishing appropriate incentive contracting for the agent (Ormazabal *et al.,* 2023) which entails an agency cost. The agency costs are designed to limit the aberrant activities of the agent (Jensen and Meckling, 1976). The agency cost referred to therein comprises the cost of monitoring, bonding and residual loss. The level of agency costs depends, among other things, on statutory and common law and on human ingenuity in devising contracts. Nevertheless, a well-functioning firm is one that minimises its agency cost (Deegan, 2006). Thus, key management personnel and shareholders should attempt to minimise agency cost by eliminating the principal-agent problem.

2.2 Evolution of Corporate Governance Guidelines and Best Practices

Multiple reports have had a marked influence on the development of corporate governance in the world. The Cadbury Report by Sir Adrian Cadbury was issued in 1992, in relation to financial aspects of corporate governance. The Greenbury Report which was published in 1995 was a pre-eminent and comprehensive governance code that focussed on the executive and director remuneration (O'Connell and Ward, 2020). The Hampel Committee was set up in 1995 to review the implementation of the Cadbury Report. That committee was responsible for the "Corporate Governance Combined Code," which was published in 1998 and incorporated the recommendations of the Cadbury and Greenbury reports. The Turnbull Guidance on internal controls (1999) was subsequently incorporated into The Combined Code (2003). The Higgs Report on the role of non- executive directors and the Smith Report on the role of audit committees, both published in 2003, aimed at improving and strengthening the Combined Code. The UK Corporate Governance Code, which replaced the Combined Code was first introduced in 2010 by the Financial Reporting Council (FRC). The UK Corporate Governance Code was revised in 2012, 2014, 2016 and 2018, requiring new disclosure provisions, assigning additional responsibilities for directors while emphasising the value of good corporate governance to sustainable growth. A revised version of the UK Corporate Governance Code was issued in January 2024, strengthening areas related to audit, risk, and internal control.

Similarly, the Treadway Commission in 1987 and Enterprise Risk Management – Integrated Framework of the Committee of Sponsoring Organisations (COSO) (2001), Sarbanes Oxley Act (2002) made a commendable contribution in developing the principles of corporate governance in the US. The Dodd-Frank Wall Street Reform and Consumer Protection Act 2010 was passed in the US to protect the US taxpayer by ending bailouts,

to protect consumers from abusive practices in financial services, and to promote financial stability by improving accountability and transparency in the financial system.

2.3 Corporate Governance Practices of Financial Sector

The Basel Committee on Banking Supervision (BCBS) issued its first guidance, "Enhancing Corporate Governance for Banking Organizations" in September 1999 which was superseded in February 2006 considering the increased national and international interest amidst several corporate governance scandals. The Basel guidance was drawn from the principles of corporate governance published by the Organization for Economic Co-operation and Development (OECD), recognising the need for effective corporate governance practices at banks to maintain public confidence in financial intermediation. Drawing on the lessons from global financial crisis, BCBS set out the best practices for good corporate governance in October 2010 as it published "Principles for Enhancing Corporate Governance" to address fundamental governance deficiencies with guidance. The committee also acknowledged the need for evaluating corporate governance policies, practices and the implementations at banks by the supervisory authorities. The guidance from the BCBS is intended to serve as a reference point for bank supervisors and banks to establish sound corporate governance practices. The BCBS revised its guide in 2015 to promote robust and transparent decision making in the banks.

Following the run-on Northern Rock and drawing on the lessons from Global Financial Crisis, Sir David Walker (2009) recommended extending the remit of the Financial Reporting Council (FRC) of the UK to include oversight of institutional investors, ensuring they also adhere to best governance practices. Upon a comprehensive consultation process, FRC published the first "UK Stewardship Code" in 2010. The UK Stewardship Code, a voluntary code which was revised in 2012 and 2020, sets high standards for those investing money on behalf of the UK savers and pensioners, and those that support them. The code applies to asset managers, asset owners and service providers. Further, the Capital Requirements Directive (CRD IV) of the European Union requires banks in member states to adhere with the corporate governance rules.

In the aftermath of global financial crisis, corporate governance of banks and financial institutions was given a greater emphasis compared to the general corporate governance standards of non-banks corporations (Klaus, 2021). The governance of banks has been firmly established in bank supervisory law and regulation. Supervisory institutions in many other jurisdictions have followed the lead set by the BCBS, with their own guidelines and principles for good governance. In Sri Lanka, prevalent law on corporate governance practices of licensed banks is satisfactory and is in line with the international best practices despite a few lapses in implementation (Edirisinghe, 2015).

2.4 Empirical Studies on Corporate Governance of Banks

Empirical studies have explored the relationship between the best corporate governance practices and bank performance. Sivaraja *et al.* (2018) specify that there exists a positive relationship between the overall corporate governance index and bank efficiency in Sri Lanka using a sample of 18 licensed banks. However, while conventional wisdom may expect banks with good corporate governance to perform better, empirical evidence remains mixed, according to Rosa *et al.* (2008). At the same time, bank executives, driven by shareholder incentives, may prioritise risky strategies, as shareholders are insulated from the losses borne by bondholders, depositors, and taxpayers (Bebchuk & Spamann, 2010). This underscores the importance of effective regulation to prevent common shareholders from benefiting from socially excessive risks, thereby reinforcing the necessity for robust prudential oversight and governance. Chahine and Safieddine (2007) illustrate the role played by Lebanese banks in fostering corporate governance practices amongst their corporate clients in the backdrop of weak external monitoring in capital markets. This study reveals the importance of good governance by corporate borrowers for the stability and performance of the banking sector. Meanwhile, greater scrutiny by banks encourage corporate borrowers to practise better risk oversight and operating activities.

Bezawada (2020) found that active engagement of directors has a positive impact on bank performance and a negative relationship with the net non-performing asset ratio. They use a sample that covered 93 per cent of the banking sector in India during 2009 to 2018. Agnihotri *et al.* (2019) highlight that bank performance is closely related to corporate governance and ethical leadership of banks while small sized boards and a higher ratio of block ownership have a positive influence on banks' efficiency. However, they opine that corporate governance principles such as having independent directors could be counter effective when banks are being run by autocratic leaders and the organisational culture generally avoids confrontations. Lundquist *et al.* (2018), using a sample of 55 Western European banks from 2007-2016, conclude that board related corporate governance mechanisms have an impact on the performance and risk-taking of banks and propose the possibility of achieving a balance between enhancing performance and reducing risk-taking by carefully selecting the optimal board size.

2.5 Key Take-aways from Theoretical Discussion

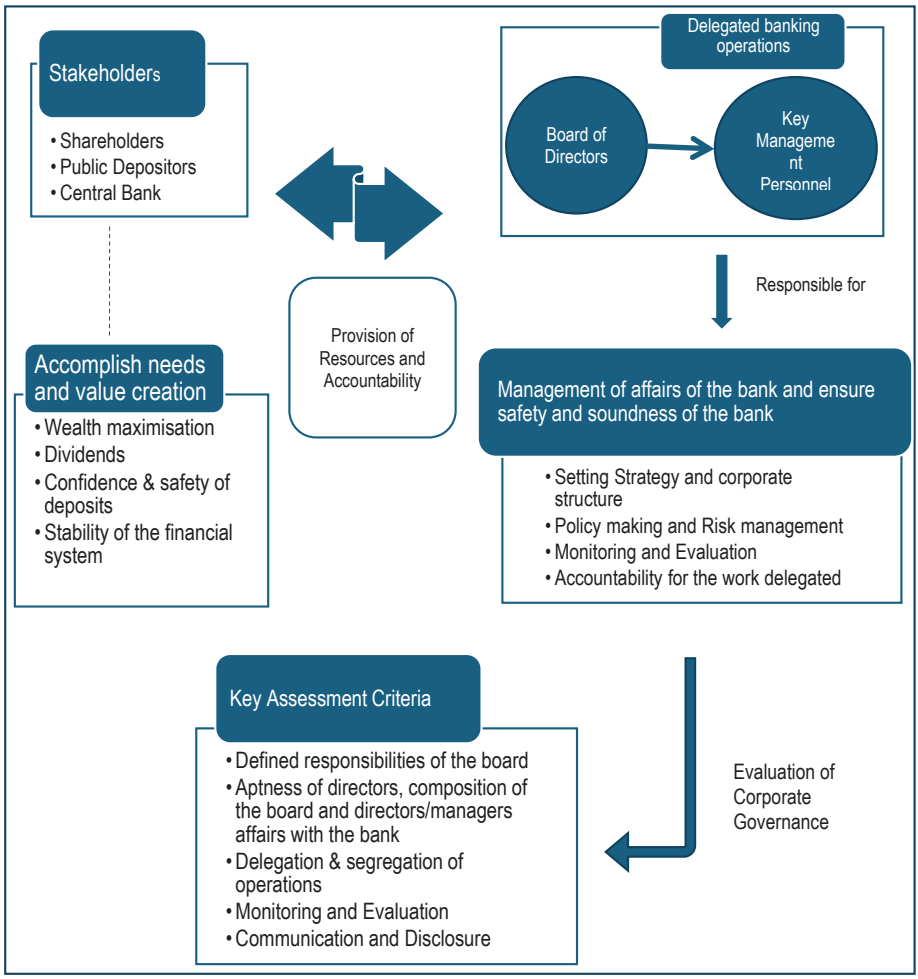
Corporate governance plays a pivotal role in ensuring accountability, balancing stakeholder interests, and enhancing financial stability, particularly in the banking sector. Rooted in agency theory, governance mechanisms aim to minimise agency costs and align managerial decisions with shareholder interests. Over time, regulatory frameworks such as the Cadbury Report, Sarbanes-Oxley Act, and Basel Committee guidelines have shaped governance best practices, reinforcing transparency, risk management, and investor protection. To curb excessive risk-taking and prevent bank failures, regulators have implemented stringent compliance requirements, as inadequate regulation often leads to taxpayer-funded bailouts. Empirical studies suggest that strong governance enhances efficiency, risk oversight, and financial stability, although factors such as leadership structure, ownership concentration, and regulatory environments influence outcomes. As governance frameworks evolve, adapting best practices to regulatory and institutional contexts remains essential for long term financial stability and sustainable economic growth.

3 Methodology

3.1 Conceptual Model of the Study

For the purpose of this study, a conceptual model has been developed to outline the corporate governance of a LCB (F*igure 3.1).* The model summarises stakeholder expectations of the bank and the delegated bank operations to directors / key management personnel and assesses the relationship between the two. A set of key assessment criteria has been proposed in this study to evaluate the corporate governance of an LCB. An LCB, being a financial institution is inevitably exposed to a wide array of variables in an economy. Considering the influential power and resourcefulness of stakeholder groups, three prime stakeholders who could insist on good corporate governance have been identified viz. public depositors, the Central Bank, and shareholders of the LCB.

Figure 3.1: Conceptual Model on Corporate Governance of a Licensed Commercial Bank



Source: Inspired by Backhouse and Wickham (2020) and Jensen and Meckling (1976)

Shareholders and depositors are key stakeholders who provide vital resources to the bank. Shareholders contribute equity, while depositors provide funding. The Central Bank, acting as the regulator, ensures stability within the financial system through oversight and regulation. These stakeholders expect sound corporate governance from the board of directors and key management personnel, to whom they have entrusted the management of the bank's affairs. The stakeholder value creation primarily depends on the quality of corporate governance. The principles of corporate governance serve as a benchmark for assessing the quality and effectiveness of governance in a bank, which, in turn, directly impacts value creation for stakeholders. The key assessment criteria identified here have been further disaggregated in the corporate governance Checklist (Table 3.1), based on the principles outlined in the Central Bank directions.

The Central Bank as the regulator is responsible for preserving the stability of the financial system. It supervises and regulates LCBs at an individual bank level and is entrusted with a mandate to conduct macroprudential policies in Sri Lanka as the Macroprudential Authority. The Central Bank is therefore a prime stakeholder in this

conceptual model, as the regulator would demand appropriate corporate governance at banks. LCBs is a prominent sector in the local financial system, and facilitates financial intermediation between cash surplus units and deficit units. Public depositors represent cash surplus units of an economy and are one of the prime providers of resources for LCBs. The stability of the banking sector depends on the ability to attract public deposits and thereby preserving public confidence. The conceptual model identifies depositors as a prime stakeholder considering their significance to LCBs. Shareholders are the equity-owners of an entity who expect accumulation of wealth and dividend in return. The board of directors shall act in the best interest of shareholders. Further, shareholders are privileged to appoint, reappoint and remove directors. Thus, shareholders are considered as a key stakeholder in this conceptual model.

Directors are assigned with the duty to manage affairs of a bank whilst ensuring safety and soundness on behalf of stakeholders. They are empowered to formulate the strategy and corporate structure, articulation of bank policies and risk management procedures, monitoring and evaluation of banking operations, etc. Stakeholders identified in this model provide resources for LCBs. However, governance is entrusted to the board of directors and key management personnel. The custodians, namely the board and key management personnel, are held responsible and accountable for the duties they perform for LCBs. Stakeholder value creation which encompasses shareholder wealth maximisation, safeguarding the interests of depositors, and implementing sound risk management practices to ensure safety and stability of the financial sector, rests with the board of directors.

To assess the governance of a LCB, a key assessment criterion has been developed within the conceptual model, taking into account the principles outlined in the mandatory corporate governance code of the Central Bank. This encompasses followings (i) Defined responsibilities of the board; (ii) Aptness of directors, composition of the board and directors/managers affairs with the bank; (iii) Delegation and segregation of operations; (iv) Monitoring and evaluation; and (v) Communication and disclosure.

3.2 Checklist Utilised for Analysis

The method of data analysis utilised in this study has been a manual content analysis. A checklist has been outlined for this purpose to summarise the corporate governance principles demonstrated by LCBs in their latest annual reports. This approach closely follows the methodologies prescribed in "*ASEAN Corporate Governance Scorecard: Country Reports and Assessments 2012–2013*" by Asian Development Bank and the "*Corporate Governance Scorecards: Assessing and Promoting the Implementation of Codes of Corporate Governance 2014"* by the International Finance Corporation. These methodologies stipulate a content analysis for the corporate governance disclosures in the published annual reports benchmarking with the mandatory codes of corporate governance of respective jurisdictions. Considering these best practices, the annual reports of domestic LCBs were objectively perused for qualitative disclosures of corporate governance principles as stipulated in the banking act directions. A list of disclosure requirements was compiled as a foundational step for conducting the content analysis. Refer Appendix *1 for a detailed corporate governance checklist*. *Table 3.1* tabulates the assessment criteria and corporate governance principles classified therein.

Table 3.1: Key Areas Addressed in Corporate Governance Checklist

Assessment criteria	Corporate Governance Principle	Reference to the CBSL Direction on corporate governance
Defined Responsibilities of the Board		
	Safety and Soundness of the bank	3(1)(i)
	Board meetings	3(1)(iii)
	Company Secretary	3(1)(vii)
	Independent professionals advise	3(1)(xi)
	Capital Adequacy Ratio	3(1)(xv)
	Annual Corporate Governance Report	3(1)(xvi)
	Self-assessment Scheme for Directors	3(1)(xvii)
Aptness of directors, composition of the board and affairs of directors		
	Composition of the Board	3(2)
	Aptness of Directors	3(3)
	Conflict of Interest	3(7)
Delegation and segregation of operations		
	The Chairman and CEO	3(5)
Monitoring and evaluation		
	Board Appointed Committees	3(6)(I)
	Guidelines on Audit Committee	3(6)(ii)
	Guidelines on Human Resources and Remuneration Committee	3(6)(ii)
	Guidelines on Nomination Committee	3(6)(iv)
	Guidelines on Integrated Risk Management Committee	3(6)(v)
Communication and Disclosure		
	Communication with Shareholders	3(1), 3(8)
	Preparation of Financial and Regulatory Reports	3(8)(I)
	Minimum Disclosure made in the Annual Report	3(8)(ii)

Source: Corporate Governance for Licensed Commercial Banks in Sri Lanka, Banking Act Direction 11 of 2007, as amended.

3.3 Level of Compliance

The level of compliance with each corporate governance principle as stated in a detailed checklist were identified under five major categories, viz. full compliance, partial compliance, non-compliance, insufficient information, and not applicable. A score has been assigned for each level of compliance. This numerical score aligns with the corporate governance scorecard established by the International Finance Corporation (IFC, 2014), which assigned 1 for full compliance, 0.5 for partial compliance, and 0 for non-compliance or insufficient information. Additionally, the ASEAN corporate governance scorecard incorporates bonus and penalty points to strengthen the assessment of good corporate governance principles (ADB, 2014). This study does not recognise the bonus/penalty points in assessing the level of compliance. Further, it excludes corporate governance principles that are not applicable to state-owned LCBs from the computation of overall scores as the relevant Acts/Ordinances supersede the provisions of corporate governance directions. Subjectivity in the assessment of

corporate governance and the use of judgement where necessary is duly recognised in corporate governance scorecard of the International Finance Corporation. The ASEAN corporate governance scorecard and International Finance Corporation's corporate governance scorecard assigns different weights to each of the core assessment criteria. However, the current study assigns equal weights to each of the core assessment criteria. Following the empirical guidelines, an overall score has been calculated for each domestic LCB for the first year of adopting the mandatory corporate governance principles. A score has also been devised for each corporate governance principle and key assessment criterion through horizontal and vertical analysis, using the arithmetic mean.

Table 3.2: Assigning a Score for each Corporate Governance Principle Stipulated in the Banking Act Directions issued in 2007/08

Level of Compliance for each Corporate Governance Principle	Description	Score Assigned, %
Full Compliance	Full compliance with the corporate governance principles/ assessment criteria stipulated in the direction	100
Partial Compliance	LCBs, which do not comply completely with the corporate governance principle yet disclose the fact in annual report	50
Non-Compliance	Banks which do not adhere with the corporate governance principles or do not disclose any pertaining to that	0
Insufficient Information	LCBs had disclosed insufficient information in annual reports to conclude whether it complied, partially complied or not complied with corporate governance principles.	0
Not Applicable	Specific statutes (i.e., Peoples Bank Act No. 29 of 1961 and Bank of Ceylon Ordinance) overrule the corporate governance directions of CBSL issued in 2007/08. A score has not been assigned and was excluded when computing the overall score for a given LCB.	N/A

3.4 Overall Scale

The overall scale which was devised considering the arithmetic mean has been computed across the check list vertically and horizontally. The vertical analysis has been carried out in order to assess the level of compliance by each LCB with the mandatory code of the Central Bank on corporate governance in the first year of implementation. Meanwhile, the horizontal analysis was conducted to assess the overall compliance of the entire domestic LCB sector with each identified corporate governance principle stipulated in the Central Bank direction. In order to interpret the overall compliance during the first year of adoption as demonstrated by each LCB and for each corporate governance principle, the following scale (*Njomo et al., 2012)* has been utilised.

Table 3.2: Scale utilised in assessing overall level of compliance

Scale	Overall score
High level of compliance	more than 80%
Moderate level of compliance	60% - 79%
Low level of compliance	less than 59%

Source: Inspired by Nomo et al., (2012)

The directions on corporate governance by the Central Bank are mandatory for all LCBs. A satisfactory level could only be achieved when a bank complies fully (i.e., 100% compliance) with the stipulated provisions. However, year 2008 was the first year of compliance with the mandatory code on corporate governance and full compliance with the code was only required by or before January 1, 2009. Thus, it is unlikely for an LCB to report a 100% overall level of compliance in its first year of implementation. When the overall score marked above 80%, it was adjudged as a high level of compliance. Moderate level of compliance was awarded when the

overall score was in between 60% and 79%. When the overall score fell below 59%, a low level of compliance was given.

3.5 The Sample and Data

Sri Lanka was domiciled for 23 LCBs in 2007-2008 when the corporate governance direction was first announced. This comprised 11 domestic and 12 foreign banks. Two state banks, seven listed banks and two unlisted banks[4] constituted the domestic banks incorporated in Sri Lanka. The study was confined to domestic LCBs. Foreign banks were excluded from the study, as their applicable corporate governance practices must be considered in conjunction with the regulations and laws of both their home countries and the host country. Further, foreign banks steer their operations in Sri Lanka with a management committee, as opposed to a board of directors. The mandatory direction on corporate governance places a greater emphasis on the board of directors compared to the management committee of a foreign LCB, and the Central Bank has little enforcement power over the parent bank in another jurisdiction.

Delimiting the study to domestic LCBs, the research was carried out for all eleven LCBs by referring to annual reports published after December 31, 2008, to assess the level of compliance with the mandatory corporate governance direction during the first year of implementation. The data collected for this study consists of secondary data. In gathering data from annual reports, careful consideration was given to sections such as the corporate governance report, management discussion and analysis, risk management report, annual report of the board of directors on the bank's affairs, board committee reports, audit report, and notes to the financial statements.

4 Analysis and Discussion

The analysis has been carried out to measure the level of compliance in the first year of implementation of the corporate governance direction by domestic LCBs under three dimensions viz. vertical, horizontal, and stratified. The vertical analysis assesses the level of compliance of each domestic LCB while the horizontal analysis examines the level of compliance by all LCBs with each identified corporate governance principle stipulated in the direction. The stratified analysis highlights homogeneous characteristics demonstrated by individual strata viz. state owned LCBs, large listed LCBs, medium-sized listed LCBs, small-sized listed LCBs, and unlisted LCBs.

4.1 Vertical Analysis: The Level of Compliance of each LCBs with the Corporate Governance Direction of the Central Bank

As stipulated in the methodology, an overall composite score has been computed for each LCB depending on their level of compliance with the corporate governance principles. Table 4.1 below provides a summary of findings of the vertical analysis on the level of compliance.

Table 4.1: Summary of Findings of the Analysis on the Level of Compliance[5]

	LLLCB1	LLLCB4	SLCB1	LLLCB2	MLLCB1	SLLCB1	MLLCB2	ULCB1	SLCB2	ULCB2	LLLCB3
Overall Score	93%	90%	90%	89%	89%	81%	81%	74%	67%	65%	42%
Rank	1	2	2	4	4	6	6	8	9	10	11

The corporate governance directions by the Central Bank are mandatory for LCBs. The directions required LCBs to commence the compliance process effective from January 1, 2008, and full compliance by or before January 1, 2009. Thus, the financial year 2008 marked the first year of adoption for the corporate governance direction

[4] These two unlisted banks were subsequently listed on the Colombo Stock Exchange

[5] Listed LCBs have been further disaggregated into Large Listed LCBs - LLLCBs; Medium-sized Listed LCBs - MLLCBs and Small-sized Listed LCBs - SLLCBs considering their total asset size. The threshold used for this disaggregation is not disclosed with the view of concealing the identity of each LCB. Abbreviations of other LCBs categories are: SLCB – State LCBs and ULCB – Unlisted LCB.

applicable to LCBs. Overall average score demonstrated by the domestic LCB sector was reported at 78% which indicates a relatively high level of compliance during the first year of adoption. 7 out of 11 banks reported a score of well above 80% which is a commendable achievement. In contrast, three banks complied moderately with the directions while one bank fell below the threshold of moderate level of compliance.

LLLCB1 outperformed peer domestic LCBs during financial year 2008, as it cruised top of the list with an overall score of 93%. This bank demonstrated its commitment to adhere to each assessment criteria in the direction. Besides, LLLCB1 ranked the best bank of the year in Sri Lanka as adjudged by two international magazines for year 2007. Further, the bank was the joint overall winner and the banking sector winner at the annual report competition by a professional accounting body in Sri Lanka. The commitment for operational and reporting excellence would have been a contributing factor for this high level of compliance. LLLCB4 and SLCB1 marked second in ranking with an overall score of 90%. LLLCB4 reported a high level of compliance with each corporate governance principle. SLCB1 being a state-owned bank had demonstrated a praiseworthy level of compliance. The state bank was incorporated and governed by an Ordinance/Act which in certain circumstances overruled mandatory code of the Central Bank on corporate governance. Therefore, in instances where the Ordinance/Act supersedes the provision of the mandatory code of the Central Bank, such corporate governance principles were excluded in computing the overall score for two SLCBs.

LLLCB2 and MLLCB1 fell marginally short of second place, where they secured fourth place with a score of 89%. LLLCB2 annual report was adjudged runners-up at the annual report competition by a professional accounting body in Sri Lanka. The top five rankers have been scattered around an average compliance score of 90%. Except SLCB1, all other LCBs within the top five are publicly listed banks with over Rs 80 billion worth of assets as at end 2008. In addition, SLLCB1 and MLLCB2 also had demonstrated a high level of compliance with the mandatory code of Central Bank. Both remain at sixth place with 81% rate of compliance. These are followed by ULCB1, SLCB2, and ULCB2, which are assessed at a moderate level of compliance. Notably, these banks disclosed insufficient information or no information regarding certain provisions of the corporate governance code. Similar to SLCB1, the Ordinance/Act that incorporated SLCB2 had overruled the corporate governance directions of the Central Bank. Such instances were excluded in computing the overall score for SLCB2. LLLCB3 was the least complied bank with an overall score of 42%. The bank exhibited extremely poor corporate governance practices during the financial year 2008. These findings precisely mirrored the serious corporate governance malpractices of the previous director board of LLLCB3.

The mean score of the distribution stood at 78% which suggests that LCBs in general are at a relatively high level of compliance with the corporate governance directions of the Central Bank. The standard deviation of the distribution of LCBs was as low as 15% indicating that the level of compliance on average would be between 78% ± 15% (i.e., between 63% - 93%). The domestic LCB sector in general has skewed towards a high level of compliance with the mandatory code of the Central Bank on corporate governance. 64% of LCBs reports a high level of compliance, 27% reports a moderate level of compliance while only 9% reports a lower level of compliance.

4.2 Horizontal Analysis: Compliance by the LCB Sector with each Provisions of Mandatory Code on Corporate Governance

This analysis reviews the overall compliance of the LCB sector with each assessment criterion during the first year of implementation. The overall score for each criterion is the arithmetic mean of the scores earned by all domestic LCBs. A score has been computed for each corporate governance principle identified in the study.

4.2.1 Defined Responsibilities of the Board

"Defined responsibilities of the board" is the first key assessment criteria defined in the conceptual model consisting of seven corporate governance principles. During the financial year 2008, all domestic LCBs demonstrated a high level of compliance with these corporate governance principles and the score stood at 86%

on average. Except for two banks namely LLLCB3 and ULCB1, all other local banks demonstrated a score of well above 80%. Nevertheless, governance principles such as existence of a self-assessment scheme for directors and provisions on board meetings reported fairly a moderate level of compliance. Further, principles such as provisions on company secretary and capital adequacy ratio which were addressed in other regulatory provisions such as the Companies Act No. 7 of 2007, Articles of Association and Banking Act, demonstrated a high level of compliance.

4.2.2 Aptness of Directors, Composition of the Board and Affairs of Directors

This key assessment criteria demonstrated a nearly high level of compliance (78%) with the corporate governance directions of the Central Bank, during the financial year 2008. SLCB2 and LLLCB3 reported a lower level of compliance with 44% and 41% respectively. Other LCBs of the sample except for ULCB2 complied with the above 80% score. ULCB2 scored a moderate level of compliance (64%). This key assessment criterion is comprised of three broad elements of corporate governance principles. The analysis revealed that the principle of "aptness of directors" was the least complied principle with a score of 41% while other broad corporate governance principles viz. conflict of interest and composition of the board marked a high level of compliance.

4.2.3 Delegation and Segregation of Operations

This key assessment criteria evaluated corporate governance principles applicable to the chairman and Chief Executive Officer (CEO). On average a moderate level of compliance (70%) was demonstrated by LCBs with respect to governance principles related to this section in the first year of the adherence. All LCBs utilised in this study had segregated roles among chairman & CEO and had defined the role of CEO as the apex executive in-charge of day-to-day operations. Most LCBs had a non-executive chairman on board. Only MLLCB1 had an independent non-executive chairman. However, following the guidelines of the Central Bank corporate governance code, three LCBs namely MLLCB2, ULCB2 and ULCB1 had appointed a senior director on their boards since the chairman was not independent. Notably, a significant number of LCBs failed to indicate in their annual reports that the chairman holds the responsibility for effective communication with shareholders.

4.2.4 Monitoring and Evaluation

This encompasses the corporate governance principles applicable to board-appointed committees, including the Audit Committee, Human Resources and Remuneration Committee, Nomination Committee, and Integrated Risk Management Committee. LCBs exhibited a moderate level of compliance with these principles which stood at 69%. Provisions related to the audit committee and human resources & remuneration committee depicted a high level of compliance while the other committees moderately complied with the provisions of the Central Bank. Generally, LCBs were unsuccessful in disclosing the secretaries of these committees and presenting a report on the performance of each committee. It was also noted that several LCBs formed human resources, nomination and integrated risk management committees subsequent to the 2008 financial year.

4.2.5 Communication and Disclosure

This assessment criteria scored a higher rate of compliance with a score of 88% with the Central Bank's directions. Communication with shareholders was the least complied with principle of this section with a compliance rate of 56%. State banks and unlisted LCBs paid least attention to build constructive dialogue with their shareholders. Reasons could be that the Government of Sri Lanka is the major shareholder of state owned LCBs while unlisted LCBs have a relatively concentrated shareholder base. Further, state owned LCBs and unlisted LCBs are not subject to the directives of Securities and Exchange Commission (SEC) which demands enhanced disclosure and communication practices. Preparation of financial and regulatory reports recorded a moderate score of 70%. Even though LCBs prepare and publish quarterly financial & regulatory reports, many had not explicitly disclosed the fact in their annual reports. Therefore, it was difficult to conclude whether they published such financial statements in newspapers in all three languages. Finally, it was evident that LCBs had complied completely with the minimum disclosure principle during financial year 2008.

4.3 Stratified Analysis: Homogeneous Characteristics Demonstrated by Strata of LCBs.

The sample of 11 domestic LCBs was clustered for 5 identifiable homogeneous strata viz. state owned LCBs, large listed LCBs, medium-sized listed LCBs, small-sized listed LCBs and unlisted LCBs. The stratified analysis has been carried out in order to examine the level of compliance demonstrated by such identified clusters with the corporate governance directions of the Central Bank. Please Refer Table 4.3.

Table 4.3: Stratified Analyses

Key Assessment Criteria	State owned LCBs	Large Listed LCBs	Medium-Sized Listed LCBs	Small-Sized Listed LCBs	Unlisted LCBs
Defined responsibilities of the bank	93%	94%	91%	86%	77%
Aptness of directors, composition of the board and affairs of directors	66%	88%	86%	91%	77%
Delegation and segregation of operations	70%	81%	75%	50%	67%
Monitoring and evaluation	79%	83%	84%	86%	41%
Communication and disclosure	83%	94%	89%	91%	84%
Overall Score	**78%**	**88%**	**85%**	**81%**	**69%**

Large listed LCB stratum dominated domestic LCB sector when complying with the mandatory code of the Central Bank on corporate governance. It reported a high level of compliance (88%) in the financial year 2008. Top 3 LCBs in this cluster was hovering in the range of 89% - 93%. However, the least complied bank, LLLCB3, was an outlier which dampened the overall score of compliance by large listed LCB stratum. Medium sized listed LCBs and small sized listed LCBs remained second and third in ranking with a high level of compliance. Overall, listed banks demonstrated a phenomenal level of compliance with the corporate governance direction during the first year of implementation.

State owned LCBs stratum secured a moderate level of compliance (78%). The stratum falls marginally below the threshold of high level of compliance. However, the overall score was on par with the domestic LCB sector average. Among the two, SLCB1 outperformed SLCB2 with a score of 90%. Weak compliance by SLCB2 with the corporate governance direction has adversely affected the overall score for the stratum. However, the stratum reported a high level of compliance for two assessment criteria while a moderate level of compliance has been reported for the rest. Unlisted LCBs were ranked last with an overall compliance of 69%. It marked a high level of compliance with one assessment criteria. Notably monitoring and evaluation criteria had reported a low level of compliance (41%). This is the least complied assessment criteria by an identified stratum. Three assessment criteria of unlisted LCBs were within a moderate level of compliance.

5 Conclusion of the Study

The objective of the study was to examine the level of compliance of domestic LCBs with the provisions of the Central Bank's mandatory code of corporate governance in the first year of its implementation and to identify salient characteristics. All LCBs utilised for the study had virtually complied with the ***minimum disclosure requirement*** of corporate governance code of the Central Bank (i.e., 99%) during their first year of adoption. The ***overall compliance*** with the mandatory code by domestic LCBs marked at 78%, which marginally fell

below the threshold of a high level of compliance[6], as defined in this study. The standard deviation of the distribution of corporate governance score of LCBs was as low as 15%.

Seven LCBs (i.e., 64% of the sample) comprising six listed LCBs and one state-owned LCB reported a high level of compliance with the mandatory code while three LCBs (i.e., 27% of the sample) encompassing a state owned LCB and two unlisted LCBs reported a moderate level of compliance. One large listed LCB marked a low level of compliance with a 42% overall score. LLLCB1 dominated its peer LCBs with an overall score of 93%. This was followed by LLLCB4 and SLCB1 where both marked a score of 90%. LLLCB2 and MLLCB1 emerged fourth place with a score of 89%. The least compliant bank was LLLCB3 which reported a lower-level compliance (42%) with the corporate governance code. The level of compliance with the mandatory code tends to rely more on the unique characteristics of an individual bank rather than the category or stratum to which it belongs.

Listed LCBs reported the highest score in terms of compliance with corporate governance directions of the Central Bank, which was 81% in year 2008. State owned LCBs marked the second highest score with 78%, which was on par with the overall LCB sector average. Unlisted LCBs recorded a compliance score of 69%, ranking them the lowest among all the assessed strata. Among the top five rankers there were four listed LCBs who marked an average compliance rate of 90%. Except for one, other members in the listed LCB stratum reported a compliance score of above 81% or above. The poor performance reported by LLLCB3 deteriorated the overall score for listed LCBs. A similar behavioural pattern could be observed with state owned LCBs, where SLCB2 reduced overall compliance score reported by the state owned LCB stratum. A general observation on SLBC2 was that it had provided insufficient information pertaining to several key assessment criteria in their annual report.

In reviewing the compliance with each assessment criteria of the conceptual model, it was found that the LCB sector reported a high level of compliance with two assessment criteria viz. communication & disclosures and defined responsibility of the board. Corporate governance principles such as safety & soundness of the bank, company secretary, annual report on corporate governance and capital adequacy ratio had contributed positively on the assessment criteria – "defined responsibility of the bank". Further, two corporate governance principles namely preparation of financial and regulatory reports and minimum disclosures made in annual corporate governance report underpinned the higher level of compliance reported by the assessment criteria – "communication and disclosure", which was identified in the conceptual model. Other assessment criteria marked a moderate level of compliance during the financial year under review. Further, monitoring and evaluation was the least complied assessment criterion by domestic LCBs, with a score of 69%. The reasons for this were nonexistence of the required number of board committees during 2008, not convening required number of committee meetings, inadequate number of independent directors and secretaries on each committee and non-availability of a report from each committee published in the annual report.

The corporate governance principles that were also addressed in other regulatory provisions such as compliance with capital adequacy ratio, appointing a secretary to the board, related party transaction disclosure etc, reported a very high level of compliance. These principles contributed positively on the overall level of compliance within the LCBs sector. LLLCB3 demonstrated a fairly poor level of compliance with these principles as well.

When analysing the provisions pertaining to the board, it was observed that boards of LCBs lacked an *independent* non-executive chairman, except one. However, in many instances the chairman was a non-executive director.

[6] The level of compliance with the mandatory code varied between LCBs. The study indicated that LCBs on average were in the range of 78% ± 15% of compliance with the provisions of mandatory code. This distribution of the score allowed to demarcate the level of compliance among individual banks. For the purpose of this study the thresholds used to define the level of compliance *(Njomo et al., 2012)*: a high level of compliance – a score of 80% or above; Moderate level of compliance – a score between 60% and 79%; a low level of compliance is a score of 59% or below.

The information provided in the annual report (interest register) was not adequate to determine whether directors exceeded the minimum of 20 directorships. Furthermore, the attendance of a director for at least 2/3 of board meetings was below satisfactory as a few directors had failed to meet the requirement during the financial year 2008. In addition, it was noted that state banks and unlisted LCBs paid least attention to build constructive dialogue with their shareholders. Availability of self-assessment schemes was another area where LCBs least complied with. Moreover, diversity on the board could be further enhanced in terms of gender, profession and age. Corporate governance principles such as self-assessment schemes for directors, aptness of directors, communication with shareholders, and guidelines on nomination committees marked a notably low level of compliance with the mandatory code.

Domestic LCBs had adopted diverse corporate governance disclosure practices which had led to several complications such as non-disclosure of information, ambiguity, inconsistent reporting, etc. The corporate governance disclosures were generally scattered in the annual report despite the mandate to present in a separate corporate governance report within the annual report. Many banks chose not to comment on corporate governance disclosures in their annual reports when they had not complied with. A few LCBs had taken measures in early adopting some of the provisions of corporate governance directions such as compliance with total period of service of a director on board, minimum number of independent non-executive directors, maximum age limit to act as a director of LCB, which would be effective on a future date. Listed LCBs adhered with the codes on corporate governance issued by Colombo Stock Exchange, Institute of Chartered Accountants of Sri Lanka, Securities and Exchange Commission in addition to their compliance with the mandatory code of the Central Bank on corporate governance.

It could be concluded that the boards of directors of domestic LCBs, to whom banking operations were entrusted, demonstrated satisfactory level of compliance with the mandatory corporate governance code in the first year of adoption, even though full compliance was only required by or before January 1, 2009. However, a low level of compliance suggests that there is room for further improvements.

The study highlights the level of compliance, and the challenges domestic banks faced in adopting corporate governance principles during their first year of implementation. Despite many years of corporate governance adoption by domestic banks, there has been limited research conducted on the banking sector. Hence, the study contributes to the corporate governance literature in Sri Lanka, particularly within the banking sector. Banks have demonstrated their commitment to complying with regulatory requirements. However, it was observed that banks need to go beyond merely meeting regulatory requirements and adopt best practices in corporate governance, particularly with regard to principles of transparency and disclosures. Appropriate methods could be developed to incentivise banks to strengthen their corporate governance practices while encouraging them to embrace the principles of good governance beyond mere compliance with the regulatory requirements. The study emphasises the importance of conducting an annual dedicated review of corporate governance practices for banks, either by the regulator or an independent agency, and making the results publicly available. As part of this annual exercise, strengths and weaknesses in corporate governance practices can be identified and communicated with both the regulator and respective banks. Further, continuous dialogue with the board of directors will help to eliminate misconceptions about corporate governance principles, enabling the regulator to guide banks toward the best practices effectively. Additionally, the regulator should closely monitor corporate governance review practices in other jurisdictions to continuously improve its effectiveness and ensure the soundness and safety of the financial sector.

5.1 Recommendation to Future Research

Further studies could be carried out to evaluate the corporate governance practices by LCBs since the implementation of the mandatory code in 2008. A corporate governance index for the domestic LCB sector could be developed to rank corporate governance disclosures and practices of LCBs. This can also be utilised for annual corporate governance competitions as an assessment criterion. Adopting a corporate governance

scorecard similar to those of ASEAN (ADB, 2014) and the IFC (IFC, 2014) would enable Sri Lanka to stay aligned with international best practices. Disclosing the level of compliance with corporate governance principles not only encourages companies to integrate good governance into their business models but also promotes research in related areas, such as corporate governance and financial performance, firm value (Zhu, 2014), and the impact of governance on the quality of annual reports (ADB, 2014 and Cohen et al., 2004). Further studies can be carried out to design corporate governance principles to address aspirations of public depositors, a prime stakeholder in financing the intermediation operations of LCBs. Studies can also be focussed in identifying means of improving shareholder participation and identifying best modes of communication in educating shareholders and public depositors of their rights.

5.2 Limitations

Analysis of annual reports was limited to a single reporting period as the author examines the level of compliance with the mandatory code of corporate governance ***in the first year of adoption*** for each domestic LCB. The annual reports for the year ending 31 December 2008 had been the first available annual report since the implementation of the Banking Act Direction No 11 of 2007. Full compliance with the provisions stipulated in the direction was required by or before January 1, 2009; hence, the evidence of full compliance can be found in the annual report for the year ending 31 December 2009. Further, the findings of the study cannot be generalised for the entire LCBs sector as foreign LCBs were excluded from the sample. The data utilised for this study were secondary data. Thus, this study is subject to inherent limitations associated with secondary data.

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Appendices

A.1 Compliance Assessment Matrix: First Time Adoption of Corporate Governance Directions by Licensed Commercial Banks (Commenced on January 1, 2008, Full Compliance by January 1, 2009)

Section	Key Assessment Criteria	Corporate Governance Principle	Reference Section of the Banking Act Direction 11 of 2007, as amended
1	**The Defined Responsibilities of the Board**		
		The Safety and Soundness of the Bank	3(1)(i)
		Communication of strategic objectives, business strategy and corporate values	
		Identification of principle risks on the and reveal risk Management Policy Annual report	
		Comment on the adequacy of the Bank's internal control system by the board	
		Identification and designation of Key Management Personnel	
		Board meetings	3(1)(iii)
		Convene minimum of 12 board meetings a year	
		Attendance of a director for at least 2/3 of the board meetings in the period of 12 months	
		The appointment of a company secretary	3(1)(vii)
		Access to independent professional advice	3(1)(xi)
		Compliance with Capital Adequacy Ratio as required by Monetary Board	3(1)(xv)
		Annual Corporate Governance report in the Annual Report of the bank	3(1)(xvi)
		Availability of Self-assessment scheme to be undertaken by each director and maintaining of such assessment record	3(1)(xvii)
2	**Aptness of Directors, Composition of the Board and Conduct of Directors**		
		The Board's Composition	
		Minimum Directors to be 7 and Maximum to be 13 on the Board	3(2)(I)
		Compliance with the total period of service of a director as per the subsequent amendments of the direction	3(2)(ii)
		No. of executive directors does not exceed 1/3 of the board	3(2)(iii)
		Minimum of 3 independent non-executive directors on the board with effective from January 1, 2010	3(1)(xii), 3(2)(iv)
		Existence of formal, considered and transparent procedures for the appointment of new directors to the board by Nomination Committee	3(2)(ix), 3(6)
		Casual vacancies are subjected to election of shareholders at the first General meeting after the appointment	3(2)(x), 3(6)
		Announcement of a director's resignation or removal and reason for such	3(2)(xi)
		No director or an employee can be appointed, elected or nominated as a director of another bank	3(2)(xii)
		Aptness of Directors	**3(3)**
		Compliance to the minimum age to act as a director shall not exceed 70 years, subject to subsequent amendments	3(3)(I)
		No person holds office as a director for more than 20 companies inclusive of subsidiaries	3(3)(ii)
		Conflict of Interest	**3(7)**
		Disclosing related party transactions	
3	**Delegation and Segregation of Operations**		
		Management Functions Delegated by the Board	
3(4)(I)		Clear understanding of the delegation arrangement by the directors	removed

3(4)(ii)		No function has been delegated to a committee or a person that would hinder ability of the board in discharging its functions	removed
3(4)(iii)		periodic review of the delegation process in place	removed
		The Chairman and Chief Executive Officer	**3(5)**
		Segregated roles among chairman and CEO	3(5)(I)
		The chairman shall be non-executive and independent director	3(5)(ii)
		The disclosure of any material relationship between chairman, CEO and any other board member	3(5)(iii)
		A statement on the fact that chairman has not engaged in direct supervision of key management personal or any other executive duties	3(5)(ix)
		Chairman held responsible for effective communication with the shareholders	3(5)(x)
		Defined Role of CEO as apex executive in -charge of the day -to day business operations of the bank	3(5)(xi)
4	**Monitoring and Evaluation**		
		Board Appointed Committees	3(6)(I)
		Existence of at least four board committees	
		Existence of secretary for each committee	
		A report by each committee	
		Audit Committee	3(6)(ii)
		Chairman of the committee is a independent non-executive director who possess accountancy and/ or audit related qualification or experience	
		All members are non-executive directors	
		The disclosure of the activities of the Audit committee, Number of meetings held during the year and details of attendance of each individual director by the board	
		Existence of Human Resource and Remuneration Committee and compliance with the rules	3(6)(ii)
		Defined responsibility for remuneration policy	
		Compliance with rules applicable to Nomination Committee	3(6)(iv)
		Chaired by an Independent Director	
		All new appointments/ reappointment by routed through the committee	
		Compliance with rules applicable to Integrated Risk Management Committee	3(6)(v)
		Consists of at least 3 non-executive directors	
		Convene meetings at least quarterly	
5	**Communication and Disclosure**		
		Relation with Shareholders	
		Circulation of Annual report and notice of AGM	
		Defined responsibilities of the board & chairman and their commitment to develop constructive dialogue with shareholders at AGM	3(1), 3(8)
		Preparation of Financial and Regulatory Reports	3(8)(I)
		Auditors Report that assures compliance with accounting, regulatory and statutory requirement	
		A statement on the annual report illustrating the facts that financial accounts were published in all three languages in the newspapers	
		Minimum Disclosure made in the Annual Report	3(8)(ii)
		Publish audited financial statements with notes	
		Directors report on the annual report	
		External auditor's certification on the effectiveness of the internal control mechanism referred above internal control mechanism	
		Profile of the board of directors and their aptness on the board	
		Net accommodation granted to each category of related party in the note to related party transaction	3(8),3(6)
		Disclosure of remuneration	
		A note on compliance with the prudential requirement, regulations and laws and internal controls	
		A note on lapses in the bank's risk management, or non-compliance with these directions for disclosure to the public	

Forecasting the Unemployment Rate in Sri Lanka using Selected Macroeconomic Variables: A Comparative Study of Machine Learning/Deep Learning and Econometric Models[1]

S R C L Gunawardhana [2]

Abstract

This study investigates the impact of key macroeconomic variables on Sri Lanka's unemployment rate and compares various forecasting models, namely, econometric, Machine Learning (ML), and Deep Learning (DL) to improve unemployment rate prediction accuracy. Using quarterly data from 1998 to 2024, including GDP growth, inflation, interest rates, exports, exchange rates, and tourist earnings, the research evaluates relationships between these indicators and unemployment rate. Traditional econometric analysis, specifically the Vector Error Correction Model (VECM), is employed to capture long term relationships, while ML models (Random Forest, Support Vector Regression, and Extreme Gradient Boosting) and DL models (Feedforward Neural Network) address non-linear and complex patterns in data. Forecast evaluation shows that Random Forest provides the highest accuracy, with a Mean Absolute Error (MAE) of 0.13, outperforming other models. The VECM, while effective in capturing long term trends, has limitations in short-term forecasting due to linear assumptions.

This study discusses the potential of ML and DL models in economic forecasting, offering robust supportive techniques to improve traditional econometric methods. These insights can support policymakers in proactive labor market interventions. Accordingly, the findings from this study highlight the need for a hybrid approach that combines economic theory, as well as the adaptability of blending non-conventional and conventional modeling techniques for economic analysis.

Key Words: *Forecasting, Machine Learning, Macroeconomic Variables, Sri Lanka, Unemployment Rate*

JEL Classification: *C32, C53, E24, E27, E37, E66*

[1] The views expressed in this paper are the author's own and do not necessarily reflect those of the Central Bank of Sri Lanka.

[2] Senior Assistant Director, Statistics Department, Central Bank of Sri Lanka (chamili@cbsl.lk)

1 Introduction

The unemployment rate, a key economic indicator, measures the percentage of individuals within the labour force who are unemployed and actively seeking work. Its fluctuations influence economic output, social stability, and overall economic health. High unemployment not only reflects an underutilisation of labour resources but can also lead to prolonged social and economic issues, while low unemployment may drive inflationary pressures due to economic overheating. In Sri Lanka, the Department of Census and Statistics (DCS) officially reports quarterly unemployment rates. However, the DCS's 12 to 14-week time lag in publishing these figures creates a critical gap for real-time decision making. This delay underscores the need for effective forecasting methods that provide timely unemployment estimates, allowing stakeholders to proactively respond to changes and enabling more immediate economic assessments and economic analysis, such as GDP and inflation forecasting.

Research across various countries has demonstrated how macroeconomic factors including GDP growth, inflation, interest rates, and external events like pandemics and natural disasters impact unemployment rates. For instance, studies in Turkey, South Africa, and other nations detailed in the Literature Review section reveal complex interactions between these economic indicators and unemployment. Specific studies on Sri Lanka have shown notable correlations, particularly between unemployment and indicators like exports, inflation, and interest rates. Additionally, the rapid advancements in ML and DL are transforming forecasting methods, offering enhanced capabilities for capturing nonlinear relationships in economic data. Techniques such as Random Forests, Decision Trees, and neural networks have demonstrated significant potential to identify underlying patterns that traditional models may not capture. In global contexts, these methods have proven valuable in economic forecasting, showing promising results in unemployment rate prediction and policy analysis.

While traditional econometric models such as VECM and Auto Regressive Integrated Moving Average (ARIMA) have been widely applied in econometric forecasting, their reliance on linear assumptions may limit their effectiveness in capturing complex, real world data dynamics. In Sri Lanka, a few studies detailed in the Literature Review have utilised advanced ML and DL techniques, leaving unexplored opportunities to improve prediction accuracy and robustness in unemployment forecasting. Thus, a critical gap exists in identifying and applying models that effectively balance short term predictive accuracy with long term insights. This study aims to address this gap by comparing conventional econometric models with advanced ML and DL techniques to identify the optimal approach for forecasting the unemployment rate in Sri Lanka.

Objectives of this study are:

1. To examine the relationships between unemployment rates and key macroeconomic variables in Sri Lanka.
2. To investigate the applicability of Okun's law and Phillips curve in Sri Lankan economic context.
3. To develop and compare forecasting models including econometric, ML, and DL approaches to improve the accuracy of unemployment rate forecasts.

   By pursuing these objectives, this research aims to contribute valuable insights for policymakers, demonstrating the practical utility of advanced forecasting techniques in enhancing both short term responsiveness and long term economic planning.

2 Literature Review

Forecasting unemployment is a multifaceted research area that spans traditional econometric models and more recent advancements in data science approaches. Globally, studies have employed models such as Vector Auto Regression (VAR) and VECM to explore the influence of GDP, inflation, interest rates, and exports on unemployment. In recent years, ML and DL models such as Gradient Boosting and neural networks have tried to capture complex, nonlinear relationships in economic data, often achieving higher accuracy levels. Although research carried out in Sri Lanka has explored ML techniques, a gap remains in utilising advanced models for local unemployment forecasting. This review aims to synthesise insights from existing research to evaluate effective forecasting methods for Sri Lanka.

2.1 Research Related to the Unemployment Rate and Other Macroeconomic Variables in Other Countries

International research highlights the intricate relationships between the unemployment rate and macroeconomic variables such as GDP, inflation, exchange rates, and exports. Econometric models are commonly applied to study these interactions. For example, Dogan (2012) used a VAR model to analyse Turkey's unemployment rate, incorporating variables such as GDP growth, exports, inflation, and exchange rates. This study demonstrated that GDP growth and exports tend to reduce unemployment, while inflation and exchange rate fluctuations appear to increase it. These findings align with Okun's Law, which indicates an inverse relationship between economic growth and unemployment, and the Phillips Curve, suggesting a positive correlation between inflation and unemployment.

Similarly, Nyahokwe and Ncwadi (2013) investigated South Africa's unemployment dynamics using VAR, GARCH, and VEC models, highlighting exchange rate volatility as a significant predictor of unemployment, particularly in export-reliant sectors. Their findings underscore the impact of global economic shifts on domestic labor markets, especially in trade-dependent economies.

Other studies, such as Gaston and Rajaguru (2011) in Australia and Asif (2013) in a comparative analysis of Pakistan, India, and China, further demonstrate how macroeconomic factors influence unemployment across different contexts. Gaston and Rajaguru linked rising export prices to reduced unemployment in Australia, while Asif found that GDP growth decreased unemployment in India and China but increased it in Pakistan, highlighting how macroeconomic policies and contexts affect labour market outcomes.

2.2 Research Related to Unemployment Rate and Other Macroeconomic Variables in Sri Lanka

In Sri Lanka, studies identify inflation, interest rates, exports, and exchange rates as key determinants of unemployment. Typically, inflation and interest rates are associated with higher unemployment, whereas exports are linked to lower rates. Ariyadasa and Gunaratne (2014) applied the Phillips Curve to demonstrate that inflation raises unemployment by increasing production costs and reducing labor demand. Further, Jayathilaka and Mahendra (2016) confirmed these findings using a VECM, suggesting that inflation lowers purchasing power and suppresses demand, which negatively impacts employment.

Research by Fernando and Karunaratne (2018), employing an ARDL model, highlighted the role of interest rates, showing that high rates discourage job creation in capital-intensive sectors. Senanayake et al. (2019), using a Granger Causality test, found that export growth in sectors like textiles reduces unemployment by creating labor-intensive jobs. Supporting these studies, Perera and Wijesinghe (2020) applied Okun's Law and the Phillips Curve in Sri Lanka, demonstrating that GDP growth is inversely related to unemployment while inflation exerts upward pressure on it. These studies collectively provide an empirical foundation for understanding unemployment in the Sri Lankan economy.

2.3 Research on Data Science Approaches to Forecast Unemployment in Other Countries

Data science advancements have expanded the toolkit for forecasting economic indicators, including unemployment rate. These methods excel at capturing nonlinear relationships, a common limitation in traditional models. For instance, Guo et al. (2018) applied a Gradient Boosting Machine (GBM) to U.S. labour market data (2005–2017), demonstrating superior performance over traditional models like ARIMA by effectively capturing seasonal patterns and complex variable interactions. Similarly, Anderson and Broadbent (2019) employed a Random Forest model on European labor data (2010–2018), focusing on GDP, inflation, and trade indices. Their findings showed that Random Forest was highly effective in managing multicollinearity and variable interactions, resulting in a significant reduction in forecast error compared to linear regression models. These studies underscore the potential of ML models to improve forecasting accuracy by accommodating data complexities.

2.4 Research on Data Science Approaches to Forecast Unemployment in Sri Lanka

In Sri Lanka, the application of ML in unemployment rate forecasting is emerging, with studies focusing on models like Gradient Boosting, Decision Trees, and Support Vector Regression (SVR). Perera and Fernando (2022) applied GBM to

manage multicollinearity between inflation and exchange rates, achieving higher forecast accuracy compared to linear models. Their findings underscore GBM's ability to handle prediction errors iteratively, enhancing model precision.
Similarly, Ranasinghe and Wijeratne (2020) used Decision Trees, which improved forecast accuracy by 15 per cent over traditional methods by effectively capturing interactions among GDP growth, exports, and inflation. Jayaratne and Senanayake (2019) employed SVR to forecast unemployment during volatile periods, finding that it outperformed ARIMA models in MAE and Mean Squared Error (MSE), demonstrating adaptability to noisy data.

2.5 Research on Data Science Approaches to Forecast Macroeconomic Variables

Beyond unemployment, ML approaches have been applied in forecasting macroeconomic variables such as GDP and inflation. Gonzalez (2000) demonstrated that neural networks outperform traditional models in GDP forecasting by capturing linear and nonlinear relationships. Fischer and Krauss (2018) used an LSTM model on daily financial data (1992–2015) to predict inflation trends, highlighting the model's strength in sequential data dependencies. Nelson et al. (2017) applied a Recurrent Neural Network (RNN) model to forecast GDP and interest rates, emphasising RNNs' capability in time-series forecasting. Additionally, studies by Adebiyi et al. (2014), Chen and Guestrin (2016), and Smola and Schölkopf (2004) further illustrate the success of ML models like neural networks, XGBoost, and SVR in predicting volatile, seasonally influenced economic data.

2.6 Research Gap

Despite substantial research linking unemployment and macroeconomic variables, a significant gap exists in the application of advanced ML and DL techniques for unemployment forecasting in Sri Lanka. While traditional models like VECM and ARIMA are commonly used, their linear assumptions limit their capacity to capture complex patterns. Moreover, while global studies highlight the effectiveness of ML techniques and DL techniques in forecasting, these methods remain underutilised in Sri Lanka. Addressing this gap could improve the timeliness and accuracy of unemployment rate forecasting, especially considering the delayed availability of unemployment data in the country. This study aims to bridge this gap by evaluating ML and DL models alongside traditional econometric approaches to identify the most reliable forecasting method.

2.7 Summary

This literature review highlights the complex relationships between macroeconomic variables and unemployment rate. While traditional econometric models provide foundational insights, ML and DL approaches hold potential for enhancing forecast precision, especially in dynamic economic environments. Addressing identified research gaps will contribute to Sri Lanka's economic forecasting capabilities, supporting more responsive and effective policymaking.

3 Data and Methodology

3.1 Data Collection and Preparation

3.1.1 Variables, their definitions and sources

The variables used in this study are listed in the below table with their definitions and sources. The Data Library maintained by the Central Bank of Sri Lanka is the main secondary data source for the study. In addition, the Annual Reports and other publications of the Central Bank and the Quarterly Labour Force Survey Reports of the DCS are also used as secondary data sources to collect data and to obtain background information of the data.

Table 1: Details of Variables

No.	Variable	Definition	Source
1.	Unemployment rate	The proportion of unemployed population to the total labour force above 15 years of age.	Department of Census and Statistics
2.	GDP growth	Economic growth is the increment in the national income and output of an economy.	Department of Census and Statistics
3.	Inflation	The percentage change in consumer price index which is compiled based on the expenditure for a basket of consumer goods.	Department of Census and Statistics

4.	Interest rate	Interest rate is referred to as the amount charged, expressed as a percentage of principal, by a lender to a borrower for the use of assets on an annual basis.	Central Bank of Sri Lanka
5.	Exports	The goods and services produced in one country and traded to other countries.	Central Bank of Sri Lanka
6.	Exchange rate	The units of domestic currency per one unit of the foreign currency.	Central Bank of Sri Lanka
7.	Tourist Earnings	The earnings received to the country through from services related to tourism	Central Bank of Sri Lanka
8.	Terrorist Attacks	A dummy variable to identify periods with severe terrorist attacks in the country.	Publicly available information
9.	COVID 19	A dummy variable to identify periods with comparatively high impact from COVID 19 in the country.	Publicly available information

3.1.2 Data Transformation

The macroeconomic variables that are not available on a quarterly basis but available in other frequencies such as daily or monthly, are converted into quarterly series considering suitable conversion techniques to each of those variables. Further actions with regard to data preparation will be carried out in the analysis. Further details of the variables used are given below.

Unemployment Rate

Unemployment rate is a crucial factor of the economy which indicates the conditions of the labour market. Unemployment rate is the percentage of the total labour force that is unemployed but actively seeking employment and willing to work. Higher unemployment rates generally reflect worse economic conditions. As mentioned in the Labour Force Survey, the Annual Report published by the DCS, the unemployment rate is calculated by the DCS on quarterly basis after conducting the quarterly Labour Force Survey since the 1st quarter of 1990. Persons available and/or looking for work, and who did not work and taken steps to find a job during last four weeks and ready to accept a job given a work opportunity within next two weeks are said to be unemployed as defined by the DCS in the above publication. Accordingly, in Sri Lanka, the unemployment rate is the proportion of unemployed population to the total labour force above 15 years of age.

Unemployment rate data was extracted by the Data Library of the Central Bank and few data gaps were filled by referring to the quarterly Labour Force Survey reports of DCS and by imputing the missing values using the averages of adjoining periods. The Labour Force Survey was not conducted for the 2nd quarter of 2001 by the DCS and thus the unemployment rate for that period was imputed by getting the average of unemployment rates of 1st quarter and 3rd quarter of 2001. Further, since the DCS was involved in post tsunami related analyses, the quarterly Labour Force Survey was not conducted during the year 2005 and a one-off survey was conducted was conducted in August 2005. That value was used for all the four quarters of the year. The quarterly Labour Force Survey was not conducted during the 4th quarter of 2011 and the 1st quarter of 2012 as the DCS was involved in the Census conducted during 2012. Thus, the unemployment rate values for those two quarters were imputed by getting the average of unemployment rates of the other three quarters of the relevant year.

GDP Growth

Economic growth is the growth in Gross Domestic Product (GDP) which is the main measure of the nation's economic activities. The GDP is the total value of goods and services produced in a country in a stipulated period of time according to the System of National Accounts 2008 publication which is used globally as the handbook in compiling GDP. Therefore, economic growth is the increment in the national income and output of an economy. A positive economic growth always indicates good economic conditions and potential development of the economy. The GDP is calculated in both real and nominal terms by the DCS on a quarterly basis.

Currently, the real GDP is calculated considering 2015 as the base year according to the National Accounts Estimates of Sri Lanka - News Release of DCS. The real GDP compiled before the year 2015, of which the base years were 1996, 2002 and 2010 were converted to 2015 base year considering the growth values. In this study the GDP growth is calculated in quarterly basis considering the quarter-on-quarter growth of real GDP.

$$\text{GDP growth rate} = \frac{(\text{real GDP t} - \text{real GDP t}-4) \times 100}{\text{real GDP t}-4} \quad (1)$$

real GDP t : real GDP in the t^{th} quarter considered in the study

$\text{real GDP t} - 4$: real GDP one year ago to the t^{th} quarter considered in the study

Inflation Rate

Inflation rate is also a primary concern of an economy which indicates the acceleration of price levels. As defined in the Consumer Price Index Manual publication which is referred globally in compiling consumer price indices and calculating inflation, briefly, inflation rate is the percentage change in consumer price index which is compiled based on the expenditure for a basket of consumer goods. When the inflation rate is high, the real value of money erodes. In times of high inflation, if the income of people would not increase, the economy would struggle.

The inflation is calculated in Sri Lanka, based on the Colombo Consumers' Price Index (CCPI) and the National Consumers' Price Index (NCPI) by the DCS on a monthly basis. In this study, quarterly figures for CCPI were calculated by taking the average of monthly values of the relevant quarter and the inflation rate is calculated considering the quarter-on-quarter growth of CCPI which is compiled considering the base year as 2021. As per the annual reports of the Central Bank, the base years of CCPI are 1952, 2002, 2006, 2013 and 2021. The CCPI compiled based on previous base years were converted to 2013 base year considering the growth values.

$$\text{Inflation rate} = \frac{(\text{CCPI}_t - \text{CCPI}_{t-4}) \times 100}{\text{CCPI}_{t-4}} \quad (2)$$

CCPI t : CCPI in the t^{th} quarter considered in the study

$\text{CCPI t} - 4$: CCPI one year ago to the t^{th} quarter considered in the study

Interest Rate

Interest rate is generally referred to as the amount charged, expressed as a percentage of principal, by a lender to a borrower for the use of assets on annual basis. It is a measure of return and an indicator of risk as well. Higher interest rates discourage investments and lead to bad economic conditions. Interest rate is generally quoted in nominal terms and the inflation adjusted interest rate is referred to as real interest rate which compensates for the time value reduction of money. The Central Bank determines the policy interest rate/s in order to control the price and availability of money in the money market.

In this study, 91 days Treasury Bill rate determined by the Central Bank on a daily basis is considered and the quarterly values were derived by calculating the average of daily values.

Exports

Exports are referred to as the goods and services produced in one country and traded to other countries. As the production and sale of such goods and services are directly connected with the economic activities of a country and labour force activities, exports are a crucial component of an economy. Growth in exports would indicate the improvements in the performance of international trade. In this study, quarterly export values were gathered in USD billion terms.

Exchange Rate

Exchange rate is the price of a nation's currency in terms of another currency. It can be used as a measure of appreciation or depreciation of currency with compared to other currencies. The volatility in exchange rates would generate bad economic conditions since a depreciation of currency causes higher cash outflows and an appreciation would cause lower cash inflows. The exchange rate can be determined in direct quote or indirect quote.

As mentioned in the Pamphlet Series No.03 on Exchange Rate published by the Central Bank in 2006, in Sri Lanka the exchange rate is calculated in direct quote which indicates the units of domestic currency per one unit of the foreign currency. A positive growth in exchange rate indicates depreciation in Sri Lankan rupee and a negative growth in exchange rate indicates appreciation in Sri Lankan rupee. Sri Lankan rupee (LKR) per USD, monthly average exchange rate is converted to quarterly terms by getting the average of relevant months to be used in this study.

Tourism Earnings

Tourism earnings can be defined as expenditure of international inbound visitors including their payments to national carriers for international transport, and any other payments or payments afterwards made for the services received in the destination country. This variable includes the earnings received from tourism-related services in USD millions. The quarterly data series for tourism earnings was available only from 2001. Therefore, quarterly values for 1998 to 2000 were imputed by equally dividing the annual series. The data were extracted from the Balance of Payments data available at the Central Bank.

Terrorist Attacks

The Sri Lankan economy was affected by terrorist attacks time to time over the period considered in this study. Therefore, a dummy variable is added to represent the periods with severe terrorist attacks since they could be attributable to the economic activities of the country and hence on unemployment.

COVID-19

The COVID-19 pandemic prevailed since 2020 affected highly on unemployment. The lockdowns, employee reductions, and closedowns of businesses resulted in job losses. Therefore, a variable to indicate periods with comparatively high impact from COVID-19 in the country was used as a dummy variable in the analysis.

3.2 Methodology for Time Series Analysis

Initially, the relationships among variables are evaluated using Pearson's Correlation Coefficient, followed by the Kruskal-Wallis Test to assess seasonality. The stationary conditions of the variables are then checked using the Augmented Dickey-Fuller (ADF) Test. To examine interconnectedness, the Johansen Test for cointegration and the Granger Causality Test are conducted. A VECM is estimated for unemployment rate forecasting based on other key macroeconomic variables. Model adequacy is subsequently tested through residual diagnostics: the Shapiro-Wilk Test for normality, the Ljung-Box Test for autocorrelation, and the Breusch-Pagan Test for heteroskedasticity.

3.2.1 Vector Error Correction Model (VECM)

The VECM is a multivariate time series model designed to capture both short term dynamics and long term equilibrium relationships between non-stationary, cointegrated variables. In VECM, the differenced data (converted to stationary form) is modeled alongside error correction terms, which represent deviations from long term equilibrium. This allows the model to adjust for discrepancies and gradually revert to the equilibrium state over time. The VECM structure is particularly useful for analysing interconnected macroeconomic variables like GDP, inflation, and unemployment, as it addresses both immediate shocks and stable, long term relationships within the dataset.

3.3 Methodology for Deep Learning and Machine Learning Analysis

The study employs a Feedforward Neural Network (FFNN) as the Deep Learning model, using layered neurons to uncover complex patterns across multiple variables. The Machine Learning models include Random Forest (RF), an ensemble method that constructs multiple decision trees to capture non-linear interactions in complex datasets; Support Vector Regression (SVR), which effectively manages noise by optimally separating data points; and Extreme Gradient Boosting

(XGBoost), a powerful gradient boosting technique that iteratively enhances forecasting accuracy by minimising prediction errors.

3.3.1 Feedforward Neural Network Model (FFNN)

The FFNN model is a supervised deep learning model with interconnected layers of neurons that map complex relationships between inputs and outputs. It consists of an input layer, one or more hidden layers, and an output layer, where each layer is connected through weighted neurons. The model minimises prediction errors by adjusting neuron weights through backpropagation and optimisation algorithms. FFNNs are effective in capturing non-linear relationships, making them suitable for time series forecasting where interactions among macroeconomic factors are often complex and multilayered.

3.3.2 Random Forest Model (RF)

RF is an ensemble learning method based on constructing multiple decision trees for prediction. In this model, each tree is trained on a random subset of data and variables, allowing it to capture diverse patterns within the dataset. Predictions from individual trees are averaged to produce a final output, enhancing model stability and reducing overfitting. Random Forest's ability to handle non-linear data and rank feature importance makes it highly effective in economic forecasting, where multiple, interrelated indicators influence the outcome.

3.3.3 Support Vector Regression Model (SVR)

SVR is a regression technique that aims to find an optimal hyperplane that maximizes the margin within which most data points fall. Unlike traditional regression, SVR introduces a margin of tolerance for error, known as the epsilon-insensitive zone, where points within the margin do not contribute to error calculations. This approach makes SVR robust to noise and effective in capturing non-linear patterns when combined with kernel functions. SVR is particularly useful in economic forecasting due to its ability to handle outliers and maintain predictive accuracy.

3.3.4 Extreme Gradient Boosting Model (XGBoost)

XGBoost is a powerful ensemble method based on gradient-boosting principles. In XGBoost, multiple decision trees are sequentially constructed, each aiming to correct the errors of the previous tree. This iterative improvement process allows XGBoost to reduce prediction errors and capture complex patterns in data. With regularization to prevent overfitting, XGBoost effectively balances model complexity and performance. Its application in economic forecasting leverages its ability to handle both linear and non-linear relationships, providing accurate and resilient predictions.

3.4 Methodology for Forecast Evaluation

Forecast accuracy in this study is assessed using four performance metrics: Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Root Mean Squared Error (RMSE), and Mean Squared Error (MSE). These metrics provide insights into the magnitude, percentage, and distribution of forecast errors, ensuring a comprehensive evaluation of model effectiveness.

3.4.1 Mean Absolute Error (MAE)

MAE calculates the average absolute differences between actual and predicted values, providing an easily interpretable measure of forecast accuracy. MAE is a non-negative metric, where lower values indicate better model performance, as it reflects the average magnitude of prediction errors.

3.4.2 Mean Absolute Percentage Error (MAPE)

MAPE expresses the average absolute error as a percentage of actual values, allowing for intuitive comparisons across models. MAPE is particularly useful when comparing models on datasets with varying scales, as it contextualises the error relative to the observed values.

3.4.3 Root Mean Squared Error (RMSE)

RMSE measures the square root of the average squared differences between actual and predicted values. By penalising larger errors, RMSE emphasises the model's ability to accurately forecast extreme values or outliers, making it suitable for assessing overall predictive accuracy.

3.4.4 Mean Squared Error (MSE)

MSE calculates the average of squared differences between actual and predicted values. MSE penalises large errors more severely than smaller ones, providing a sensitive indicator of forecast accuracy. Lower MSE values reflect better model performance in terms of consistency and reliability.

4 Empirical Analysis and Discussion

This chapter presents the empirical findings from the analysis of selected time series variables, focusing on their temporal variations, model estimation, and forecasting performance. Initially, the temporal dynamics of each variable are considered, setting the stage for developing and evaluating several forecasting models. Accordingly, a time series econometric model, a deep learning model and three machine learning models are estimated to forecast unemployment rate of Sri Lanka. Further, a comparative analysis of forecast performance is carried out to identify the most effective model for accurate unemployment rate forecasting.

4.1 Data Preparation

This study uses seven key macroeconomic variables, namely, unemployment rate, GDP growth, inflation rate, interest rate, exports, exchange rate and tourist earnings. In addition, two dummy variables, namely, terrorist attacks and COVID-19 are also considered. The quarterly data from the year 1998 to the second quarter of 2024 are collected and transformed into quarterly time series as appropriate.

Accordingly, the unemployment rate data collected from the quarterly Labour Force Survey conducted by the DCS are used for the analysis. The real GDP compiled considering base periods of 1996, 2002,2010 and 2015 are collected, and the 1996, 2002 and 2010 base series are converted to combine with 2015 series considering the growth values. The analysis uses quarterly growth values of GDP, calculated based on the quarter-on-quarter percentage increase of the real GDP series. The third variable used in the study, "inflation rate" is calculated based on the monthly CCPI series. The CCPI is also compiled considering different base years, 1952, 2002, 2006,2013 and 2021, and thus, converted into 2021 series using growth values. Using this series, quarterly figures for CCPI are calculated by taking the average of monthly values of the relevant quarter, and the inflation rate is calculated considering the quarter-on-quarter growth of CCPI quarterly series. The variable, "interest rate" is represented in this study by the 91 days Treasury Bill rate determined by the Central Bank on a daily basis. A quarterly series of interest rates is derived by averaging the daily values relevant to the quarter. In terms of the variable, "exports", the quarterly export values in USD billion terms published by the Central Bank are used for the analysis. The sixth variable, "exchange rate" is calculated based on the monthly average exchange rate values (LKR per USD) available at the Central Bank. The quarterly values are obtained by averaging these monthly values. In terms of the variable, "tourist earnings", the monthly values in USD million terms, collected based on the survey conducted by the Sri Lanka Tourism Development Authority and published by the Central Bank are used for the analysis after converting into a quarterly series by aggregating the relevant three months pertaining to the quarter.

4.2 Temporal Variation of Time Series Variables Selected for the Study and their Association

Figure 1: Unemployment Rate from 1998 to 2024

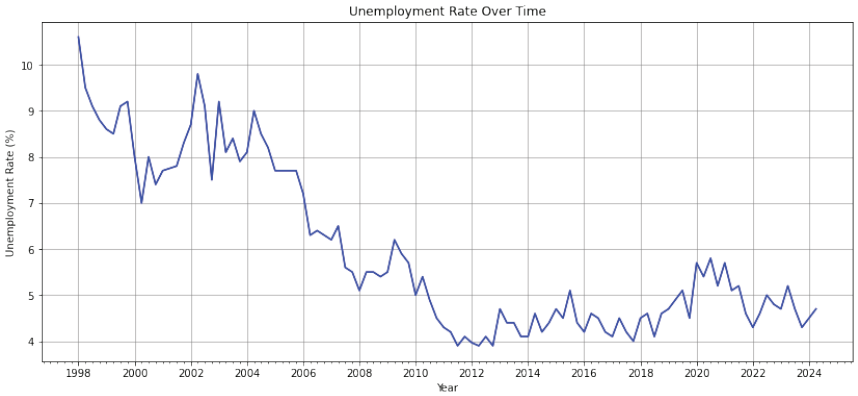


Figure 1 illustrates the fluctuations of unemployment rate of Sri Lanka from 1998 to the second quarter of 2024 reflecting broader economic conditions impacting labor markets. The unemployment rate shows a declining trend until the latter part of 2012 and remained relatively stable with minor fluctuations until mid-2019. Thereafter, it increased predominantly due to the effects of Easter Attack followed by the COVID-19 outbreak. However, from 2022 onwards it fluctuates with relatively low volatility. Analysing these trends offers valuable insights into the persistence of unemployment in Sri Lanka over time, supporting in the estimation of appropriate models for forecasting.

Figure 2: Time Series Variables Selected for the Study

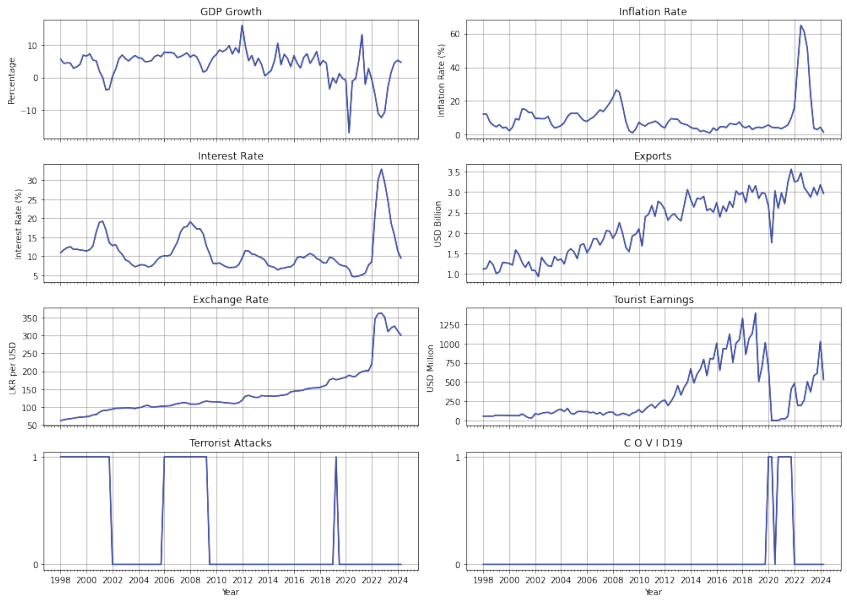


Figure 2 presents the temporal patterns of the time series variables selected for this study, including the two dummy variables, namely, terrorist attacks and COVID-19. Each variable is plotted over time, providing a comparative view of trends, seasonal effects, and potential structural breaks. These visualisations help highlight how factors such as GDP growth, inflation, interest rate, exports, exchange rate, and tourist earnings interact with the unemployment rate.

4.2.1 Relationship of Unemployment Rate with Time Series Variables Selected for the Study

Pearson's correlation coefficient which quantifies the strength and direction of the linear relationship between two continuous variables are used to understand how strongly variables are related, guiding model selection and interpretation.

Table 2: Pearson's Correlation Coefficient

Variable	GDP Growth	Inflation Rate	Interest Rate	Exports	Exchange Rate	Tourist Earnings
Unemployment Rate	0.032	-0.007	0.056	-0.868	-0.519	-0.585

The analysis reveals that unemployment has a strong inverse relationship with exports (-0.868) and tourist earnings (-0.585), indicating that growth in these sectors significantly contributes to employment creation. Additionally, there is a moderate negative correlation between unemployment and the exchange rate (-0.519), suggesting that higher unemployment may coincide with an appreciating local currency. However, correlations with GDP growth (0.032), inflation rate (-0.007), and interest rate (0.056) are weak and Okun's law under the considered time span. However, all these variables are used in the study considering their interconnectedness in the economy.

4.2.2 Test for Seasonality of Time Series Variables

Seasonality captures recurring patterns or periodic fluctuations within time series data, influenced by economic cycles or seasonal factors. Identifying seasonality is essential for improving forecasting models. The Kruskal-Wallis test is a statistical method superior to visual inspection alone, providing a quantifiable measure of seasonality. This test assesses whether observed seasonal differences in variables are statistically significant, which helps ensure more reliable model adjustments and forecasts.

Table 3: Kruskal-Wallis Test Results Summary

Variable	Kruskal-Wallis Chi-squared	Degrees of Freedom (df)	p-value
UnemploymentRate	0.75883	3	0.8593
GDPGrowth	0.54566	3	0.9088
InflationRate	0.11831	3	0.9896
InterestRate	0.48288	3	0.9226
Exports	3.2301	3	0.3575
ExchangeRate	0.015539	3	0.9995
TouristEarnings	1.988	3	0.5749

In all tested variables, the p-values are significantly higher than 0.05, indicating that there are no significant differences in the distributions of these macroeconomic variables across different quarters. Thus, it can be concluded that seasonal effects do not significantly influence these variables over the period under consideration. Therefore, seasonal decomposition is not necessary in conducting further time series analysis.

4.2.3 Test for Stationary of Variables

A stationary time series has a constant mean, variance, and autocorrelation over time, making it more predictable and suitable for forecasting. Stationarity is a critical property in time series analysis, as non-stationary data can lead to unreliable and spurious results in econometric modeling. In this study, the ADF test was employed to assess stationarity. Establishing stationarity is essential before modeling by obtaining differenced series, particularly for techniques like VECM, which require non-stationary series that are cointegrated for meaningful long term relationship analysis.

Table 4: Augmented Dickey-Fuller (ADF) Test Results Summary

Variable	Dickey-Fuller Statistic	Lag Order	p-value	Stationarity Status
Diff_UnemploymentRate	-4.2182	4	0.01	Stationary (p-value < 0.05)
Diff_GDPGrowth	-6.3401	4	0.01	Stationary (p-value < 0.05)
Diff_InflationRate	-4.625	4	0.01	Stationary (p-value < 0.05)
Diff_InterestRate	-3.4641	4	0.04883	Stationary (p-value < 0.05)
Exports	-3.7854	4	0.02239	Stationary (p-value < 0.05)
Diff2_ExchangeRate	-5.9357	4	0.01	Stationary (p-value < 0.05)
Diff2_TouristEarnings	-7.0732	4	0.01	Stationary (p-value < 0.05)

The ADF test confirms that all variables in the study have achieved stationarity after appropriate differencing, essential for effective time series modeling. Only exports are stationary at their original level, while unemployment rate, GDP growth, inflation rate, and interest rate are stationary after first differencing. Additionally, Exchange Rate and Tourist Earnings reached stationarity after second differencing, indicated by p-values below 0.05 across all differenced forms. This ensures stable fluctuations in the data, supporting robust forecasting using models like the VECM.

4.2.4 Cointegration of Unemployment Rate with other variables selected in the study

Cointegration is an essential measure in time series analysis, particularly when examining multiple variables that are individually non-stationary but may exhibit a stable, long term relationship. Cointegration occurs when a linear combination of these non-stationary variables is stationary, indicating that despite individual trends, the variables move together in the long run. Detecting cointegration is crucial as it allows for the application of models like the VECM, which accounts for both short term dynamics and long term equilibrium among variables. This approach provides valuable insights into the interconnectedness of economic indicators, financial metrics, or other time-dependent variables, helping to capture both transient and persistent effects in complex systems. The Johansen test which is a statistical method used to identify the number of cointegrating relationships in a system of variables is used as follows.

Johansen Test Results

Table 5: Number of Cointegrating Relationships

Hypothesis (r)	Test Statistic	10% Critical Value	5% Critical Value	1% Critical Value	Conclusion
$r = 0$	187.39	118.99	124.25	136.06	Cointegration exists
$r \leq 1$	108.84	85.18	90.39	104.2	At least 2 cointegrating relationships
$r \leq 2$	61.22	66.49	70.6	78.87	No further cointegrating relationships

As per the results, there are two cointegrating relationships among the variables, suggesting that certain variables, including the unemployment rate, are bound together in a long-term equilibrium.

Table 6: Eigenvalues (Strength of Cointegration)

Rank (r)	Eigen Value
1	0.5441
2	0.3788
3	0.2535

The Johansen test's eigenvalues help gauge the strength of cointegrating relationships. Here, the highest eigenvalue (0.5441) suggests a strong primary cointegrating relationship, indicating a stable long-term equilibrium among the variables. The subsequent eigenvalues (0.3788 and 0.2535) reflect progressively weaker relationships, showing that while additional equilibrium connections exist, they have less impact on the system's overall stability.

Table 7: Normalized Eigenvectors for Cointegration Relations

Variable	Unemployment Rate	GDP Growth	Inflation Rate	Interest Rate	Exports	Exchange Rate	Tourist Earnings
Coefficient	1	0.973	-0.825	0.538	0.927	0.062	-0.005

The normalised eigenvectors for cointegration relations reveal key long term associations between unemployment rate and other economic variables. A positive relationship with GDP growth suggests that higher economic growth is associated with higher unemployment. The inverse relationship with inflation aligns with the Phillips curve, indicating that inflation may help reduce unemployment under certain conditions. The positive link with interest rates implies that higher borrowing costs could hinder employment creation. Exports and exchange rate have minor positive relationships, suggesting limited direct impact on unemployment, while tourist earnings show a slight inverse relationship, implying at marginal employment creation within tourism related sectors.

Table 8: Adjustment to Equilibrium (Loading Matrix)

Variable	Unemployment Rate	GDP Growth	Inflation Rate	Interest Rate	Exports	Exchange Rate	Tourist Earnings
Adjustment Coefficient	-0.014	-1.352	0.379	0.076	0.007	0.402	0.824

The adjustment coefficients reveal that while unemployment rate adjusts slowly to restore equilibrium, GDP growth and tourist earnings respond more rapidly, underscoring their active roles in economic stabilization. This indicates that GDP growth, inflation, and interest rates are primary drivers in the long term equilibrium with unemployment rate. Policy measures targeting these areas may significantly impact unemployment, though the slow adjustment of unemployment rate itself suggests that structural changes are required for quick shifts. This interconnected framework emphasises the importance of a balanced policy approach to managing unemployment rate within broader economic conditions.

According to the above Johansen test results, cointegration exists among the variables. Specifically, there are two significant cointegrating relationships, indicating a long term equilibrium between the unemployment rate and other economic indicators. This suggests that these variables do not drift apart indefinitely but are bound together by underlying economic forces. At this background using VECM to forecast the unemployment rate is well-suited due to its ability to model long-term equilibrium relationships among variables that are cointegrated. The VECM framework allows for incorporating both the short term dynamics and long term relationships between unemployment and key economic indicators considered.

4.3 Applicability of Okun's Law and Phillips Curve

Okun's Law and Phillips Curve are key theories that explain the relationship between unemployment and other economic variables. Both theories offer insights into unemployment dynamics, though their applicability may vary across different economic contexts. According to the results obtained above indicating the association of unemployment rate with other variables, the applicability of these two theories for this study can be assessed.

Okun's Law suggests an inverse relationship between GDP growth and unemployment, where a 1 per cent increase in economic output typically results in a 0.5 per cent decrease in unemployment. While this relationship holds in many economies, its applicability can be influenced by factors such as labor market structure, fiscal policies, and external shocks. As per the previous studies in Sri Lanka, while Okun's Law generally holds, the impact of growth on unemployment is moderated by challenges such as informal employment, regional disparities, and external economic shocks (Perera and Wijesinghe, 2020; Jayathilaka and Mahendra, 2016; and Fernando and Karunaratne, 2018). The results of this study indicate that Okun's Law, does not strongly apply in the Sri Lankan context over the study period. The Pearson correlation coefficient between unemployment and GDP growth is very weak (0.032), which implies that the expected negative relationship proposed by Okun's Law is not clearly observed. This weak correlation suggests that factors influencing unemployment in Sri Lanka may not be directly driven by economic growth alone. Additionally, while GDP growth is

typically a key driver of employment creation, the structural factors in Sri Lanka, such as labour market inefficiencies and external shocks, might weaken the strength of this relationship. Therefore, the findings challenge the straightforward applicability of Okun's Law in this specific economic environment.

Meanwhile, the Phillips Curve posits that there is an inverse relationship between inflation and unemployment, meaning that lower unemployment typically leads to higher inflation. As identified in previous studies in Sri Lanka, the Phillips Curve generally holds in the short run, with inflation and unemployment showing a negative relationship, although this can be affected by external shocks, supply-side factors, and structural issues like informal employment and wage rigidity (Jayathilaka and Mahendra, 2016; Perera and Wijesinghe, 2020; and Jayaratne and Senanayake, 2019). As per the results of this study, the Phillips Curve, appears to show a weak correlation. The Pearson correlation between unemployment and inflation is -0.007, indicating an almost nonexistent relationship between these two variables. Additionally, the cointegration results from the Johansen test reveal a negative relationship between unemployment and inflation, which is consistent with the traditional Phillips Curve theory, albeit weakly. However, the relationship is influenced by other variables like GDP growth and interest rates, which play a larger role in determining long term equilibrium in the model. The weak link between inflation and unemployment in Sri Lanka may suggest that other macroeconomic factors, such as export performance and external economic conditions, are more dominant drivers of unemployment, leading to a less pronounced tradeoff between inflation and unemployment as suggested by the Phillips Curve in this context. Therefore, while the theory holds some relevance, its applicability is limited due to the complex interplay of structural factors in the Sri Lankan economy.

4.4 Estimation of Vector Error Correction Model

The VECM is specifically designed for time series that are non-stationary in levels but exhibit stationarity after differencing, and that are cointegrated, meaning they share a long-term equilibrium relationship. Further, the VECM framework is well-suited to understanding both the transient responses to economic shocks and the persistent relationships among the variables, making it valuable for policy analysis and forecasting in an interconnected economic system. Therefore, a VECM model is estimated to forecast unemployment rate, and it is crucial to decide the parameters, number of cointegrating relationships (r) and lag length in fitting the VECM model.

4.4.1 Select number of cointegrating relationships for VECM

The Johansen test results confirm at least two cointegrating relationships, as the trace statistic for $r = 0$ (187.39) exceeds critical values, rejecting the null hypothesis of no cointegration. For $r \leq 2$, the statistic (61.22) falls below the critical values, establishing two cointegrating relationships. Thus, $r = 2$ is chosen for the VECM, capturing two stable, long-term relationships within the system.

4.4.2 Select Optimal Lag Length

Table 9: Lag Length

Optimal Lag Length												
AIC(n)	HQ(n)	SC(n)	FPE(n)									
10	10	10	10									
Lag Length Selection Criteria												
Lag length	1	2	3	4	5	6	7	8	9	10	11	12
AIC(n)	10.9920	10.2294	7.7499	5.4564	4.0581	2.2726	-0.6199	-3.3000	-118.3050	-Inf	-Inf	-Inf
HQ(n)	12.0127	12.1688	10.6080	9.2331	8.7535	7.8866	5.9128	4.1514	-109.9350	-Inf	-Inf	-Inf
SC(n)	13.5256	15.0433	14.8441	14.8309	15.7128	16.2076	15.5954	15.1955	-97.5292	-Inf	-Inf	-Inf
FPE(n)	59925.9321	29481.8700	2852.2466	386.3011	162.4784	68.0062	18.2036	22.8356	0.0000	0	0	0

In time series analysis, model selection criteria such as Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ), Schwarz Criterion (SC/BIC), Final Prediction Error (FPE) are essential tools for determining the optimal lag length. When selecting the optimal lag length, aiming for a balance between model fit and simplicity can be crucial, especially when the model needs to be interpretable and robust. In this case, while the criteria indicate an optimal lag length around 10, experimenting with slightly shorter lags (around 8 to 10) can help assess if the model maintains adequate fit with fewer parameters. Due to the limited data available for the study, lag length 8 is selected for the study.

4.4.3 Model Estimation

Using two cointegrating relationships and eight lags, a VECM model is fitted focusing on forecasting unemployment rate. The stationary variables, namely, first difference of unemployment rate, first difference of GDP growth, first difference of inflation rate, first difference of interest rate, exports, second difference of exchange rate, second difference of tourist earnings and two dummy variables indicating the presence of terrorist attacks and COVID-19 during the quarter were used for the model estimation. A sample of 100 data points were used for model fitting and another 4 data points were kept aside for forecast evaluation.

According to the long term relationship identified through cointegrating vectors, unemployment is inversely related to inflation, suggesting that higher inflation tend to reduce unemployment rate in the long term. The positive association with interest rates suggests that high borrowing costs might discourage employment. COVID-19, with a high positive coefficient, indicates that the pandemic has had a lasting, negative impact on employment. Further, GDP growth shows a strong relationship with inflation, interest rates, and exports, suggesting that economic growth indirectly affects unemployment by influencing inflation and interest rates. As per the short term dynamics of lagged variables, past increases of unemployment rate tend to self-correct in subsequent periods. In addition, short term increases in inflation raise unemployment, while increases in interest rates can have a stabilising effect by reducing it. Further, export growth lowers unemployment in the short term, while exchange rate depreciations increase it. The Error Correction Terms (ECTs) in VECM, indicate the speed at which each variable adjusts to restore long term equilibrium following economic disruptions. Accordingly, unemployment rate adjusts slowly to economic shocks, which may be due to structural labour market characteristics.

At this background, VECM analysis highlights the interconnected nature of unemployment with other economic indicators and underscores the roles of GDP growth, inflation, and interest rates in influencing employment trends. This information provides a comprehensive framework for policy interventions that address both short term fluctuations and long term stability in unemployment forecasting.

4.4.4 Residual Assumptions

In econometric modeling, examining residuals is essential to validate the reliability and accuracy of the model's predictions. Residuals, which are the differences between the actual observed values and the model's predicted values, serve as indicators of the model's performance. Analysing residuals helps determine if the model assumptions hold and if the model is an appropriate fit for the data. Key assumptions include that residuals should ideally be normally distributed, exhibit no significant autocorrelation, and display homoscedasticity (constant variance) across time. Violations of these assumptions could suggest potential model misspecification or the need for further refinement.

Therefore, to assess the reliability of the VECM in forecasting the unemployment rate, a series of diagnostic tests were performed on the residuals. The Shapiro-Wilk test checks if residuals follow a normal distribution, which can be used for balanced forecasting. Normality can be observed through residual plots as well. The Ljung-Box test ensures no significant autocorrelation, indicating that residuals are independent and free from time based patterns. Lastly, the Breusch-Pagan test confirms homoscedasticity, implying consistent variance across residuals. Together, these tests help determine if the model is statistically reliable or if adjustments are needed to enhance forecast accuracy.

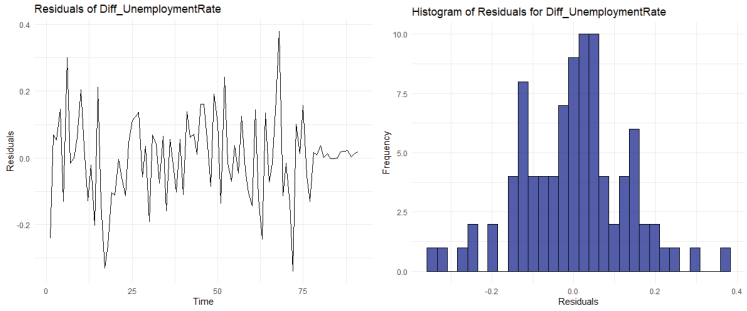
4.4.4.1 Shapiro-Wilk Test for Normality of *Diff_UnemploymentRate* Residuals

Test Statistic and Results:

- W = 0.98779: The Shapiro-Wilk test statistic (W) is close to 1, suggesting that the distribution of the residuals is nearly normal.
- p-value = 0.5618: With a p-value well above the conventional significance levels (e.g., 0.05 or 0.01), we do not reject the null hypothesis of normality.

The Shapiro-Wilk test results indicate that the residuals from the *Diff_UnemploymentRate* equation of VECM are approximately normally distributed. This is a favorable outcome for the VECM model, as normality in residuals supports the model's assumptions and enhances the reliability of parameter estimates. This result suggests that the model is capturing the underlying dynamics of *Diff_UnemploymentRate* reasonably well, with minimal unexplained, non-normal deviations.

Figure 3: Residual Plots



Further, the above residual plots indicate normal distributions.

4.4.4.2 Ljung-Box Test for Autocorrelation in VECM Residuals

The Ljung-Box test assesses whether residuals from each equation in the VECM model exhibit significant autocorrelation, with results as follows:

Key Test Results for Diff_UnemploymentRate:

X-squared = 9.2151, p-value = 0.5118

The high p-value (0.5118) indicates no significant autocorrelation in the *Diff_UnemploymentRate* residuals, suggesting that the VECM model sufficiently accounts for time dependencies in this variable.

4.4.4.3 Breusch-Pagan Test for Heteroskedasticity in Diff_UnemploymentRate Residuals

Test Results:

- Test Statistic (BP): 4.4872
- Degrees of Freedom (df): 9
- p-value: 0.8765

The p-value of 0.8765 is significantly higher than conventional significance levels (0.05), indicating that the residuals for *Diff_UnemploymentRate* do not exhibit heteroskedasticity, and the variance of residuals is likely consistent across different levels of the independent variables.

At this background, the favorable results across normality, autocorrelation, and homoscedasticity tests indicate that the VECM model is statistically robust for forecasting Diff_UnemploymentRate. This strong diagnostic performance enhances the model's reliability for both understanding long term dynamics and making short-term forecasts in the unemployment rate.

4.4.5 Granger Causality Tests

The Granger causality tests assess whether past values of one variable can significantly predict future values of another. By examining these relationships, the test helps identify potential predictive linkages among economic indicators, offering insights into which factors may influence changes in dependent variable over time. This analysis aids in understanding dynamic interactions within the dataset.

Table 10. Granger Causality Statistics

Variable	F-Test Value	p-value	Interpretation
Diff_GDPGrowth	1.1451	0.245	No Granger causality; Diff_GDPGrowth does not significantly predict other variables.
Diff_InflationRate	1.0855	0.3341	No Granger causality; Diff_InflationRate does not significantly predict other variables.
Diff_InterestRate	1.142	0.2492	No Granger causality; Diff_InterestRate does not significantly predict other variables.
Exports	1.1993	0.1793	No Granger causality; Exports does not significantly predict other variables.
Diff2_ExchangeRate	1.7171	0.003157	Granger causality present; Diff2_ExchangeRate significantly predicts other variables.
Diff2_TouristEarnings	1.4867	0.02306	Granger causality present; Diff2_TouristEarnings significantly predicts other variables.
TerroristAttacks	1.1412	0.2503	No Granger causality; TerroristAttacks does not significantly predict other variables.
COVID19	5.7941	< 2.2e-16	Strong Granger causality; COVID19 has a significant predictive effect on other variables.

The Granger causality tests reveal that among the variables examined, Diff2_ExchangeRate, Diff2_TouristEarnings, and COVID19 show significant predictive power for changes in the unemployment rate (Diff_UnemploymentRate). The exchange rate and tourism earnings have a predictive effect on unemployment, suggesting that fluctuations in exchange rates influence export competitiveness, which in turn may impact employment in export-oriented sectors, while tourism earnings affect employment in tourism-dependent industries. The COVID-19 variable demonstrates a particularly strong predictive relationship with unemployment, highlighting the substantial and enduring economic disruptions caused by the pandemic, especially in labor-intensive sectors such as hospitality and services. In contrast, variables like GDP growth, inflation rate, interest rate, exports, and terrorist attacks do not significantly predict unemployment changes in this model, indicating that while these may influence unemployment in broader contexts, they do not provide predictive value within this specific time series framework. These results underscore the impact of sectoral and external shocks on unemployment trends, informing targeted economic responses.

4.4.6 Forecast

The fitted VECM model is used to forecast unemployment rate covering four quarters. Since the model consists of the first difference of unemployment rate, the forecasts were initially drawn for that and then converted to unemployment rate.

In evaluating forecasts, MAE, MAPE, RMSE, and MSE are key indicators of accuracy, where lower values across these metrics generally signify a better model fit. MAE assesses the average magnitude of errors, with smaller values reflecting fewer absolute deviations from actual values. MAPE represents error as a percentage, allowing for intuitive comparisons across models, where lower percentages denote higher accuracy. RMSE, which squares errors before averaging, is particularly sensitive to larger errors, making it an ideal measure for capturing models' overall accuracy with lower values preferred. MSE, similar to RMSE but without the square root, penalizes larger errors and reflects model consistency.

Table 11: Forecast Results

Date	Unemployment Rate	Forecasted Diff_UnemploymentRate	Forecasted Unemployment Rate	Difference
7/1/2023	4.7	2.108915	7.308915	-2.60892
10/1/2023	4.3	-3.74166	3.567255	0.732745
1/1/2024	4.5	0.095111	3.662366	0.837634
4/1/2024	4.7	5.674544	9.33691	-4.63691

Table 12: Forecast Accuracy

	Value
Mean Absolute Error (MAE)	2.204
Mean Absolute Percentage Error (MAPE)	47.46%
Root Mean Squared Error (RMSE)	2.718
Mean Squared Error (MSE)	7.386

The error metrics indicate varying levels of accuracy in the model's unemployment rate forecasts. The MAE of 2.204 suggests that, on average, the model's forecasts deviate from the actual unemployment values by about 2.2 percentage points. The MAPE of 47.46% reveals a relatively high percentage error, implying that forecast deviations are quite significant when considered as a proportion of the actual unemployment values, which may reduce reliability in practical contexts. The RMSE of 2.718 highlights the presence of larger errors, as RMSE penalises larger deviations more heavily, further emphasizing the model's difficulty in achieving precise forecasts. The MSE of 7.386 reinforces this, as it represents the average squared error, illustrating that overall forecast consistency may be affected. Overall, these metrics suggest that while the model captures general trends, it struggles with precise accuracy, particularly with larger errors, as indicated by the high MAPE.

The analysis above effectively outlines the results and implications of using the VECM to forecast the unemployment rate based on macroeconomic variables. By incorporating econometric tests and residual analyses, it underscores the value of traditional time-series modeling in capturing long term economic relationships and assessing the impact of key drivers like GDP growth, inflation, and external shocks (e.g., COVID-19, terrorist attacks). However, the model's limitations in handling complex, non-linear relationships and its relatively high error metrics suggest that alternative forecasting approaches could improve prediction accuracy. While VECM provides a strong foundation by modeling equilibrium relationships, incorporating deep learning and machine learning models can significantly enhance forecast precision, adapt to non-linear and complex interactions, and provide a more resilient approach in highly volatile economic environments.

4.5 Deep Learning and Machine Learning Approaches for Unemployment Rate Forecasting

In this study, DL and ML models are employed to enhance the accuracy of unemployment rate forecasting by leveraging their advanced capabilities in handling complex, non-linear relationships. The Deep Learning model applied here is the FFNN, which uses layered neurons to uncover intricate patterns across multiple variables. The Machine Learning models include RF, an ensemble method that constructs multiple decision trees to capture non-linear interactions, making it ideal for complex datasets, SVR, which optimally separates data points for effective handling of noise in predictions and XGBoost, an efficient and powerful gradient-boosting approach that iteratively improves forecasting accuracy by reducing prediction errors. This combination of DL and ML models enables a more robust analysis, capturing subtle dynamics within the economic indicators influencing unemployment.

4.5.1 Feed Forward Neural Network (FFNN) model

The FFNN is a deep learning model often applied to forecast complex relationships in datasets, including economic indicators. It uses interconnected layers of neurons to capture non-linear relationships, making it ideal for scenarios where traditional linear models may fall short.

In this analysis, the FFNN model was trained to forecast unemployment rates. The model fitting process began with data preprocessing to ensure a consistent input structure, followed by configuring the FFNN with an appropriate architecture for time series forecasting. K-Fold cross-validation was employed to evaluate the model's performance and assess its generalization capability. Over 100 training epochs, the model's loss gradually reduced, indicating effective learning from the training data.

Table 13: FFNN Model Performance Summary

	Value (Cross-Validation)	Value (Forecast Period)
Mean Absolute Error (MAE)	0.55	0.51
Mean Squared Error (MSE)	0.39	0.48
Root Mean Squared Error (RMSE)	0.62	0.68
R^2 (Coefficient of Determination)	-13.03	0.75
Mean Absolute Percentage Error (MAPE)	12.36%	8.40%

The FFNN model's forecast performance reveals a moderate level of accuracy based on various key metrics. The MAE of 0.55 suggests that the forecasted unemployment rates deviate by approximately 0.55 percentage points from actual values on average, indicating reasonable accuracy. The RMSE of 0.62 further supports this, showing minor but present deviations in forecasted values. Additionally, a MAPE of 12.36% highlights moderate reliability, with lower MAPE values generally indicating higher model robustness. Together, these metrics indicate that while the FFNN model captures general patterns, its capacity to fully explain variance is limited, suggesting room for improvement in forecast precision. Overall, the FFNN provides moderate forecasting accuracy with the given data.

4.5.2 Random Forest Model

The Random Forest model is a powerful ensemble learning algorithm that combines multiple decision trees to enhance predictive accuracy and robustness. Known for its resilience to overfitting, especially in the presence of noisy data, Random Forest averages the results from individual trees, which helps in capturing complex, non-linear relationships between variables. Additionally, the model provides insights into feature importance, aiding in the understanding of which variables most significantly impact the target outcome. These qualities make Random Forest particularly well-suited for tasks involving complex datasets and a mix of categorical and continuous variables.

In this analysis, a Random Forest model was trained to forecast the unemployment rate, utilizing K-Fold cross-validation to evaluate and refine model performance. Initially, default parameters were used; however, careful parameter tuning, such as adjusting the number of trees, maximum tree depth, and minimum samples per leaf, was identified as a potential improvement. A grid search or randomised search could be employed for optimal parameter selection. The cross-validation process allowed for iterative evaluation, providing robust metrics to ensure the model's generalisation. Additionally, the model included relevant economic indicators (e.g., GDP growth, inflation rate) to capture factors influencing unemployment, helping improve its predictive power for the targeted timeframe.

Table 14. Random Forest Model Performance Summary

	Value (Cross-Validation)	Value (Forecasting)
Mean Absolute Error (MAE)	0.388	0.13
Mean Squared Error (MSE)	0.248	0.044
Root Mean Squared Error (RMSE)	0.489	0.21
R^2 (Coefficient of Determination)	0.888	-0.605
Mean Absolute Percentage Error (MAPE)	6.33%	2.97%

The Random Forest model demonstrated strong performance in both cross-validation and forecasting phases, showcasing its predictive accuracy for unemployment rates. During cross-validation, the MAE of 0.388 indicates that predictions deviate by less than 0.4 percentage points from actual values, underscoring minimal errors. The MSE and RMSE were also low at 0.248 and 0.489, respectively, reflecting an accurate fit with minimal significant errors. In the forecasting phase, the

model's MAE reduced further to 0.130, and MAPE was notably low at 2.97%, indicating close alignment with actual unemployment values. Overall, the Random Forest model's consistent performance makes it a reliable choice for forecasting unemployment rates with minimal deviations from true values.

4.5.3 Support Vector Regression (SVR) Model

SVR is a robust and flexible regression technique that is effective in modeling both linear and non-linear relationships. By utilizing a kernel function, like the Radial Basis Function (RBF), SVR can capture complex patterns in the data, making it well-suited for economic indicators that exhibit non-linear trends. This method focuses on minimising error within a specified margin, which enhances its accuracy and resilience to outliers.

In this study, the SVR model was applied with an RBF kernel to capture non-linear relationships in the unemployment rate data. To ensure reliable performance, K-Fold cross-validation was used, which divides the dataset into multiple subsets to validate the model across different data splits. This approach allows the model to generalise better, reducing the risk of overfitting. For parameter selection, grid search techniques could be applied to optimise SVR's hyperparameters for further refinement. This setup helped in creating a model responsive to the dynamic patterns in economic indicators.

Table 15: SVR Model Performance Summary

	Value (Cross-Validation)	Value (Forecast Period)
Average Mean Absolute Error (MAE)	0.5084	0.2342
Average Mean Squared Error (MSE)	0.4812	0.0797
Average Root Mean Squared Error (RMSE)	0.6782	0.2824
Average R^2	0.7456	-1.8993
Average Mean Absolute Percentage Error (MAPE)	8.4052	5.2836

The SVR model showed consistent performance across cross-validation and forecasting phases. In cross-validation, the MAE was 0.5084, indicating moderate accuracy with an average deviation of about 0.51 percentage points from actual values. The MSE of 0.4812 and RMSE of 0.6782 also suggest satisfactory predictive precision. During the forecast period, the model improved with an MAE of 0.2342 and a MAPE of 5.28%, indicating closer alignment with actual values. This improvement in forecast performance demonstrates that the SVR model can effectively predict unemployment rates with satisfactory closeness to observed values, particularly in shorter forecast periods.

4.5.4 Extreme Gradient Boosting (XGBoost) model

XGBoost is an advanced machine learning algorithm known for its speed and efficiency in handling structured data and producing accurate predictions. It uses gradient boosting, an ensemble learning technique, which iteratively adds decision trees to minimize prediction errors. XGBoost is particularly effective for time series forecasting tasks, like predicting unemployment rates, as it can handle non-linear relationships and capture complex interactions between variables.

For this analysis, the XGBoost model was configured to predict unemployment rates by training on economic indicators. The model was set up with cross-validation to assess generalisation across different subsets of the data. Model fitting involved determining key hyperparameters, such as the learning rate, maximum depth of trees, and the number of boosting rounds, which were optimized using a grid search approach. The training phase focused on minimising error metrics, and the final model was fitted on the entire dataset after cross-validation to generate forecasts.

Table 16: XGBoost Model Performance Summary

	Value (Cross-Validation)	Value (Forecast)
Mean Absolute Error (MAE)	0.4286	0.276
Mean Squared Error (MSE)	0.306	0.1521
Root Mean Squared Error (RMSE)	0.5507	0.3899
R^2	0.8469	-4.5294
Mean Absolute Percentage Error (MAPE)	7.03%	6.22%

The XGBoost model showed robust performance during cross-validation, with an R^2 of 0.8469, indicating it explains around 84.69% of the unemployment rate variance. The MAE of 0.4286 and RMSE of 0.5507 suggest a low average error, demonstrating accuracy in general predictions. In the forecast period, XGBoost achieved a reduced MAE of 0.2760 and a MAPE of 6.22%, suggesting satisfactory prediction closeness to actual values. However, the model's performance variations across periods indicate it may benefit from further refinement to enhance consistency in generalisation. Overall, the XGBoost model performs well as a predictive tool, with strong potential for accurate unemployment rate forecasts.

4.6 Forecast Comparison

Unemployment rate of Sri Lanka is forecasted for a one-year time span from third quarter of 2023 to second quarter of 2024 employing five different models. The forecasts estimated are plotted along with the actual unemployment rate in Figure 4. However, the forecasts obtained from the fitted VECM model significantly deviate from the actual unemployment rate. Therefore, to get a clear graphical representation of other forecasts, VECM forecasts are excluded from Figure 5.

Figure 4: Actual and Forecasted Unemployment Rate

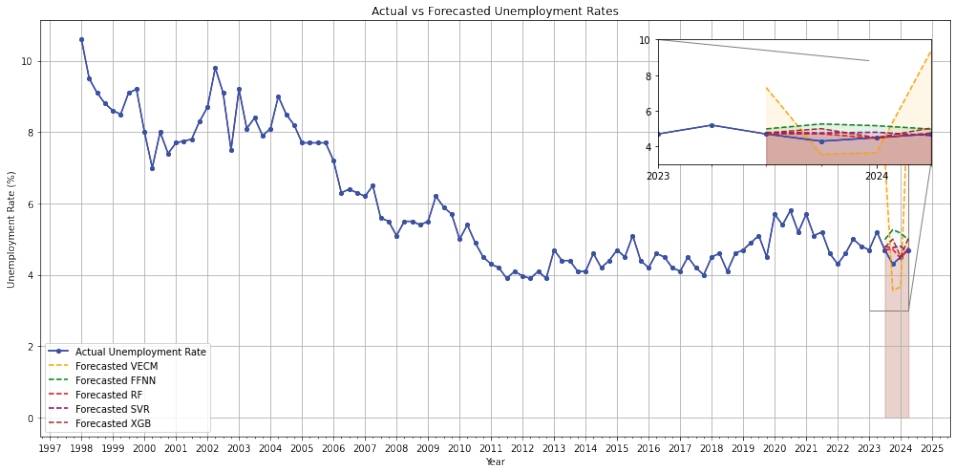


Figure 5: – Actual and Forecasted Unemployment Rate (Excluding VECM)

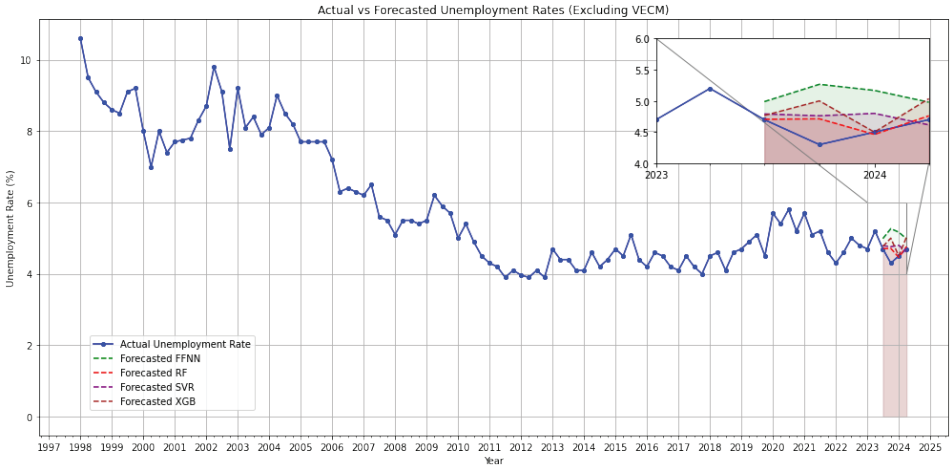


Table 17: Actual and Forecasted Unemployment Rate

Year	Quarter	UnemploymentRate	Forecasted Unemployment Rate_ VECM	Forecasted Unemployment Rate_ FFNN	Forecasted Unemployment Rate_ RF	Forecasted Unemployment Rate_ SVR	Forecasted Unemployment Rate_ XGB
2023	3	4.70	7.31	4.99	4.71	4.79	4.77
2023	4	4.30	3.57	5.27	4.71	4.76	5.00
2024	1	4.50	3.66	5.17	4.46	4.80	4.50
2024	2	4.70	9.34	4.98	4.76	4.62	5.04

The table illustrates the actual unemployment rates alongside forecasts from five models: VECM, FFNN, RF, SVR, and XGB, over four quarters from Q3 2023 to Q2 2024. Among these models,

- RF consistently provides the most accurate forecasts, closely aligning with actual rates across all quarters, underscoring its effectiveness for unemployment rate prediction.
- FFNN and SVR offer reasonable forecasts but display slight overestimations in some quarters, indicating moderate predictive capability.
- VECM shows the highest deviations, particularly in Q2 2024, indicating challenges in capturing short-term changes effectively.
- XGB produces forecasts that are fairly close to the actual values, though with minor overestimations in a couple of periods.

The Random Forest model emerges as the most reliable option for forecasting unemployment rates in this dataset, while VECM's performance highlights its limitations in short-term forecasting.

Table 18: Summary of Forecasting Model Performance

Model	MAE	MSE	RMSE	MAPE
VECM	2.2041	7.3865	2.7178	47.46%
FFNN	0.5512	0.3858	0.6212	8.40%
RF	0.1295	0.0441	0.2101	2.97%
SVR	0.2342	0.0797	0.2824	5.28%
XGB	0.276	0.1521	0.3899	6.22%

The evaluation of various models for forecasting unemployment rates reveals that the RF model outperforms the others in both cross-validation and forecasting metrics. RF achieves the lowest errors across MAE, MSE, RMSE, and MAPE, demonstrating superior accuracy and minimal deviation from actual values. Its ensemble approach effectively captures both linear and non-linear dependencies in economic data, proving robust approach for complex patterns.

Other models, such as SVR and XGBoost, perform well but fall short of RF in terms of accuracy. While SVR captures non-linear relationships through kernel functions and XGBoost leverages gradient boosting for effective response to macroeconomic volatility, both models show signs of overfitting in forecasting, suggesting they may require further tuning for long term stability. The FFNN also shows potential with moderate accuracy but needs enhanced tuning to improve generalization.

The VECM, grounded in economic theory, captures long term equilibrium relationships but shows the highest error rates due to limitations in handling non-linear shifts and rapid economic changes. Overall, Random Forest stands out as the best model for forecasting unemployment, balancing accuracy, and resilience to economic fluctuations, making it highly suitable for real-time forecasting and policymaking. This analysis highlights the strength of ensemble models, such as RF, in providing reliable forecasts that adapt to economic trends effectively.

4.7 Integrating Econometrics with Advanced, Novel Techniques for Better Forecasting

Econometric estimates have long been integral to economic analysis, offering a structured approach to understanding relationships between economic variables. These models, grounded in economic theory, allow for the quantification of relationships and hypothesis testing, offering valuable insights for policy analysis, forecasting, and decision making. Econometric techniques, such as ordinary least squares, instrumental variables, and maximum likelihood estimation, provide accurate estimates of how changes in one variable influence another, often based on assumptions like linearity and stationarity. However, these models may struggle with complex, nonlinear patterns in large datasets, which is where ML and DL methods come into play.

ML and DL techniques have revolutionized predictive modeling by handling large, high-dimensional datasets and identifying patterns that traditional econometric models may overlook. These methods do not rely on strong assumptions and are capable of capturing intricate relationships between variables, including non-linearities and interactions. Machine learning methods such as random forests, support vector machines, and neural networks excel at processing vast amounts of data and making accurate predictions. However, while these models are highly effective for prediction, they often lack the interpretability and theoretical grounding that econometric models provide. Econometrics, on the other hand, offers valuable insights into the causal mechanisms at play, making it essential for understanding the relationships between economic variables.

To address the limitations of both approaches, a hybrid solution is increasingly being embraced, combining the strengths of econometrics with the power of ML and DL techniques. Econometrics can provide a solid theoretical foundation, helping to structure relationships and test hypotheses. Machine learning and deep learning can then enhance predictive accuracy by capturing patterns and complexities that econometric models might miss, ultimately leading to better forecasts. Moreover, Artificial Intelligence (AI) techniques can further improve the hybrid models by optimising decision making processes, identifying hidden trends, and refining predictions through continuous learning and adaptation.

Therefore, integrating AI, ML, and DL with traditional econometric methods leads to more dynamic, flexible models that are better equipped to adapt to changing economic conditions and deliver improved forecasts. While econometrics remains

vital for understanding causal relationships and grounding models in economic theory, AI, ML and DL enhance the ability to process large, complex datasets and improve predictive performance. The integration of these advanced techniques helps analysts to refine traditional economic methods, offering more precise insights and empowering better informed decisions. Ultimately, this hybrid approach can lead to improved economic outcomes by providing a more accurate, comprehensive understanding of the economy's dynamics and the ability to make well-informed decisions in an ever-evolving environment.

5 Conclusion

This study examined the relationships between unemployment rates and key macroeconomic variables in Sri Lanka and evaluated the effectiveness of econometric, machine learning, and deep learning models for forecasting unemployment rate. By analysing variables such as GDP growth, inflation, interest rates, and exports, significant relationships were identified. The applicability of Okun's Law and the Phillips Curve in Sri Lanka is limited, as weak correlations between unemployment rate and GDP growth/inflation suggest that factors like labor market inefficiencies and external shocks play a more significant role. These findings underscore the importance of macroeconomic stability in managing labor market conditions in Sri Lanka.

The study also demonstrated the potential of ML and DL approaches in improving forecast accuracy, particularly when capturing non-linear patterns that traditional econometric models may overlook. Specifically, Random Forest emerged as the most reliable model for forecasting unemployment rate in Sri Lanka, showing minimal deviation from actual values across multiple error metrics. In contrast, while the VECM effectively captured long term equilibrium relationships, it exhibited limitations in handling short term fluctuations and non-linear interactions. This suggests that integrating ML and DL models with traditional econometric approaches could enhance forecast accuracy and enable policymakers to respond to labor market changes more proactively.

In summary, while traditional econometric models offer valuable insights into unemployment dynamics, advanced ML and DL methods add predictive power, especially in volatile economic environments. The findings from this study contribute to the understanding of unemployment rate forecasting in Sri Lanka, highlighting a more comprehensive approach that combines conventional and non-conventional modeling techniques for more responsive policy formulation.

Accordingly, the findings of the study emphasis that the integration of traditional econometric techniques with advanced ML and DL, significantly enhance economic analysis and forecasting. While econometrics offers a solid theoretical framework for understanding causal relationships, ML and DL excel at processing vast datasets and identifying complex, non-linear patterns that traditional models may overlook. By combining these powerful tools, analysts can refine conventional methods, creating more dynamic and adaptable models that provide more accurate, real-time forecasts, ultimately leading to better informed decisions and improved economic outcomes.

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இலங்கை மத்திய வங்கி

CENTRAL BANK OF SRI LANKA