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The Sri Lankan Journal of Banking and Finance (SLJBF) is a referred Journal bi-annually published research papers and scholarly work by the Department of Banking and Finance, Wayamba University of Sri Lanka. The main objective of the SLJBF is to publish scientific research findings that address issues and developments related to economics in general and money, banking, financial markets in particular at both national and international level. All research articles submitted are double blind reviewed prior to publishing. Views expressed in the research articles are not the views of the Department of Banking and Finance, Wayamba University of Sri Lanka or the Editorial Board.

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Editorial Preface

We are pleased to present Volume 7(1) of the Sri Lankan Journal of Banking and Finance (SLJBF), a refereed journal of Banking and Finance published by the Department of Banking and Finance, Wayamba University of Sri Lanka. SLJBF provides a unique platform for researchers, academicians, professionals, and research students to impart and share knowledge in the form of high-quality research papers to infuse innovative systems and methods to the economy and finance as a whole. In line with that SLJBF invites you to join with us by writing quality manuscripts in the discipline of economics, banking and finance.

We received a good response for the call for papers and out of the paper received five papers selected for the publication through the rigorous blind review process. We wish to thank all the authors who contributed to this issue by submitting their novel research findings. The volume 7(1) of SLJBF deals with timely important topics, distributional incidence of indirect taxation on consumer groups in Sri Lanka, constructing a discount function with parsimonious extended Nelson-Siegel function based on Nigerian Eurobond, impact of digital financial inclusion on banking sector stability, impact of remote work on employee job satisfaction and factors influencing behavioral intentions to adopt mobile banking in Sri Lanka. Thus, the journal has widened its scope to appeal to a wider readership with varied interest and needs.

On this occasion, I would like to extend my sincere thanks to the dedicated panel of distinguished reviewers, members of the editorial advisory board, members of the editorial board and the assistant editors for their unstinting and voluntary contribution to make this issue a success. The continued support of the governing body of the Wayamba University of Sri Lanka in this endeavor is also acknowledged.

Prof. R.A Rathanasiri
Editor in Chief
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Aims and Scope

The Sri Lankan Journal of Banking and Finance (SLJBF) is a refereed Journal bi-annually published research papers and scholarly work by the Department of Banking and Finance, Wayamba University of Sri Lanka. Sri Lankan Journal of Banking and Finance (SLJBF) publishes theoretical and empirical papers spanning all the major research fields in economics, banking and finance The aim of the SLJBF is to bringing the gap existing in the theory and practice of Economics, Banking and Finance by encouraging researchers, academicians, professionals, and research students to impart and share knowledge in the form of high quality research papers to infuse innovative system and methods to the economic and financial system as a whole. Thus, the journal's emphasis is on theoretical and empirical developments and policy-oriented research in economics, banking and finance.

Core Principles

- Publication in the journal of banking and finance is based upon the editorial criteria cited and the evaluation of the reviewers (each manuscript will be sent two reviewers);
- Priority is given for novelty, originality, and to the extent of contribution that would make to the particular field.
- Conceptual papers based upon current theory and empirical findings and contribute to the development of theory in the domain of Banking and Economics are also welcome.

The journal welcomes and publishes original articles, literature review articles and perspectives and book reviews describing original research in the fields of economics, banking and finance. The core focus areas of the journal include;

- Financial Intermediation
- Bank Solvency and Capital Structure
- Banking Efficiency
- Bank Failure and Financial crisis
- Behavioral Finance
- Corporate Finance
- Corporate Governance and Ethics
- Credit Rating

- Derivative Pricing and Hedging
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DISTRIBUTIONAL INCIDENCE OF INDIRECT TAXATION ON CONSUMER GROUPS IN SRI LANKA: A DESCRIPTIVE STUDY

Y D R Kuruppuarachchi
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Abstract

This study investigates how the indirect tax burden was distributed among households under different aspects. Sri Lanka's tax structure represents more indirect tax and significantly less direct tax income. Direct taxes satisfy the equity principle of taxation, while indirect tax is violated. Direct taxes are imposed according to the ability to pay. Persons who have a higher income will pay a higher rate of income tax, and persons who have less income will pay a lower rate of income tax. Unlike direct taxes, indirect taxes are paid by both rich and poor persons irrespective of their income level. Thus, the burden of the indirect tax will be badly impacted on poor households because when they purchase goods and services from the market, they pay a significant portion of indirect taxes compared with the average income. A consumer survey was performed, and data were collected using a structured questionnaire under the light of the Stratified Convenient Sampling Method. One hundred fifteen commodity baskets were selected based on the Colombo Consumer Price Index under the broad categories of food and non-food and eleven subcategories of commodity groups. Colombo District was selected as the sample district. Four hundred eighty-two respondents were collected, representing low-income, middle-income, and high-income households. The descriptive and quantitative approach were used for the analysis. The findings of the study emphasized that the indirect tax burden rate of low-income households was significantly greater than the indirect tax burden rate of high-income households. The regressive effect was reflected in the findings, indicating that poor households are bearing a higher indirect tax burden rate in terms of average income and average expenditure. The derived Lorenz Curves and the calculated Gini Coefficients also emphasized the regressive effect of the indirect tax, presenting an upward-sloping Lorenz Curve and negative Gini Coefficient values.

Keywords: Burden Rate, Expenditure Deciles, Indirect Tax, Income Deciles, Income Groups

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1. INTRODUCTION

Taxation is a highly debatable topic in Sri Lanka and also one of the most important and highly sensitive topics. With the recent tax reforms, the government has increased the income tax level and PAYE rates. Most professionals are continuously struggling by pressuring the government to reduce income tax rates. The opinion of professionals was it was totally unfair to increase income tax during the current economic crisis in Sri Lanka. This article is not expected to discuss the injustice of increasing the income tax levels. Income tax is a kind of direct tax mode. Here, we are focussing on the burden of indirect taxes on different consumer groups in Sri Lanka.

A nation's income from the government is crucial. The national income will be used to determine the government's current and capital expenses. The government can invest more in public goods when its revenue is increased. Then, the government can provide more facilities for infrastructure, education, and health, and the general public's well-being will be boosted. The government should have a reliable source of money. The largest amount of government revenue comes from taxes. The government should have a proper tax system that upholds tax principles and does not adversely affect the general populace's standard of living.

Each party in the nation would be significantly impacted by the imposition of indirect taxes. The equity principle underlies the imposition of direct taxes. This implies that those who have more income will pay more income tax. However, everyone is required to pay indirect taxes regardless of income level. People with low and moderate incomes will be particularly impacted by indirect taxes (Amirthalingam, 2010). As further indicated by Amirthalingam (2010), in developing nations like Sri Lanka, direct taxes which include levies on earnings, income, and capital gains have produced fewer revenues. Over time, nations with historically weaker economic foundations have experienced tremendous growth in direct tax revenue. Aside from that, indirect taxes have tremendously regressive social and economic implications.

According to the Central Bank report in 2021, 11% of Sri Lanka's government revenue is non-tax revenue, and 89% is tax revenue. Out of the total tax revenue, 23% is direct tax, and 77% is indirect tax revenue. It is clear from this statistic that the Sri Lankan government has mainly tried to establish its dependence on indirect taxes. There are more than 20 types of indirect taxes operated in Sri Lanka, of which the main indirect tax revenue sources for the government are Value Added Tax (VAT), Excise Duty, Port and Airport Levy (PAL), CESS levy, Customs Duty, and Special Commodity Levy (Central Bank of Sri Lanka, 2021).

Considering the tax structure of global economies, direct taxes represent a high percentage (more than 65%) of tax revenue in most developed countries. Examples include the United States (91%), Japan (80%), Canada (77%), Belgium (75%), and Switzerland (74%). Other South Asian countries also show high direct tax revenue compared to Sri Lanka. Examples include Maldives (53%), Bangladesh (33%), Bhutan (59%), India (54%), and Pakistan (38%) (Centre for Tax Policy and Administration, 2020).

By looking at the global tax structures, it can be clearly seen that Sri Lanka has imposed a significant level of indirect taxes on goods and services. The imposition of high indirect tax significantly impacted low-income people in society. According to Kaplanoglo (2014), a regressive effect can be identified with respect to indirect taxation, which has a higher indirect tax burden on the low-income population. Low-income people do have a relatively lower level of income, and that income is also not safe and fixed. The regressive impact represented that out of the little income of poor people, a significant portion would be paid as indirect tax to the government. In other words, the indirect tax burden rate is significantly higher for poor people rather than for rich people. High-income people have a relatively higher income. The percentage of indirect tax payments by rich people is relatively low. Thus, a higher burden of indirect tax is transferred to the poor people.

Plothick (1982) is concerned that indirect taxation has a negative impact on equity. One of the fundamental tenets of taxation is equity. In fact, equity is a major concern in taxation practically everywhere. According to the concept of "equity in taxation," taxes should be imposed based on a person's capacity to pay. The two dimensions of equity are typically horizontal and vertical. According to the principle of horizontal equity, taxpayers with equal income should pay the same amount of tax regardless of the source or type of their income. Vertical equity states that those with greater financial means should contribute more. According to the idea of horizontal fairness, tax rates should be the same for persons with equal incomes. An indirect tax system affects the entire population of the country. Low-level income groups have to bear such indirect taxes even though they don't know they are paying taxes. So, the cost of living for low- and middle-income people will be high and cause different social problems. The research problem has been established based on that rationale as "people earn income. But their living cost is high due to indirect tax". There is an inequal distribution of the burden of indirect taxation. People who belong to the low-income category have to pay a higher rate of indirect tax to the government rather than to the rich people.

The objective of this study was to identify the indirect tax burden on different consumer groups in Sri Lanka and measure the inequal distribution of the indirect tax among the same consumer groups. Three kinds of consumer groups have been identified in this study. Expenditure deciles, income deciles, and income groups were the identified consumer categories. There are ten expenditure deciles, ten income deciles, and three income groups (low-income, middle-income, and high-income) (Department of Census and Statistics, 2019). It was expected to measure the indirect tax burdens of individual subcategories of main consumer groups and identify how indirect taxes are distributed.

Mieszkowski (1969) describes the theory as an investigation of the distributive impact of taxes done through the examination of tax incidence. Incidence theory, which focuses on how different tax regimes affect factor returns and commodity prices, is generally applied to distribution theory. While the effects of some taxes are rather complex, those of others have pretty clear-cut distributive implications. For instance, a household's part of the national income determines the burden of a

proportional income tax, which is levied on all income. On the other hand, taxes that don't apply to all forms of income or all commodities alter relative commodity prices, have an impact on how certain factors are used in specific industries, and alter the way the economy is produced. In order to fully account for changes in commodity and factor prices caused by taxes, a general equilibrium technique is necessary for analyzing the incidence of taxes that result in these effects.

In the global and local context, relatively fewer studies have been conducted on the area of indirect tax, especially on the distributional impact of indirect taxation. Theories of taxation discussed how indirect taxes are shifted into the product price based on the elasticities of demand and supply. But practically, irrespective of the elasticity concept, the entire tax portion may be transferred to the product price by manufacturers. Also, tax theories focus on how taxes are distributed among consumers and producers. Theories are not concerned with how the burden of indirect tax impacts the poor population in a country. By considering the said significance, it is expected to fill many gaps while achieving the objective of this study.

2. LITERATURE REVIEW

Decoster et al., (2009), while looking into the incidence of indirect tax for five European nations that are members of the OECD (Organization of Economic Co-operation and Development), namely Belgium (BE), Greece (GR), Hungary (HU), Ireland (IE), and the United Kingdom (UK), the study concentrated on the distributional image of indirect taxes. They added that the indirect tax instrument is important, which stands in stark contrast to the minimal attention the microsimulation community gave it. Most Microsimulation Models (MSMs) have focused on the micro-mathematical modeling of social security contributions, personal income taxes, and other benefits rather than indirect taxes. Decoster et al., (2009) contend that this isn't due to a lack of theoretical support for the study of indirect taxation. Indirect taxes and the direct-indirect tax mix have both been widely researched in theoretical public finance studies.

Furthermore, it cannot be a result of indirect tax legislation's complexity. Systems for indirect taxes are simpler than those for direct taxes. According to the Decoster et al., (2009) study, impoverished persons have a considerably greater indirect tax liability as a percentage of their disposable income than rich people. When compared to disposable income, indirect taxes are unmistakably regressive in every country. The tax rate decreases monotonically as income levels equalize. In every country, the bottom 10% of households pay at least twice as much in indirect taxes as the richest 10%. The image demonstrates how low-income individuals are severely impacted by the cost of indirect taxes.

According to Decoster et al., (2009), It is evident that the distribution of indirect tax burden among income deciles is unequal across all five countries. Decile one begins with the poorest people and decile ten finishes with the richest people. Low-income households are represented by the first four deciles and have a heavier indirect tax burden. Poor people in some nations, like Greece, pay the government more than 28% of indirect taxes relative to their income. The decile one illustrates the worst case.

The lowest income bracket pays a lot more indirect tax. The richest groups in a nation are typically found in the ninth and tenth deciles. High-income groups pay a considerably smaller share of indirect taxes than the poor. Poor people are negatively impacted by this kind of regressive influence.

Kaplanoglo (2014) conducted a household expenditure survey in Greece (1899–2011) to perform research on the distributional effects of indirect taxation. The analysis concluded that the indirect tax system appears to be the most regressive across the study period in terms of its effect on inequality and its unfavourable burden on sensitive goods. Two vulnerable demographic groups that were most harmed by the policies were families, including children (especially the poorest ones), and the unemployed.

Savage and Tim (2015) focused on identifying the distributional impact of indirect taxation. Based on Ireland's 2009 and 2010 VAT systems, they found that the poorest families paid about 16% of their discretionary income in VAT, whereas the richest families paid only about 6%. The poorest households would contribute the largest percentage of their available money toward paying VAT.

Savage and Tim's (2015) analysis of the indirect tax system in 2010 illustrates how much disposable income is spent on indirect taxes at various income levels. The results show how regressive Ireland's indirect tax system is. Over one-fourth of the disposable income paid by the bottom decile (the poorest 10%) is thought to have gone toward indirect taxes. Indirect taxes typically have a regressive effect on disadvantaged households.

Husain and Ayesh (2021) conducted a study on the effects of indirect taxation in the setting of Iraq. Indirect taxes, he claimed, are a sizable source of funding, but as they rise, the cost is shifted from the taxpayer to another expense where it is produced, exported, or imported in some way. This indirect cost is then passed on to the final consumer through the high prices of produced, exported, or imported goods. In a study conducted in Japan, Adachi (2018) predicted that indirect taxes, particularly the consumption tax, will raise household costs. Low-income groups will bear a disproportionate amount of the burden. The regressivity of the consumption tax is a problem since it disproportionately impacts lower-income groups in Japan.

According to studies on the incidence of taxation, all indirect taxes are regressive, as Richard (1987) examined. This investigation covered 22 emerging nations. DeWulf (1975) backed up this claim by pointing out that a sizable amount of the poor's income is devoted to indirect taxes. Therefore, a regressive effect can be detected among the lower-income groups. That means that when it comes to indirect taxation, the poor are most susceptible.

According to McLure (1977), the average tax rate on the incomes of the urban poor was 10%, compared to a slightly lower percentage on the incomes of the rural poor. The bottom half of the island's population pays the majority of the indirect taxes, which amount to close to 20% of all income taxes. According to the study by McLure (1977), which was also done in Jamaica, the most regressive tax in Jamaica would be

on tobacco, which is also scarcely taxed. Since a large portion of the impoverished population uses tobacco products, poor households will be impacted by the tobacco tax's regressive effect. Food is hardly taxed in Jamaica, according to Wasylenko (1986), which has an impact on the well-being of the country's poor population.

A different perspective has been presented by Omodero (2020) in the Nigerian context. Items that are necessary and vital and are heavily consumed by poor households have been exempted from the VAT as part of Nigeria's introduction of a new finance act. In Nigeria, a few examples of goods that are exempt from sales tax are milk, almonds, seasoning oil, baby food, books, educational materials, pharmaceuticals, and nourishments. The government has identified the necessity of items and the tax burden on poor households and exempted those essential products from indirect taxes.

In order to quantify the disparity of the distribution of the indirect tax burden, researchers have utilized a variety of inequality measures. As seen in the Kaplanoglo (2014) study conducted in Greece, several inequality indices have been employed to express distinct value judgments regarding the significance of a person's welfare in various distributional sectors. In order to gauge inequality, he has employed the Gini coefficient, Atkinson index, and Theil indices. In 1988, 2002, 2005, 2008, and 2011, the indirect tax system affected inequality changes. Since a uniform tax was put in place in 1988, a small distributional impact can be detected. After 1988, it seemed that the indirect tax system had a negative distributional impact. According to Kaplanoglo (2014), 2011 was the most regressive year since 1988.

Decoster et al., (2009) also utilized the Suits Index to calculate indirect taxation's regressive impact. In order to look into the uneven distribution of the indirect tax burden, Decoster et al. (2009) undertook a study in 5 European countries. The Suits Index was negative for all nations, indicating a regressive effect that shows those with lower incomes pay more indirect taxes overall, which consumes a larger share of their disposable income. This rate of regressivity is highest in Greece. The UK is the nation with the lowest regressive rate out of the five.

Decoster et al., (2009). Furthermore, it was noted that in every country, the bottom 10% of taxpayers pay twice as much in indirect taxes as the top 10%. The suits index ranges from -1 to +1. A progressive tax has an index value that is positive, which means that persons with higher incomes will pay more in taxes. In a regressive tax system where lower-income individuals or households are required to pay a larger share of indirect tax, the index value is negative. For proportional tax, the index value is zero, signifying that each person pays an equal amount of tax. When the wealthiest people pay all taxes, the index value is positive (+1), and when the poorest people pay all taxes, the index value is negative (-1).

The overall indirect tax burden as a share of disposable income for all nations was regressive, as shown in Table 01 as per the study of Decoster et al. (2009). Negative suits index scores reflect the regressive effect. The inequality distribution is also shown using the Gini coefficient.

Table 01: Regressive Effect of Indirect Taxation

	Country				
	BE	**GR**	**HU**	**IE**	**UK**
Average Income Tax	11.8	15.7	15.3	13.2	10.3
Suits Index	-0.079	-0.101	-0.086	-0.143	-0.120
Gini Coefficient	0.319	0.324	0.318	0.331	0.368

Source: Decoster et al. (2009)

3. METHODOLOGY

Data were collected from the Colombo District with the representation of all secretariat divisions in the same district and the representation of low-income, middle-income, and high-income households. The expected sample size was 500, and the sample was selected using the stratified judgment sampling method. The sample consisted of 40% of low-income households, 40% of middle-income households, and 20% of high-income households. According to the Household Income and Expenditure Survey in 2019, conducted by the Department of Census and Statistics Department, entire households have been divided into ten national household income deciles (10% each). Out of which, the first four deciles belong to low-income households, the next four deciles belong to middle-income households, and the last two deciles belong to high-income households.

Based on Kaplanoglo's study (2014), a structured questionnaire was prepared for the household consumption survey in order to calculate the indirect tax payments by each Household. 115 nondurable consumption basket was selected from the consumption basket of the National Consumer Price Index. The questionnaire was designed, and data was collected through the KOBO ToolBod platform. Once the data was collected, nominal indirect tax rates were applied to the respective commodities Kaplanoglo (2014) to obtain the indirect tax payments to the government. Indirect tax rates for each commodity were obtained from the VAT schedule, special commodity levy imposed commodity list, import tariff list and social security contribution levy schedule, and special gazette notifications. The analysis was performed while measuring the indirect tax burden on different consumer groups in Sri Lanka. First, measure the indirect tax burden of expenditure deciles, then the indirect tax burden of income deciles, and lastly, the indirect tax burden of income groups. The definitions of the above-mentioned expenditure deciles, income deciles, and income groups are presented in Tables 02, 03, and the Table 04.

Table 02: National Household Expenditure Deciles

Income Decile	**% of Household**
Less than or equal to Rs. 20,140	10%
Rs. 20,141 - Rs. 27,588	10%
Rs. 27,589 - Rs. 33,972	10%
Rs. 33,973 - Rs. 40,380	10%
Rs. 40,381 - Rs. 47,544	10%
Rs. 47,545 - Rs. 55,634	10%
Rs. 55,635 - Rs. 66,761	10%
Rs. 66,762 - Rs. 82,858	10%
Rs. 82,859 - Rs. 114,984	10%
More than Rs. 114,984	10%

Source: Household Income and Expenditure Survey (2019)

Table 03: National Household Income Deciles

Income Decile	% of Household
Less than or equal to Rs. 18,500	10%
Rs. 18,501 - Rs. 28,057	10%
Rs. 28,058 - Rs. 36,381	10%
Rs. 36,382 - Rs. 44,429	10%
Rs. 44,430 - Rs. 53,333	10%
Rs. 53,334 - Rs. 63,533	10%
Rs. 63,534 - Rs. 77,264	10%
Rs. 77,265 - Rs. 97,590	10%
Rs. 97,591 - Rs. 141,605	10%
More than Rs. 141,605	10%

Source: Household Income and Expenditure Survey (2019)

Table 04: Income Group Classification

Income Group	Deciles Contain	Lower and Upper Limits of Monthly Income
Low-income	1, 2, 3, and 4	Less than Rs. 44,429
Middle-income	5, 6, 7, and 8	Rs. 44,430 – Rs. 97,590
High-income	9 and 10	More than Rs. 97,591

Source: Household Income and Expenditure Survey (2019)

4. RESULTS

Descriptive statistics techniques have been employed to measure the burden of indirect tax among different commodity groups, and the Lorenz Curve and the Gini Coefficients have been used to present the inequal distribution of the indirect tax burden.

4.1. Indirect Tax Burden by National Expenditure Deciles

Expected to calculate the indirect tax portion paid by each expenditure decile group and calculate the burden rates. The idea of the burden rate is how much of the amount paid as indirect tax to the government, compared with the average expenditure of the respective expenditure deciles. It is also expected to measure the inequality of the distribution of indirect tax burden among expenditure deciles. Calculated indirect tax portions and the burden rates of respective expenditure deciles are presented in Table 05.

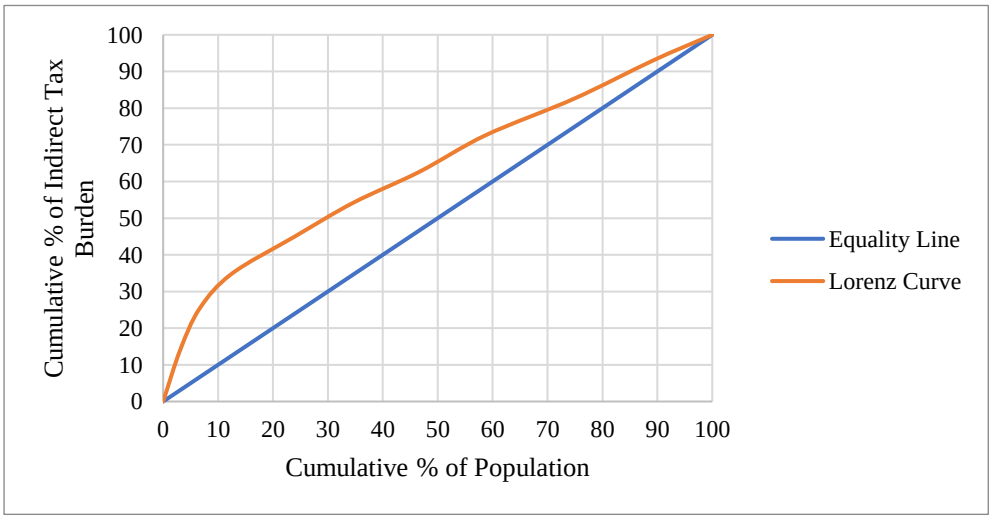
Table 5: Indirect Tax Burden Rates by Expenditure Deciles

Expenditure Decile	Avg. Tax Burden	Avg. Expenditure	Tax Burden Rate of Exp. Decile
1	2,880.19	14,592.00	19.74%
2	3,775.98	23,900.00	15.80%
3	4,067.38	30,743.00	13.23%
4	5,269.78	37,174.00	14.18%
5	5,732.35	43,860.00	13.07%
6	6,075.54	51,420.00	11.82%
7	8,506.36	60,930.00	13.96%
8	10,408.75	74,202.00	14.03%
9	14,028.93	96,384.00	14.56%
10	19,452.15	198,169.00	9.82%

Source: Author Estimation

According to Table 05, the lowest expenditure decile (1st income decile) households are paid Rs. 2,880.19 as indirect tax per month. That amount is 19.74% compared with the decile's average expenditure. Thus, the poorest households are paid nearly 20% of their monthly expenditure as indirect tax to the government. When considering the second expenditure decile, the respective households are paid Rs. 3,775.98 as indirect tax per month, which is 15.8% compared with the average expenditure of the second income decile. Households available in the third expenditure decile are paid Rs. 4,067.38 per month, which is 13.23% of the average expenditure of the third expenditure decile.

When considering the tenth expenditure decile, there is a different picture. The tenth expenditure decile represents the richest households in the country. The households in the tenth expenditure decile are paid Rs. 19,452.15 per month as indirect tax, which is 9.82% of the average expenditure of the particular expenditure decile. There is a significant finding to be pointed out. In the lower expenditure deciles, respective households are paid a higher amount as indirect taxes compared with the average expenditure. And by looking at the higher expenditure deciles, they paid a relatively lower indirect tax percentage compared with their average expenditure. Households in the highest expenditure decile represent the richest households in the country. The richest people are consuming a higher portion of goods and services. So naturally, the richest people are paying a higher indirect tax amount than the poor people. But when it comes to the burden rate, poor people bear a higher burden than rich people. It is important to adopt measurements to identify the inequal distribution of indirect tax burden among expenditure deciles. Based on the literature, the Gini Coefficient and the Lorence Curve were selected as the measurements of inequality. The derived Lorenz Curve based on the indirect tax burden tare of respective expenditure deciles is presented in Figure 01.



Source: Author Estimation

Figure 01: Lorenz Curve for Indirect Tax Burden by Expenditure Deciles

Figure 01 clearly shows the regressive effect of the indirect tax burden. That means the curve has an upward-sloping nature. This means households in the lower expenditure deciles have to bear a higher indirect tax burden rate than the households in higher expenditure deciles. When deriving the Lorenz Curve for income distribution in a country like Sri Lanka, the curve slopes downward. The meaning of such a downward-sloping Lorenz Curve is that the higher portion of the income will be absorbed by the higher-income people. But here, the situation is different. In the case of the indirect tax burden, the higher rate of burden is absorbed by the lower-income or the poor people.

Based on the derived Lorenz Curve, the Gini Coefficient was also calculated to measure the degree of inequality. The calculated Gini Coefficient for the distribution of indirect tax burden was -0.27. The coefficient value gets a negative value. The negative sign of the Gini Coefficient indicates the regressive impact. This means lower expenditure households have to bear a higher rate of the indirect tax burden.

4.2. Indirect Tax Burden by National Income Deciles

According to Table 06, households in the lowest-income decile (the poorest population in the country) paid Rs. 3,813.40 per month as indirect tax to the government. That amount is 32.62% of the average income of the particular decile. The figure confirmed that a significant portion of the income of the poorest population is taken by the government as an indirect tax. When considering the second income decile, respective households paid Rs. 5,555.32 per month as indirect taxes, which represents 23.68% of the average income of the second income decile. In the third income decile, relevant households are paid Rs. 5,720.76 per month as indirect tax. The amount was 17.75% of the average income of the third income decile.

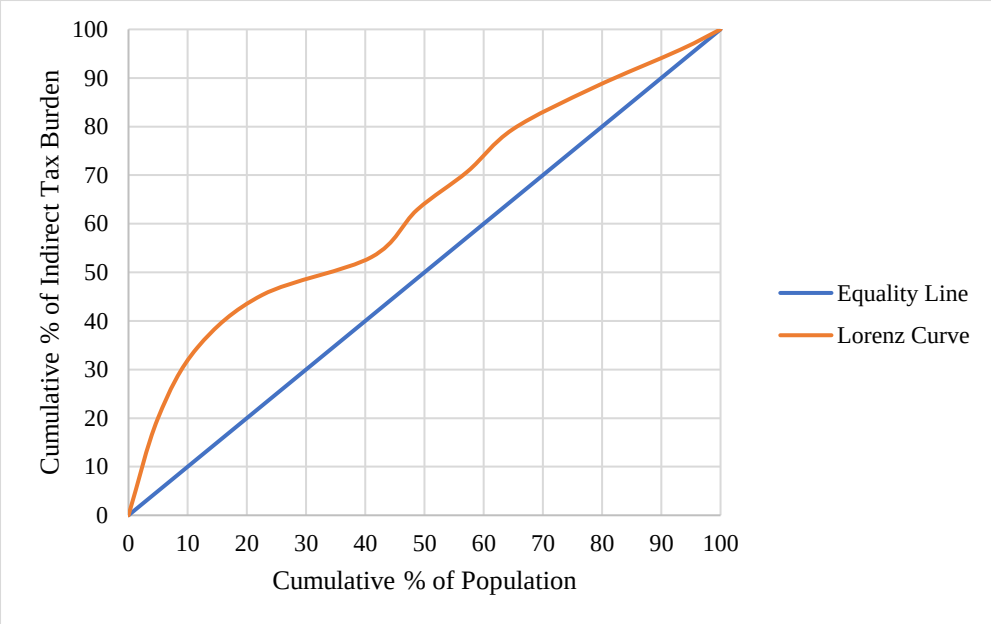
Table 06: Indirect Tax Burden Rates by Income Deciles

Income Decile	Avg. Tax Burden	Avg. Income	Tax Burden Rate of Income Decile
1	3,813.40	11,692.00	32.62%
2	5,555.32	23,459.00	23.68%
3	5,720.76	32,231.00	17.75%
4	5,142.04	40,347.00	12.74%
5	7,738.01	48,777.00	15.86%
6	7,486.61	58,270.00	12.85%
7	9,987.48	70,190.00	14.23%
8	12,172.48	86,669.00	14.04%
9	14,600.49	115,742.00	12.61%
10	19,030.17	276,889.00	6.87%

Source: Author Estimation

By looking at the tenth income decile in Table 06, the respective households are paid Rs. 19,030.17 per month, which is only 6.87% of the average income of the richest population. Just like the analysis made on the expenditure deciles, according to the indirect tax calculated based on the income deciles, the higher tax burden goes to the poor households, and a regressive effect can be seen.

Graphically and mathematically measure the inequality of the distribution of the indirect tax among income deciles. For the graphical presentation of the inequal distribution of the indirect tax, the Lorenz Curve has been derived, and it is shown in Figure 02.



Source: Author Estimation

Figure 02: Lorenz Curve for Indirect Tax Burden by Income Deciles

The Lorenz Curve, shown in Figure 02, also represents the regressive impact of the indirect tax burden. The same Lorenz Curve is also upward-sloping and placed above the perfect equality line. The Lorenz curve shows a higher indirect tax burden absorbed by poor households (lower income decile). It shows the distance between the perfect equality line and the derived Lorenz curve. The higher distance between the said lines is available during the lower income deciles. This confirms the regressive impact of the indirect tax on poor households. The distance between those two lines is much less during the higher income deciles. That means the indirect tax burden is much lower than that of poor households. The calculated Gini Coefficient based on the derived Lorenz Curve was -0.23. The negative Gini Coefficient also confirms the regressive effect of indirect taxes. That means the higher impact of indirect tax goes to poor households.

4.3. Indirect Tax Burden by Income Groups

According to Table 07, low-income households paid Rs. 5,202.70 per month as indirect tax to the government, which is 19.32% compared to the average income of the low-income group. Households in the middle-income group paid Rs. 9,757.89 per month as indirect taxes. That is 14.79% of the average income of the middle-income group households. There is a significant thing to point out in the high-income group. The households in the high-income group paid Rs. 16,091.71 per month as an indirect tax to the government. However, when comparing the average income of the high-

income groups, the paid indirect tax amount was only 8.16%. Like the previous analysis made on national expenditure deciles and the national income deciles, when considering the income groups also, there is a high indirect tax burden pressure on poor households. 19.32% of the income of the low-income group is paid as indirect taxes, while the high-income group households are paid only 8.16% of their income. Thus, poor households absorb more of the tax burden rate. Therefore, a regressive effect can be identified here as well.

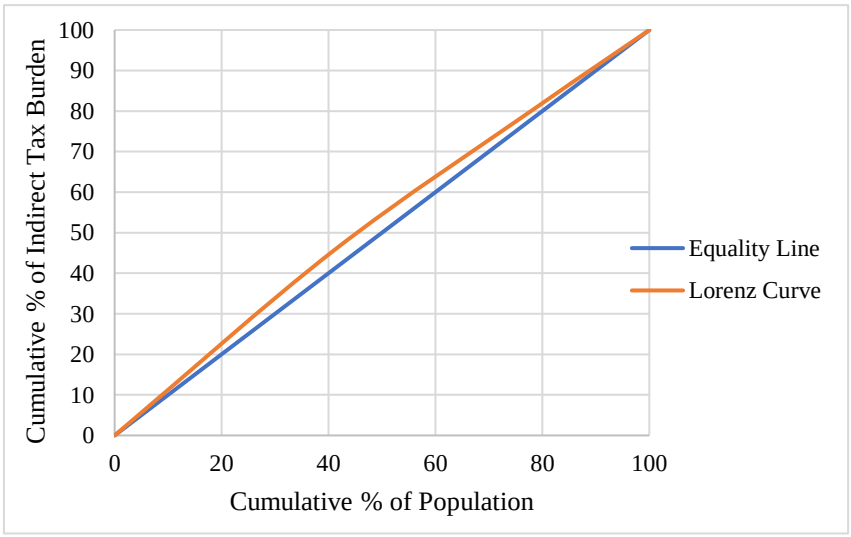
Table 07: Indirect tax Burden Rates by Income Groups

Income Group	Avg. Tax Burden	Avg. Income	Tax Burden Rate of Income Group
Low Income	5,202.70	26,930.00	19.32%
Middle Income	9,757.89	65,976.00	14.79%
High Income	16,019.71	196,289.00	8.16%

Source: Author Estimation

Lorenz Curve is used to identify the inequal distribution of the burden of indirect tax among income groups. Lorenze Curve also satisfied the regressive impact of the indirect tax burden while depicting an upward-sloping curve. Figure 03 shows the Lorenz Curve for the indirect tax burden by income groups.

The calculated Gini Coefficient for the indirect tax burden by income groups was -0.05. This also confirms the regressive effect. Based on the value of the Gini Coefficient, it can be concluded that there is a high indirect tax pressure on poor households. According to the Household Income and Expenditure Survey in 2019, the upper limit of the lower income group was the national poverty line. Therefore, 40% of poor households that lie under the national poverty line had to bear a higher portion of the indirect tax burden rate than higher-income households.



Source: Author Estimation

Figure 03: Lorenz Curve for Indirect Tax Burden by Income Groups

5. DISCUSSION AND CONCLUSSION

In every country, taxation plays a significant role. The tax income represents a significant portion of a government's general revenue. Different countries have different tax structures. Tax structures, in a sense, are direct and indirect tax compositions. Most developed countries have a higher percentage of direct tax and a lower percentage of indirect taxation. Direct taxes are imposed on the income and profits of persons, which confirms the equity principle of taxation. That means the direct taxes are paid according to the ability to pay. When considering indirect tax, the principle of equity can not be seen. Indirect taxes are paid irrespective of income level. Every person/household, including poor and rich, is paying indirect taxes (goods and services taxes) to the government.

Paying taxes indirectly as goods and services taxes may not have a significant impact on rich people. The indirect tax payment per month is a relatively low amount compared with their average income. But that is different for the poor. Poor people do have an unstable, unsecured, and relatively lower amount of income. When poor people purchase their necessary products from the market, they pay several indirect taxes. The indirect tax amounts paid by poor people are a significant portion compared to poor people's average income. That will be a huge economic and social impact. Increasing indirect tax payments will reduce the disposable income of poor people.

We discussed the regressive impact of indirect taxation. The regressive impact refers to the poor people's side. The indirect tax portion paid by the poor people represented a significantly higher portion of their income. Thus, poor people bear a higher rate of the indirect tax burden than rich people. According to the findings of the study, the poorest population of the society paid nearly 32% of the indirect tax portion compared with their income. Based on the initial findings, it can be seen that for every hundred rupees of poor people's income, the government gets thirty-two rupees as an indirect tax. As mentioned above, due to the higher indirect tax burden on poor people, their disposable income will be reduced. Reduction of disposable income refers to insufficient funds for essential activities like food, health, education, etc. Economically, due to the indirect tax, there are several side effects such as the reduction of consumption, increase in living cost, and decrease in the living standard. According to the study, most of the poor households had expenses exceeding their income level, which indicated a minus saving. Thus, poor people are unable to maintain savings for future requirements.

As a summary of findings, it can be stated that poor households have to bear a higher rate of the indirect tax burden than rich households because the indirect tax amount paid by the rich households was a relatively insignificant percentage compared with the average income and expenditure of the rich households. Similarly, the indirect tax paid by the poor households was a significant portion compared with the average income and expenditure of the poor households. Thus, in Sri Lanka, a regressive impact will be reflected in the indirect tax, which indicates a higher rate of indirect tax burden going to poor households, while a low rate of indirect tax burden reflects the high-income households.

6. RECOMMENDATIONS

In Sri Lanka, the tax structure has been established as regressive for poor households. That confirms the findings of the study. The study found that a higher rate of indirect tax burden goes to poor (low-income) households, and higher-income households bear a lower rate of indirect tax burden. The reason for that was having a significantly higher percentage of indirect tax in Sri Lanka. As researchers, we are recommending that the government decrease the indirect taxes and increase the direct taxes. Then, one can argue what the justice of increasing income tax is. Sri Lanka is currently going on protests and strikes by professionals to reduce the income tax rates. Everyone knows that there is a huge economic crisis in Sri Lanka. While having that crisis, the government increased the income tax significantly. Increasing the income tax during this economic crisis was a highly disappointing situation.

As researchers, we are not recommending further imposing income taxes on existing taxpayers. The government needs to identify new taxpayers. How is it achieved? In Sri Lanka, there are plenty of people who have the ability to pay income tax but do not pay taxes. Developed countries have good practices in their tax system. Developed countries have a proper mechanism to trace all people's income. People in such countries are also willing to pay income tax because they know that they also obtain benefits from the government's welfare activities, and they know to which welfare activity they are contributing by paying income tax. But in Sri Lanka, the picture is different. People do not have the willingness to pay taxes and are always trying to escape from the income tax.

Most of the developed countries maintain their direct tax portion of more than 60% of the total tax income. Instantly, Sri Lanka may not be able to increase the direct tax portion to such a level. However, direct tax contributions should be continuously increased. In the short term, we recommended maintaining the tax structure as 40% direct tax and 60% indirect tax, and in the long term, we recommended maintaining the tax structure as 60% direct tax and 40% indirect tax. Then, the adverse impact of the indirect tax on poor people will be eliminated. The government and respective tax authorities should introduce new laws & regulations and amend the existing regulations in order to achieve the target. And the transparency of the spending tax revenue should be enhanced.

In Sri Lanka, tax policies are directly linked with political policies. When changing the ruling party, they changed their economic policies along with the tax policies. Changing the tax policies is one of the major political campaigns in Sri Lanka. In Sri Lanka, there is no national tax policy. Those are changed government by government. Thus, we recommend implementing a national tax policy in the country that does not change with political agendas.

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CONSTRUCTING THE DISCOUNT FUNCTION WITH THE PARSIMONIOUS EXTENDED NELSON-SIEGEL FUNCTION: EVIDENCE FROM THE NIGERIAN EUROBOND

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Abstract

Nigeria currently carrying out economic reforms is under the surveillance of institutional investors. To construct the market discount function through its yield curve, we applied the extended functional Nelson-Siegel parsimonious function with time-decay parameters to the Eurobond data to employ flexibility of the model and estimate the time varying parameters. In order to present a deep investigation of the Euro-bond market by reason of time to maturity, our contribution is anchored on following objectives: (i) construct the discount function (ii) investigate the limiting behavior of the yield curves and (iii) predict the in-sample yield. The data presented involves the daily closing of the Nigerian Eurobond yield covering January to December 2021 and 2022. The data was fitted to the observed Nigerian Eurobond yield curve to model the discount function. The ordinary least square method is used for the analysis and the estimated parameters were used to compute the in-sample yield. Test of goodness of fit was conducted showing that the model fits in well to the observed data demonstrated by the model's R-square adjusted through the predicted yields after obtaining the two decay factors. This paper has implications on life insurance products associated with minimum guaranteed benefit schemes for the insured. Based on the terms and conditions of the contract, the insured pays regular premium invested in debt instruments and receives benefit at death or at maturity of the policy depending on the market performance of the fund. There is a guaranteed benefit which the insured earns irrespective of the performance of the life fund. The insurer would then pay the guaranteed amount even if the benefit eventually drops below the guaranteed amount. Given the discount $\delta(\tau)$and benefit$\emptyset$, the present value of future death benefits is modeled as $PVFB = \emptyset_1\delta(1) + \emptyset_2\delta(2) + \cdots + \emptyset_{T-1}\delta(T-1) + \emptyset_T\delta(T)$.

Keywords: Consol, Extended Nelson-Siegel, Eurobond, Parsimonious, Yield Curve

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1. INTRODUCTION

This study is concerned with the estimation of the nominal yield curve and the associated discount function by means of integral transform approach while focusing on a model of the forward rate curve from where the functional form of the yield curve could be derived by integrating the specified forward rate function. This technique could be explained as a generalization of the commonly employed parsimonious form of the yield curve estimation initially proposed in Nelson and Siegel (1987). Valuable market information is entrenched in the yield curve such as market's expectation on the future trajectory of interest rate analysis. Yield curves are not directly observable despite the availability of prices and the yields of bonds in the market. To obtain a yield curve directly from the market data, a zero coupon bond over a continuum of maturities will be required. Although bonds are issued over a defined set of maturities, many bonds for longer term maturities are fixed coupon bonds. Consequently, effort to extract yield curve from the bond market requires modelling zero rates.

The yield curve considered here will be specifically based on the extended Nelson-Siegel model which can be suited to the less liquid and less developed markets similar to the Nigerian market. The extended Nelson-Siegel model represents a zero coupon parsimonious model which accounts for distinct deformations of the yield curves to enable a dynamic evaluation of the market with time varying parameters which can be estimated from the market data and representing the curve as a smooth surface.

It has been assumed that a similar interest rate is applied for discounting cash inflows or outflows for all maturities. However, this assumption does not always hold in practice since the rates applied for discounting a series of cash-flows at various maturities vary. This can be verified by contrasting the actual interest rates on zero coupon bonds which disburses a single payment at maturity under no intermediate coupon payments. Consequently, these bonds are usually discounted at varying rates based on their remaining term to maturity. The term structure of interest rates represents the connection between yields on comparable financial instruments of varying degree of maturities. A spot rate S_k for maturity k periods is an interest rate payable on a debt instrument of maturity k periods which starts immediately and accumulates interest to maturity, $k \in Z^+$. However, a single forward rate $f(\xi)$ is an interest rate payable on a future debt which begins at time ξ to $\xi+1$; $\xi = 0,1,2,3,...$ while a short interest rate is a rate applied to a short interval of time up to a year including instantaneous rate over an infinitesimal interval of time. Suppose we apply one year as short interest rate to derive forward rate function, we obtain

$$(1+S_k)^k = (1+f(1))(1+f(2))(1+f(3))\times...\times(1+f(k-1)) \quad (1)$$

or equivalently;

$$\left(1+f\left(k-1\right)\right)=\frac{\left(1+S_k\right)^k}{\left(1+S_{k-1}\right)^{k-1}} \tag{2}$$

From the continuously compounded interest rate perspective, we let $\delta(\xi)$ be the spot force of interest and $\Phi(\xi)$ be the forward force of interest to obtain a functional form as

$$e^{\xi\times\delta(\xi)}=e^{\int_0^{\xi}\Phi(u)du} \tag{3}$$

$$\xi\delta\left(\xi\right)=\int_0^{\xi}\Phi\left(u\right)du\Rightarrow\delta\left(\xi\right)=\frac{1}{\xi}\int_0^{\xi}\Phi\left(u\right)du \tag{4}$$

Differentiating both sides we have the first order differential equation

$$\Phi\left(\xi\right)=\xi\frac{d}{d\xi}\delta\left(\xi\right)+\delta\left(\xi\right) \tag{5}$$

2. LITERATURE REVIEW

In Castello and Resta (2019), the trajectory motion of term structure is defined by the yield curves which are potentially obtained from a large number of prices of debt instruments. From the author's view, we see that their information content could be encapsulated into a parsimonious number of parameters provided the particular trend shown by these curves is identified. Hence the yield curve describes the correspondence between interest rates payable on debt instruments with varying time to maturity spectrum. Nigeria is currently under the surveillance of institutional investors and the recent reforms carried out in the financial sector as part of the globalization process constitute an avalanche of economic uncertainties. Consequently, examining its yield curve is markedly significant to the regulators, government, financial institutions and institutional investors to design pricing and hedging strategies against those financial risks so as to quantify financial risks associated with portfolios. The yield curve provides the requisite information to elucidate the fiscal policies that could be explained in terms of the market expectation of fiscal policies and financial market operations over short, medium and long time spectrum so as to design economic strategies.

As observed in Javier (2009), the yield curve therefore elicits instrumental economic information in terms of fiscal inputs to simplify institutional regulation such that when the nominal yield is estimated, the term structure of interest rate will be numerically modelled. The term structure of interest rates is usually obtained from the optimized instantaneous forward rates through technical numerical integration techniques although irrespective of the numerical process applied, a major limitation

associated with modelling yield curves seems to anchor on the argument that they usually reflect as many relevant movements in the underlying term structure of interest rates. The rationale behind the functional technique is to derive continuous forward rate function analytically such that the constructed analytical discount bond prices will fit the observed smooth bond price function.

The models developed in Nelson-Siegel (1987) class, in particular the extended Nelson-Siegel in Svensson (1994) assume a continuous function for the instantaneous forward rates which seem to satisfy the solution of a second order differential equation with constant coefficients. The yield curve as observed in Javier (2009) could elicit further economic information in the form of fiscal inputs to ease institutional regulation such that the moment the nominal yield is computed, the term structure of interest rate will be numerically modelled.

In Saunders and Cornett (2014); Castello and Resta (2019); Stelios and Avdoulas (2020), the term structure of interest rate measures the investor's return in a market income instrument. Although extensive works in Chakroun and Abid (2014); Filipovic (2009); Diebold and Rudenbusch (2013); Walli and Bari (2018) Hess (2020) ranging from deterministic to stochastic techniques have been researched on the term structure of interest rates, their discussions have been impressively centered on the advanced economies in America, Canada and Europe but regrettably these authors have not deeply examined the emerging economies like Nigerian markets. The apparent dearth of contributions on the emerging economies in view of their potential fiscal strength capabilities seems to be myopically obscured by these researchers because the trajectories of the yield curve of these economies appear to exhibit some levels of volatilities with frequent market humps as opposed to the yield curve of advanced economies where the yield function is less volatile. Nigeria is embarking on some key economic reforms and the current unabated cash crunch are drivers of financial risks. Furthermore, the apparent dearth of rich academic literature on the term structure plaguing few emerging economies as argued in Chakroun and Abid (2014); Walli and Bari (2018); Stuart (2020) marks the evolution of this study. Although zero coupon yield rates are commercially furnished by market data vendors, they are usually nontransparent and hence may not be trustworthy.

3. METHODOLOGY

As a big market player in Africa, it is observed that Nigeria does not have any standard technique of measuring its term structure up till now through yield curves. As a result of this gap, we shed light on the extended Nelson-Siegel parsimonious function that is both smooth and flexible to construct a computational pool of yield and forward curve trajectories from where the discount and spot rate functions could be derived.

The first approach is to construct an analytical form of the yield curve and then derive the particular yield curve corresponding to the extended Nelson-Siegel. This yield curve function is then used to derive the console and the short rates.

Suppose $f(\tau,\beta)$ defines the forward rate trajectories at current time τ with maturity β. We can partition the interval (τ,β) into k equal sub-intervals such that

$$k \times \Delta\tau = \beta - \tau \tag{6}$$

$$f(\tau,\beta) = \lim_{k\to\infty} \left\{ \begin{array}{l} f(\tau,\tau+\Delta\tau)\dfrac{\Delta\tau}{\beta-\tau} + f(\tau+\Delta\tau,\tau+2\Delta\tau)\dfrac{\Delta\tau}{\beta-\tau} \\ + f(\tau+2\Delta\tau,\tau+3\Delta\tau)\dfrac{\Delta\tau}{\beta-\tau} \\ + f(\tau+(k-1)\Delta\tau,\tau+k\Delta\tau)\dfrac{\Delta\tau}{\beta-\tau} \end{array} \right\} \tag{7}$$

$$f(\tau,\beta) = \frac{1}{\beta-\tau}\sum_{j=0}^{k-1} f(\tau+j\Delta\tau,\tau(j+1)\Delta\tau)\Delta\tau \tag{8}$$

$$f(\tau,\beta) = \lim_{k\to\infty}\left\{\frac{1}{\beta-\tau}\sum_{j=0}^{k-1} f(\tau+j\Delta\tau,\tau(j+1)\Delta\tau)\Delta\tau\right\} \tag{9}$$

$$f(\tau,\beta) = \frac{1}{\xi-\tau}\int_{\tau}^{\xi} f(u,u)\,du \tag{10}$$

For the extended Nelson-Siegel function, the forward rate function is defined as

$$f(\tau) = \beta_0 + \beta_1 e^{-\frac{\tau}{\lambda_1}} + \beta_2\left(\frac{\tau}{\lambda_1}e^{-\frac{\tau}{\lambda_1}}\right) + \beta_3\left(\frac{\tau}{\lambda_2}e^{-\frac{\tau}{\lambda_2}}\right) \tag{11}$$

The parameter β_0 defines the asymptote of the zero coupon yield trajectory and represents the long run level of interest rates. The factor β_1 describes the deviation of the forward function from the asymptotic level and represents the variation between long term and short term instantaneous forward rates. The factors β_2 and β_3 govern the magnitudes and directions of humps. The factors λ_1 and λ_2

govern the convergence speed of the exponential term and control the maturity at which the medium term rates approach their maximum. Extreme values of $\{\lambda_1,\lambda_2\}$

would result in slow decay and determine better fit at long maturity but not in the short term when visible curvatures are apparent. Nevertheless low values of $\{\lambda_1, \lambda_2\}$ decay quickly and consequently a better fit for short maturity but not in the long run.

Estimating the parameters of the extended Nelson-Siegel essentially requires transforming the instantaneous forward rate function into zero rates to price coupon bearing bonds. The zero rates is obtained by evaluating the integral of the instantaneous forward rates in equation (11)

Using equation (10), we then construct the yield function

$$y_\tau(\tau) = \frac{1}{\tau}\int_0^\tau \left[\beta_0 + \beta_1 e^{-\frac{u}{\lambda_1}} + \beta_2\left(\frac{u}{\lambda_1}e^{-\frac{u}{\lambda_1}}\right) + \beta_3\left(\frac{u}{\lambda_2}e^{-\frac{u}{\lambda_2}}\right)\right]du \tag{12}$$

$$y_\tau(\tau) = \frac{1}{\tau}\times\beta_0\int_0^\tau du + \frac{1}{\tau}\times\beta_1\int_0^\tau e^{-\frac{u}{\lambda_1}}du + \frac{1}{\tau\lambda_1}\times\beta_2\int_0^\tau\left(ue^{-\frac{u}{\lambda_1}}\right)du + \frac{1}{\tau\lambda_2}\times\beta_3\int_0^\tau ue^{-\frac{u}{\lambda_2}}du \tag{13}$$

$$y_\tau(\tau) = \frac{\beta_0}{\tau}[u]_0^\tau + \frac{\beta_1}{\tau}\left[\frac{e^{-\frac{u}{\lambda 1}}}{\frac{-1}{\lambda_1}}\right]_0^\tau + \frac{\beta_2}{\tau\lambda_1}\left(\left[\frac{ue^{-\frac{u}{\lambda_1}}}{-\frac{1}{\lambda_1}}\right]_0^\tau - \int_0^\tau \frac{e^{-\frac{u}{\lambda_1}}}{\frac{-1}{\lambda_1}}du\right) + \frac{\beta_3}{\tau\lambda_2}\left\{\left[\frac{ue^{-\frac{u}{\lambda_2}}}{-\frac{1}{\lambda_2}}\right]_0^\tau - \int_0^\tau \frac{e^{-\frac{u}{\lambda_2}}}{\frac{-1}{\lambda_2}}du\right\} \tag{14}$$

$$y_\tau(\tau) = \frac{\beta_0}{\tau}[u]_0^\tau - \frac{\beta_1}{\tau}\left[\frac{e^{-\frac{u}{\lambda 1}}}{\frac{1}{\lambda_1}}\right]_0^\tau - \frac{\beta_2}{\tau\lambda_1}\times\left[\frac{ue^{-\frac{u}{\lambda_1}}}{\frac{1}{\lambda_1}}\right]_0^\tau + \frac{\beta_2}{\tau\lambda_1}\times\int_0^\tau \frac{e^{-\frac{u}{\lambda_1}}}{\frac{1}{\lambda_1}}du - \frac{\beta_3}{\tau\lambda_2}\times\left[\frac{ue^{-\frac{u}{\lambda_2}}}{\frac{1}{\lambda_2}}\right]_0^\tau + \frac{\beta_3}{\tau\lambda_2}\times\int_0^\tau \frac{e^{-\frac{u}{\lambda_2}}}{\frac{1}{\lambda_2}}du \tag{15}$$

$$y_\tau(\tau) = \frac{\beta_0}{\tau}[u]_0^\tau - \frac{\beta_1}{\tau}\left[\frac{e^{-\frac{u}{\lambda 1}}}{\frac{1}{\lambda_1}}\right]_0^\tau - \frac{\beta_2}{\tau\lambda_1}\times\left[\frac{ue^{-\frac{u}{\lambda_1}}}{\frac{1}{\lambda_1}}\right]_0^\tau + \frac{\beta_2}{\tau}\times\int_0^\tau e^{-\frac{u}{\lambda_1}}du - \frac{\beta_3}{\tau\lambda_2}\times\left[\frac{ue^{-\frac{u}{\lambda_2}}}{\frac{1}{\lambda_2}}\right]_0^\tau + \frac{\beta_3}{\tau}\times\int_0^\tau e^{-\frac{u}{\lambda_2}}du \tag{16}$$

$$y_\tau(\tau)=\frac{\beta_0}{\tau}\left[u\right]_0^\tau-\frac{\beta_1}{\tau}\left[\frac{e^{-\frac{u}{\lambda 1}}}{\frac{1}{\lambda_1}}\right]_0^\tau-\frac{\beta_2}{\tau\lambda_1}\times\left[\frac{ue^{-\frac{u}{\lambda_1}}}{\frac{1}{\lambda_1}}\right]_0^\tau+\frac{\beta_2}{\tau}\times\left[\frac{e^{-\frac{u}{\lambda_1}}}{-\frac{1}{\lambda_1}}\right]_0^\tau$$

$$-\frac{\beta_3}{\tau\lambda_2}\times\left[\frac{ue^{-\frac{u}{\lambda_2}}}{\frac{1}{\lambda_2}}\right]_0^\tau+\frac{\beta_3}{\tau}\times\left[\frac{e^{-\frac{u}{\lambda_2}}}{-\frac{1}{\lambda_2}}\right]_0^\tau \tag{17}$$

$$y_\tau(\tau)=\frac{\beta_0}{\tau}\left[\tau-0\right]-\frac{\beta_1}{\tau}\left[\frac{e^{-\frac{\tau}{\lambda 1}}}{\frac{1}{\lambda_1}}-\frac{1}{\frac{1}{\lambda_1}}\right]-\frac{\beta_2}{\tau\lambda_1}\times\left[\frac{\tau e^{-\frac{\tau}{\lambda_1}}}{\frac{1}{\lambda_1}}-0\right]$$

$$-\frac{\beta_2}{\tau}\times\left[\frac{e^{-\frac{\tau}{\lambda_1}}}{\frac{1}{\lambda_1}}-\frac{1}{\frac{1}{\lambda_1}}\right]-\frac{\beta_3}{\tau\lambda_2}\times\left[\frac{\tau e^{-\frac{\tau}{\lambda_2}}}{\frac{1}{\lambda_2}}-0\right]-\frac{\beta_3}{\tau}\times\left[\frac{e^{-\frac{\tau}{\lambda_2}}}{\frac{1}{\lambda_2}}-\frac{1}{\frac{1}{\lambda_2}}\right] \tag{18}$$

$$y_\tau(\tau)=\beta_0-\frac{\beta_1}{\tau}\left[\lambda_1 e^{-\frac{\tau}{\lambda 1}}-\lambda_1\right]-\frac{\beta_2}{\tau\lambda_1}\times\tau\lambda_1 e^{-\frac{\tau}{\lambda_1}}-\frac{\beta_2}{\tau}\times\left[\lambda_1 e^{-\frac{\tau}{\lambda_1}}-\lambda_1\right]$$

$$-\frac{\beta_3}{\tau\lambda_2}\times\lambda_2\tau e^{-\frac{\tau}{\lambda_2}}-\frac{\beta_3}{\tau}\times\left[\lambda_2 e^{-\frac{\tau}{\lambda_2}}-\lambda_2\right] \tag{19}$$

$$y_\tau(\tau)=\beta_0-\frac{\lambda_1\beta_1}{\tau}\left[e^{-\frac{\tau}{\lambda 1}}-1\right]-\beta_2 e^{-\frac{\tau}{\lambda_1}}-\frac{\lambda_1\beta_2}{\tau}\left[e^{-\frac{\tau}{\lambda_1}}-1\right]$$

$$-\beta_3 e^{-\frac{\tau}{\lambda_2}}-\frac{\lambda_2\beta_3}{\tau}\left[e^{-\frac{\tau}{\lambda_2}}-1\right] \tag{20}$$

The equation (20) can then be applied to derive the console and the short rates.

3.1. The Console's Theorem

$$\lim_{\tau\to\infty} y_\tau(\tau)=\beta_0 \tag{21}$$

Proof

The yield is given by

$$y_\tau(\tau) = \beta_0 - \frac{\lambda_1\beta_1}{\tau}\left[e^{-\frac{\tau}{\lambda 1}} - 1\right] - \beta_2 e^{-\frac{\tau}{\lambda_1}} - \frac{\lambda_1\beta_2}{\tau}\left[e^{-\frac{\tau}{\lambda_1}} - 1\right]$$
$$-\beta_3 e^{-\frac{\tau}{\lambda_2}} - \frac{\lambda_2\beta_3}{\tau}\left[e^{-\frac{\tau}{\lambda_2}} - 1\right] \quad (22)$$

We need to take limit at infinity

$$\lim_{\tau\to\infty} y_\tau(\tau) = \lim_{\tau\to\infty}\beta_0 - \lim_{\tau\to\infty}\frac{\lambda_1\beta_1}{\tau} \times \lim_{\tau\to\infty}\left[e^{-\frac{\tau}{\lambda 1}} - 1\right] - \beta_2 \lim_{\tau\to\infty} e^{-\frac{\tau}{\lambda_1}}$$
$$-\lim_{\tau\to\infty}\frac{\lambda_1\beta_2}{\tau} \times \lim_{\tau\to\infty}\left[e^{-\frac{\tau}{\lambda_1}} - 1\right]$$
$$-\beta_3 \lim_{\tau\to\infty} e^{-\frac{\tau}{\lambda_2}} - \lim_{\tau\to\infty}\frac{\lambda_2\beta_3}{\tau} \times \lim_{\tau\to\infty}\left[e^{-\frac{\tau}{\lambda_2}} - 1\right] \quad (23)$$

$$\lim_{\tau\to\infty} y_\tau(\tau) = \beta_0 - 0\times(-1) - \beta_2 \times 0 - 0\times(-1) - \beta_3 \times (0) - 0\times(-1) \quad (24)$$

$$\lim_{\tau\to\infty} y_\tau(\tau) = \beta_0 \quad (25)$$

Q.E.D

3.2. The Short Rate Theorem

The short term rate

$$\lim y_\tau(\tau) = \beta_0 - \beta_2 - \beta_3 \quad (26)$$

Proof

The yield curve rate is

$$y_\tau(\tau) = \beta_0 - \frac{\lambda_1\beta_1}{\tau}\left[e^{-\frac{\tau}{\lambda 1}} - 1\right] - \beta_2 e^{-\frac{\tau}{\lambda_1}} - \frac{\lambda_1\beta_2}{\tau}\left[e^{-\frac{\tau}{\lambda_1}} - 1\right]$$
$$-\beta_3 e^{-\frac{\tau}{\lambda_2}} - \frac{\lambda_2\beta_3}{\tau}\left[e^{-\frac{\tau}{\lambda_2}} - 1\right] \quad (27)$$

$$\lim_{\tau\to 0} y_\tau(\tau) = \lim_{\tau\to 0}\beta_0 - \lim_{\tau\to 0}\frac{\lambda_1\beta_1}{\tau}\times\lim_{\tau\to 0}\left[e^{-\frac{\tau}{\lambda 1}}-1\right] - \lim_{\tau\to 0}\beta_2 e^{-\frac{\tau}{\lambda_1}}$$
$$-\lim_{\tau\to 0}\frac{\lambda_1\beta_2}{\tau}\times\lim_{\tau\to 0}\left[e^{-\frac{\tau}{\lambda_1}}-1\right]$$
$$-\lim_{\tau\to 0}\beta_3 e^{-\frac{\tau}{\lambda_2}} - \lim_{\tau\to 0}\frac{\lambda_2\beta_3}{\tau}\times\lim_{\tau\to 0}\left[e^{-\frac{\tau}{\lambda_2}}-1\right] \quad (28)$$

Applying the L'Hopital rule to the quotient terms only and take the limit at zero, we have

$$\lim_{\tau\to 0} y_\tau(\tau) = \lim_{\tau\to 0}\beta_0 - \lim_{\tau\to 0}\frac{0}{1}\times\lim_{\tau\to 0}\left[-\frac{1}{\lambda_1}e^{-\frac{\tau}{\lambda 1}}\right] - \lim_{\tau\to 0}\beta_2 e^{-\frac{\tau}{\lambda_1}}$$
$$-\lim_{\tau\to 0}\frac{0}{1}\times\lim_{\tau\to 0}\left[-\frac{1}{\lambda_1}e^{-\frac{\tau}{\lambda_1}}\right]$$
$$-\lim_{\tau\to 0}\beta_3 e^{-\frac{\tau}{\lambda_2}} - \lim_{\tau\to 0}\frac{0}{1}\times\lim_{\tau\to 0}\left[-\frac{1}{\lambda_2}e^{-\frac{\tau}{\lambda_2}}\right] \quad (29)$$

$$\lim_{\tau\to 0} y_\tau(\tau) = \beta_0 - \beta_2 - \beta_3 \quad (30)$$

Thus the difference between the console and the short rate is given as

$$\lim_{\tau\to\infty} y_\tau(\tau) - \lim_{\tau\to 0} y_\tau(\tau) = \beta_2 + \beta_3 \quad (31)$$

Q.E.D

Following Diebold and Li (2006), we obtain lamda as $\lambda_1 = 0.03778$ and $\lambda_2 = 0.0669$ through unconstrained optimization.

3.3. Application in Life Insurance Death Benefits

Suppose an insured purchases a term insurance with maturity date T. The insured receives death benefits at the end of the year of death when the assured dies between year m and year $m+1$. The death benefit is the higher of the investment at time zero and the fund value at time of death. However, applying the actuarial assumption to the death benefit, then $\int_0^\infty l_{x+t}\mu_{x+t}dt$ lives would die per unit scheme with probability

$F_{T(x)}(t) = 1 - \exp\left(-\int_0^t \mu_{x+\xi} d\xi \right)$. The benefit at time t payable upon death will be the greater value of G_t and S_t

$$G_t = S_0 e^{gt} \tag{32}$$

The benefit ϕ_t at time t is given as

$$\phi_t = \begin{cases} S_t & if \quad S_t > G_t \\ G_t & if \quad S_t < G_t \end{cases} \tag{33}$$

$$\phi_t = \max\left(G_t, S_t\right) \tag{34}$$

$$\phi_t = \max\left(G_t - S_t, 0\right) + S_t \tag{35}$$

$$\phi_t = \left(G_t - S_t\right)^+ + S_t \tag{36}$$

G_t is the death benefit guaranteed level interest rate g per unit investment over time while S_t is the value of the underlying equity investment at time t representing the accumulation function from time 0 to t where we assume $S_0 = 1$.

3.4. The Present Value of Future Benefits

This paper has implications on life assurance products marketed by life offices associated with minimum guaranteed benefits schemes for the assured. Based on the terms and conditions of the contract, the assured life pays regular premium investible in market debt instruments and consequently, receives benefit at death or at maturity of the policy depending on the market performance of the fund. Nevertheless, there is a guaranteed benefit which the assured earns irrespective of the performance of the life fund. The life office is then obliged to pay the guaranteed sum even if the benefit at maturity or death eventually becomes smaller than the guaranteed sum, although this represents a risk that is usually built into the contract. The present value of the future death benefits is expressed as

$$PVFB = \phi_1 \delta(1) + \phi_2 \delta(2) + ... + \phi_{T-1} \delta(T-1) + \phi_T \delta(T) \tag{37}$$

where $\delta(\tau)$ is the discount rate function and ϕ is the benefit. The discount rate shows the needed rate of return from the bond. The needed rate of return is the addition of

the yield on bonds which are free of default uncertainties and a risk premium that characterizes the default risk of the bond being valued.

$$PVFB = \left\{\left(G_1 - S_1\right)^+ + S_1\right\}\delta(1) + \left\{\left(G_2 - S_2\right)^+ + S_2\right\}\delta(2) + \ldots$$
$$+ \left\{\left(G_{T-1} - S_{T-1}\right)^+ + S_{T-1}\right\}\delta(T-1) + \left\{\left(G_T - S_T\right)^+ + S_T\right\}\delta(T) \quad (38)$$

The expectation of $PVFB = \sum_{k=1}^{T}\phi_k\delta(k)$ under the risk neutral measure $\mathbf{Q}$ becomes

$$APVFB = \sum_{k=1}^{T}\mathbf{E}^{\mathbf{Q}}\phi_k\delta(k)\left({}_{k-1}q_x\right) \quad (39)$$

$$APVFB = \sum_{k=1}^{T}\mathbf{E}^{\mathbf{Q}}\phi_k\delta(k)\left(\frac{l_x - l_{x+k-1}}{l_x}\right) \quad (40)$$

where

$$l_x = \int_0^{\infty} l_{x+t}\mu_{x+t}dt \quad (41)$$

is the survival function at age x

$$APVFB = \sum_{K=1}^{T}\mathbf{E}^{\mathbf{Q}}\phi_k\delta(k) - \frac{1}{l_x}\sum_{K=1}^{T}\mathbf{E}^{\mathbf{Q}}\phi_k\delta(k)l_{x+k-1} \quad (42)$$

$$APVFB = \sum_{K=1}^{T}\mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]\delta(k) - \frac{1}{l_x}\sum_{k=1}^{T}\mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^t + S_t\right]\delta(k)l_{x+k-1} \quad (43)$$

$$APVFB = \sum_{K=1}^{T}\left\{\mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]\delta(k) - \frac{1}{\left(\int_0^{\infty} l_{x+t}\mu_{x+t}dt\right)}\sum_{k=1}^{T}\mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]\delta(k)\times l_0 e^{-\int_0^{x+k-1}\mu_t dt}\right\} \quad (44)$$

where $\mu(x) = GM(1,2)$ is the chosen mortality intensity

$$APVFB = \sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^t + S_t\right] e^{-ky(k)} - \left\{ \frac{1}{\left(\int_0^{\infty} l_{x+t}\mu_{x+t}dt\right)} \sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^t + S_t\right] e^{-ky(k)} \times e^{-\int_0^{x+k-1}\mu_t dt} \right\} \quad (45)$$

where

$$y_t(\tau) = \beta_0\tau + \beta_1\tau\left[\frac{1-e^{-\frac{\tau}{\lambda_1}}}{\frac{\tau}{\lambda_1}}\right] + \beta_2\tau\left[\frac{1-e^{-\frac{\tau}{\lambda}}}{\frac{\tau}{\lambda_1}} - e^{-\frac{\tau}{\lambda_1}}\right] + \beta_3\tau\left[\frac{1-e^{-\frac{\tau}{\lambda_2}}}{\frac{\tau}{\lambda_2}} - e^{-\frac{\tau}{\lambda_2}}\right] \quad (46)$$

$$APVFB = \frac{\sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]}{e^{ky_t(k)}} - \frac{\sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]}{\left(\int_0^{\infty} l_{x+t}\mu_{x+t}dt\right)e^{ky(k)}} \times e^{-\left(\int_x^{x+k-1}\mu_t dt\right)} \quad (47)$$

Suppose $GM(1,2)$ is the mortality intensity $\mu(x) = A + BC^x$ where A, B and C are parameters of the mortality law, then the integrated hazard of mortality is

$$\int_x^{x+k-1} \mu_t dt = \int_x^{x+k-1} \left(A + BC^t\right) dt \quad (48)$$

$$\int_x^{x+k-1} \mu_t dt = \left[At + \frac{BC^t}{\log_e C}\right]_x^{x+k-1} \quad (49)$$

$$\int_x^{x+k-1} \mu_t dt = A(x+k-1) - Ax + \frac{BC^{x+k-1}}{\log_e C} - \frac{BC^x}{\log_e C} \tag{50}$$

$$\int_x^{x+k-1} \mu_t dt = Ax + Ak - A - Ax + \frac{BC^x}{\log_e C}\left(C^{k-1} - 1\right) \tag{51}$$

The total severity is obtained as

$$\int_x^{x+k-1} \mu_t dt = A(K-1) + \frac{Bc^x}{\log_e C}\left(C^{k-1} - 1\right) \tag{52}$$

$$APVFB = \sum_{K-1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right]$$
$$-\sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right] e^{-ky(k)} \times e^{-\left\{A(k-1) + \frac{BC^x}{\log_e C}\left(C^{k-1}-1\right)\right\}} \tag{53}$$

$$APVFB =$$
$$\frac{1}{e^{ky_t(k)}} \left\{ \begin{array}{l} \sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right] \\ -\sum_{k=1}^{T} \mathbf{E}^{\mathbf{Q}}\left[\left(G_t - S_t\right)^+ + S_t\right] \times e^{-\left\{A(K-1) + \frac{Bc^x}{\log_e C}\left(C^{k-1}-1\right)\right\}} \end{array} \right\} \tag{54}$$

3.5. Estimation and Data Analysis

The classical term structure hypothesis suggests that the smooth yield curve $y(\tau)$ be estimated from the observed bond prices. Recently, the common approach is to compute the implicit forward rates needed to price successive longer maturity bonds at the observed maturities. The smoothed forward rate function is hence derived by fitting a parsimonious functional form to the unsmoothed rates. The unsmoothed forward rates could be transformed to the unsmoothed yield through averaging. We observe currently that minimizing the price errors ultimately leads to grossly large yield errors for bonds particularly bonds with short and medium maturities. This is because prices are most insensitive to yields for short maturities.

Consequently, it is more reasonable to estimate parameters so as to minimize yield errors. In financial modelling, the emphasis is on interest rates rather than prices and as such, it is more reasonable to minimize errors in the yield rather than minimizing errors in the price. To obtain the parameters of the extended Nelson-Siegel model, we estimate the parameters as such to minimize the sum of squared errors between the

estimated yields y^E and observed yields to maturity y and hence we can write $\widehat{\theta}_i = \arg\min_{\theta_i} \sum_{i=1}^{p} \left(y_i^E - y_i \right)^2$.

The data presented involves the daily closing of the Nigerian Eurobond yield which comprises data from January to December 2021 and 2022 to be analyzed using descriptive statistics in fitting the observed Nigerian Eurobond yield curve under the extended Nelson-Siegel model structure. The data for the twelve months for both 2021 and 2022 were analyzed and the resulting findings were also depicted in curves and tabular forms to incorporate other statistics not captured on the curve and also to enhance easy access to the statistical values and corresponding graph are shown in Table 1 and figure 1 for the first three quarters.

Table 1: First three quarters descriptive statistics-2021

Tenors (τ)	N	Minimum	Maximum	Mean	Std. Deviation
One year	166	.84	6.22	2.0292	.64054
Two years	166	2.26	2.98	2.6323	.15806
Four years	166	3.88	4.82	4.2375	.15617
Six years	166	4.71	5.83	5.2816	.20958
Nine years	166	5.67	7.04	6.2206	.20969
Ten years	166	6.14	7.24	6.6915	.21741
Eleven years	166	6.24	7.43	6.7980	.21563
Seventeen years	166	6.80	7.88	7.3502	.20490
Twenty-six years	166	6.95	7.97	7.4861	.20316
Twenty-eight years	166	7.39	8.42	7.8931	.15832

Source: Authors' computation

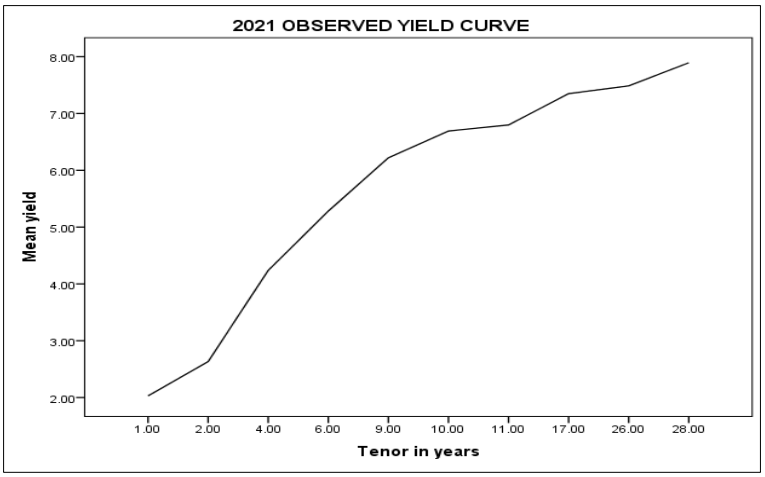

Figure 1: First three quarters' yield curve

This observed data analyzed descriptively consisted of the first three quarters of the year 2021. The data was separated from the fourth quarter due to the increase of additional tenors as recorded. The three quarters contained 10 tenors which are one year, two years, four years, six years, nine years, ten years, eleven years, seventeen years, twenty-six years and twenty-eight with corresponding yield of

$$\left\{\begin{array}{l} 2.0292,\ 2.6323,\ 4.2375,\ 5.2816,\ 6.2206,\ 6.6915,\ 6.7980,\ 7.3502, \\ 7.4861\ and\ 7.8931 \end{array}\right\}$$

Respectively. The slope of the yield curve is upward sloping; therefore, it can be concluded that the relationship between tenors and yields is directly proportional. In Table 2 below, the last quarter of 2021 is significant because there were additional tenors that appears as recorded. The quarter contains 13 maturities (tenors) which are One year, Two years, Four years, Six years, Seven years, Nine years, ten years, eleven years, twelve years, seventeen years, twenty six years, twenty eight years, and thirty years with corresponding yield as;

$$\left\{\begin{array}{l} 2.1195,\ 3.6437,\ 5.2924,\ 6.1897,\ 6.4153,\ 7.1320,\ 7.6881,\ 7.7216, \\ 7.6664,\ 8.2340, 8.3439,\ 8.7784,\ and\ 8.5303 \end{array}\right\}$$

respectively. The yield in this quarter as depicted by the figure above is consistently sloping upward with a decline on twelve years maturity. Therefore, we can conclude that as maturity increases, yield also increases.

Table 2: Fourth quarter descriptive statistics-2021

Tenors (τ)	N	Minimum	Maximum	Mean	Std. Deviation
One year	58	1.48	3.43	2.1195	.33856
Two years	58	2.94	4.36	3.6437	.34460
Four years	58	4.67	6.02	5.2924	.40861
Six years	58	5.76	6.85	6.1897	.31858
Seven years	58	5.98	7.14	6.4153	.33007
Nine years	58	6.75	7.85	7.1320	.31443
Ten years	58	7.26	8.39	7.6881	.33013
Eleven years	58	7.29	8.47	7.7216	.35613
Twelve years	58	7.19	8.45	7.6664	.34597
Seventeen years	58	7.80	8.88	8.2340	.31403
Twenty-six years	58	7.92	8.97	8.3439	.29639
Twenty-eight years	58	8.41	9.36	8.7784	.29491
Thirty years	58	8.12	9.15	8.5303	.30737

Source: Authors' computation

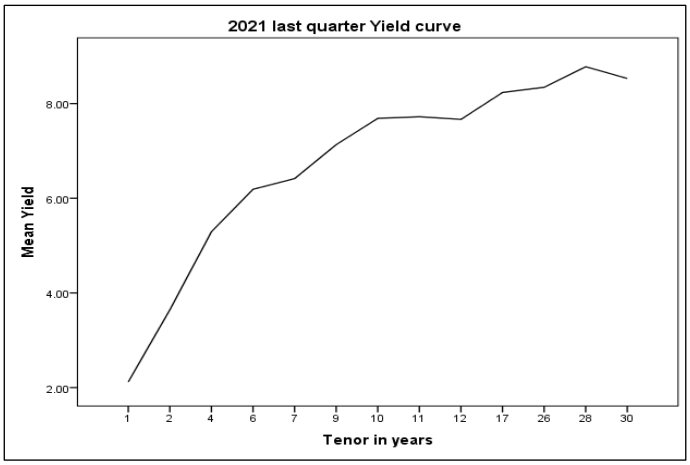

Figure 2: Fourth quarter yield curve

Figure 2 show the zero-coupon yield curve when the parameters are fitted to the average yield curve in the fourth quarter. The average yield to maturity is increasing over maturities, we then infer that the data set is consistent with the condition that the yield curve over time is increasing and concave. The essence is to justify and validate the construction of the extended Nelson-Siegel model.

Table 3: Descriptive statistics-2022

Tenors (τ)	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
One year	241	2.76	10.89	6.5488	2.02279
Three years	241	4.94	13.82	9.4788	2.60400
Five years	241	6.10	15.44	10.6853	2.57722
Six years	241	6.47	15.61	10.8068	2.52283
Eight years	241	7.28	15.99	11.2024	2.39675
Nine years	241	7.84	15.99	11.6304	2.24195
Ten years	241	8.01	16.88	11.6191	2.19466
Eleven years	241	.00	15.55	11.3677	2.21467
Sixteen years	241	8.50	15.21	11.7122	1.81228
Twenty-five years	241	8.60	14.83	11.4600	1.60907
Twenty-seven years	241	9.06	15.67	11.9866	1.70691
Twenty-nine years	241	.42	15.40	11.7561	1.88498

Source: Authors' computation

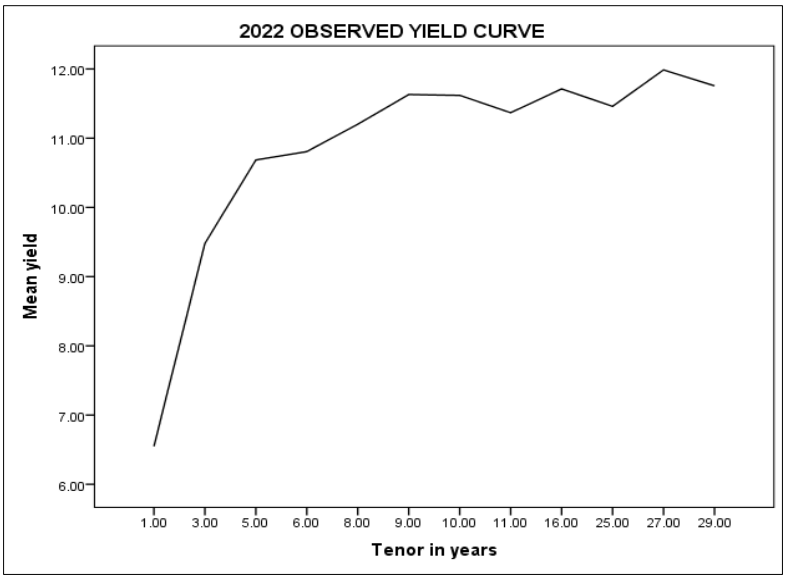

Figure 3: Observed yield curve for 2022

The 2022 statistics consisted of twelve tenors which are one year, three years, five years, six years, eight years, nine years, ten years, eleven years, sixteen years, twenty five years, twenty even years and twenty nine years which from the descriptive analysis has an average yield of

$$\left\{\begin{matrix} 6.5488,\ 9.4788,\ 10.6853,\ 10.8068,\ 11.2024,\ 11.6304,\ 11.6191, \\ 11.3677,\ 11.7122, 11.4600,\ 11.9866\ \textit{and}\ 11.7561 \end{matrix}\right\}$$

respectively. The overall statistics experience a higher level of changes which can be described as a measure of risk on the bond market. These can be attributed to the numerous data volatilities over the observed monthly market operations which provoked such behavior. It is imperative to note that the trading yield over the months are not the same. Some months have higher trading yield while others lower trading yield which significantly affect the variation in the data. The aggregate yield curve of observed yield for the year 2022 as depicted on the Figure 3 revealed that the yield curve is sloping upwards giving an increase of time to maturity. However, there was a decline as experienced on the nine years tenor to ten years before the observed upward movement and a decline in twenty five years tenor and a rise on twenty seven whereas there is a decline at the last tenor. Despite the noticeable fluctuations experienced over some tenors, we can conclude that the overall yield curve is upward sloping.

3.6. Predicting the In-Sample Yield of τ

The extended Nelson-Siegel four-factor model parameters as established in the previous section for yield analysis in respect of the observed data for the year 2021 and 2022 can be used for the prediction of in-sample tenors but not captured in the observed data given the parameters. The parameters were estimated using the

ordinary least square method. For this study, we used the value 0.03778 and 0.0609 for λ_1 and λ_2 respectively. The results obtained are presented on table below.

Table 4: Model Parameters

First 3 quarters 2021		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	β_1	8.388	.152		55.048	.000
	β_2	-6.104	.707	-.731	-8.635	.000
	β_3	3.451	2.150	.128	1.605	.160
	β_4	-8.911	3.227	-.379	-2.762	.033
Last quarter 2021		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	**Beta**		
1	β_1	9.312	.168		55.470	.000
	β_2	-9.166	.905	-1.035	-10.124	.000
	β_3	-.550	2.554	-.021	-.216	.834
	β_4	1.365	4.056	.057	.337	.744
2022		**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
		B	**Std. Error**	Beta		
1	β_1	11.879	.176		67.590	.000
	β_2	-8.165	.917	-1.164	-8.905	.000
	β_3	6.014	2.804	.318	2.145	.064
	β_4	.991	4.352	.054	.228	.826

Source: Authors' computation

From the Table 4, the parameters estimated were substituted into the model in order to estimate the in-sample maturities that were not captured on the observed data. Since the in-sample yield does not exceed a maturity of more than twenty-nine years and thirty years for 2021 and 2022 respectively, we write the model given a conditional statement for in-sample estimation of yield as follows: For the *first three quarters* 2021.

Let τ be the current time and suppose $f(u)$ represents the forward rate function at time $t + u$. Then the current price of a zero coupon bond maturing at par, at time $t + \tau$ is given by $\delta(\tau) = exp\left(-\int_0^\tau f(u)du\right)$. Consequently, the yield $y(\tau)$ and the price $p(\tau)$ of the bond as well as the forward rate function $f(u)$ all satisfy the relation $\tau y(\tau) = \ln p(\tau) = \int_0^\tau f(u)du$.

From the discount function $\delta_t(\tau) = exp\{-\tau y_t(\tau)\}$, we obtain

$$\delta_t(\tau) = \exp\left\{\begin{array}{l} -8.388\tau + 6.104\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau}\right)\tau \\ -3.451\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau} - e^{-0.03778\tau}\right)\tau \\ +8.911\left(\dfrac{1-e^{-0.0669\tau}}{0.0669\tau} - e^{-0.0669\tau}\right)\tau \end{array}\right\} \quad (55)$$

and the yield function is

$$\begin{aligned} y_t(\tau) &= 8.388 - 6.104\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau}\right] \\ &+3.451\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau} - e^{-0.03778\tau}\right] \\ &-8.911\left[\frac{1-e^{-0.0669\tau}}{0.0669\tau} - e^{-0.0669\tau}\right] \end{aligned} \quad (56)$$

where $0 \le \tau \le 336$. For the *fourth quarter* 2021

$$\delta_t(\tau) = \exp\left\{\begin{array}{l} -9.312\tau + 9.166\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau}\right)\tau \\ +0.55\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau} - e^{-0.03778\tau}\right)\tau \\ +1.361\left(\dfrac{1-e^{-0.0669\tau}}{0.0669\tau} - e^{-0.0669\tau}\right)\tau \end{array}\right\} \quad (57)$$

$$\begin{aligned} y_t(\tau) &= 9.312 - 9.166\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau}\right] - 0.55\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau} - e^{-0.03778\tau}\right] - \\ &1.361\left[\frac{1-e^{-0.0669\tau}}{0.0669\tau} - e^{-0.0669\tau}\right] \end{aligned} \quad (58)$$

where $0 \le \tau \le 360$

For all quarters in 2022

$$\delta_t(\tau)=\exp\left[\begin{Bmatrix}-11.879\tau+8.165\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau}\right)\tau\\-6.014\left(\dfrac{1-e^{-0.03778\tau}}{0.03778\tau}-e^{-0.03778\tau}\right)\tau\\-0.991\left(\dfrac{1-e^{-0.0669\tau}}{0.0669\tau}-e^{-0.0669\tau}\right)\tau\end{Bmatrix}\right] \quad (59)$$

$$y_t(\tau)=11.879-8.165\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau}\right]+6.014\left[\frac{1-e^{-0.03778\tau}}{0.03778\tau}-e^{-0.03778\tau}\right]+$$

$$0.991\left[\frac{1-e^{-0.0669\tau}}{0.0669\tau}-e^{-0.0669\tau}\right] \quad (60)$$

$0 \le \tau \le 360$. The comparative yield for observed data and the in-sample prediction using the above model is presented below:

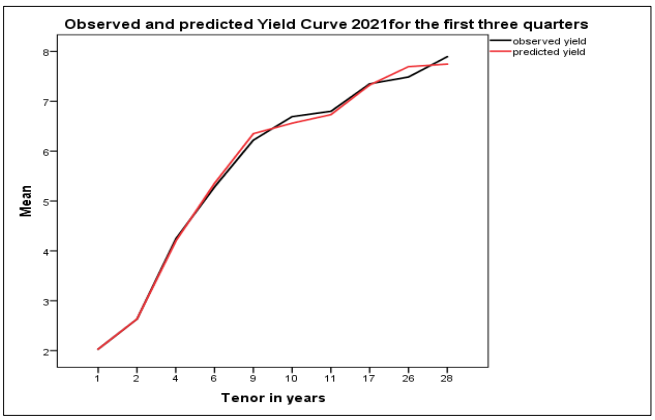

Figure 4: Predicted yield curves 2021 first three quarters

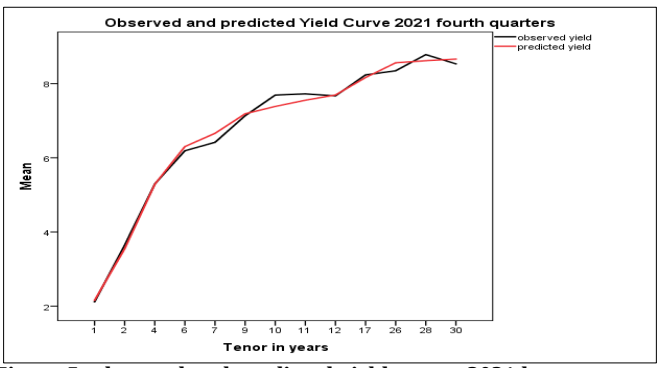

Figure 5: observed and predicted yield curves 2021 last quarter

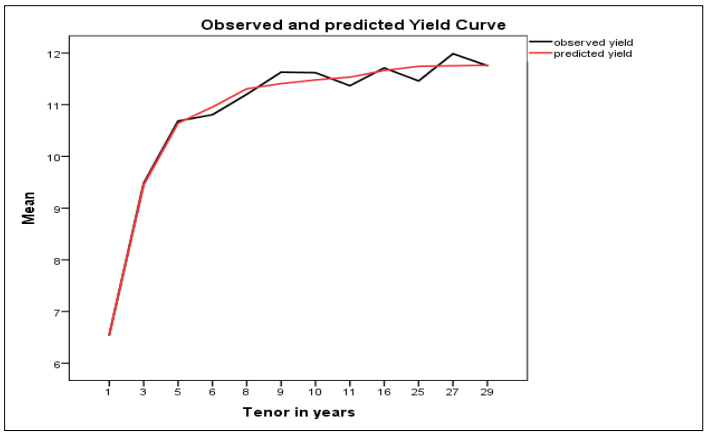

Figure 6: Observed and predicted yield curves 2022

3.7. Fitting the Model into the Observed Data

The measure of goodness of fit analysis is determined when ordinary least square method is applied on data by R square, R^2 adjusted and standard error estimation. The model measure of fit analysis is depicted in table below.

Table 5: Model Summary

First 3 quarters 2021	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
	.999[a]	.997	.996	.13653209	2.454
Last quarter 2021	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
	.997[a]	.994	.992	.18389683	1.982
2022	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
	.995[a]	.989	.985	.18325833	.989

Source: Authors' computation

The R square defines the degree in which the independent variable fits in the dependent variable, it determines how well the model was able to predict the observed dependent variable. For this study, the unobserved variable was able to define the observed yield with a high degree of accuracy. As seen from the table above, the R square for the first three quarters of 2021 , last quarter of 2021 and the overall yield of 2022 are 0.999, 0.997 and 0.995 respectively and the adjusted R square of the study scope as 0.996, 0.992 and 0.985. When using the results of adjusted R square values, it can be inferred that the model fits in the observed yield by 99% for the first three quarters of 2021, 99% for the last quarter 2021 and 98% for 2022. By these, the model can be used for estimation and prediction of yield.

3.8. The Effect of the Time to Maturity on Term Structure of Interest Rate

Theoretically, the relationship that existed between time to maturity or tenors of a set of a bond and its corresponding yield is referred to as the term structure of interest

rate. To determine whether time to maturity has an effect on the term structure of interest rate, we used correlation between time to maturity and its corresponding yield as presented in the table 6 using the data set of 2021.

Table 6: Correlation Analysis

		Yield	Tenor in Years
Yield	Pearson Correlation	1	.847**
	Sig. (2-tailed)		.002
	N	10	10
Tenor in Years	Pearson Correlation	.847**	1
	Sig. (2-tailed)	.002	
	N	10	10

Source: Authors' computation

The Pearson correlation determines the degree to which the movement of tenors and yields are associated. The above table reveals that the correlation is significant given the confidence level of significance as 0.01. The correlation revealed a positive relationship between tenors and its corresponding yield. The correlation value of 0.847 means that 84.7% of the data explains the degree to which the tenor and yield correlate in a positive direction. The observed curves shown in this study also indicated that the slope of yield against its tenors is moving directly proportionally. That is, when the tenor increases, the corresponding yield also increases in percentage. We can conclude that time to maturity has a significant effect on the term structure of interest rate.

4. RESULTS AND DISCUSSION

From equation (37) using the first three quarters in 2021 for example, we have

$$PVFB=\sum_{i=1}^{T}\phi_i\left[\exp\left\{\begin{array}{l}-8.388\tau_i+6.104\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i}\right)\tau_i\\-3.451\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i}-e^{-0.03778\tau_i}\right)\tau_i\\+8.911\left(\dfrac{1-e^{-0.0669\tau_i}}{0.0669\tau_i}-e^{-0.0669\tau_i}\right)\tau_i\end{array}\right\}\right] \quad (61)$$

While for the fourth quarter in 2021.

$$PVFB = \sum_{i=1}^{T} \phi_i \left[\exp\left\{ \begin{array}{l} -9.312\tau_i + 9.166\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i} \right)\tau_i \\ +0.55\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i} - e^{-0.03778\tau} \right)\tau_i \\ +1.361\left(\dfrac{1-e^{-0.0669\tau_i}}{0.0669\tau_i} - e^{-0.0669\tau} \right)\tau_i \end{array} \right\} \right] \quad (62)$$

However, using the combined 4 quarters in 2022, we have

$$PVFB = \sum_{i=1}^{T} \phi_i \left[\exp\left[\left\{ \begin{array}{l} -11.879\tau_i + 8.165\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i} \right)\tau_i \\ -6.014\left(\dfrac{1-e^{-0.03778\tau_i}}{0.03778\tau_i} - e^{-0.03778\tau_i} \right)\tau_i \\ -0.991\left(\dfrac{1-e^{-0.0669\tau_i}}{0.0669\tau_i} - e^{-0.0669\tau_i} \right)\tau_i \end{array} \right\} \right] \right] \quad (63)$$

The analysis of the Nigerian Eurobond yield for the years 2021 and 2022 includes descriptive analysis for the daily trading of the Nigerian Eurobond, the model analysis of extended Nelson-Siegel four factor model as well as correlation analysis. From the descriptive statistics obtained, the mean yield increases in direct proportional to tenor and consequently the yield increases as tenor increases. By this, we can confirm the market condition that the higher the risk, the higher the expected return. The risk in this case involves the long-term maturity that there is a higher risk on long-term securities in general. These risks include interest rate changes and rising inflation that depreciates the value of money value. The extended Nelson-Siegel four factor model was estimated using the quadratic loss function method. The unobserved variables become the independent variable whereas the observed yield becomes the dependent variable. The results of the four-factor parameters computed were substituted into the model so as to obtain a solution for predicting the in-sample yield of the tenors not captured in the observed yield. The model goodness of fit was tested in order to find how well the model fits in the observed data yield to assume its prediction capability. The output result came out with a high level of fit which was evidence from the *R* square adjusted for both 2021 and 2022 given an average of 99%. From this we can conclude that the extended Nelson-Siegel four factor model can be used for the analysis and prediction of yield. The correlation analysis was able to verify the relationship that existed between tenors and their corresponding yield. The result shows a positive relationship which confirms the direct proportionality. Figures 7-14 describes the trajectories of the predicted model parameters while Tables 7-14 describe the values of the predicted model parameters.

4.1. The Impact of the Console and Short Rate on the Associated Exponential Terms

The following limiting results were obtained from the coefficients of β_i.

$$\lim_{\tau\to 0}\frac{\lambda_1}{\tau}\left[1-e^{-\frac{\tau}{\lambda_1}}\right]=\lim_{\tau\to 0}\frac{\lambda_1}{\tau}\times\lim_{\tau\to 0}\left(1-e^{-\frac{\tau}{\lambda_1}}\right)=\lim_{\tau\to 0}\frac{0}{1}\times\lim_{\tau\to 0}\left(\frac{1}{\lambda_1}e^{-\frac{\tau}{\lambda_1}}\right)=0 \tag{63a}$$

If $Z=e^{-\frac{\tau}{\lambda_t}}=e^{-\tau\times\lambda_t^{-1}}$ (64)

$$\frac{dZ}{d\lambda_t}=-\tau\lambda_t^{-2}e^{-\tau\times\lambda_t^{-1}} \tag{65}$$

$$\lim_{\lambda_t\to 0}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}\right]=\lim_{\lambda_t\to 0}\left[-\frac{\tau\lambda_t^{-2}e^{-\tau\times\lambda_t^{-1}}}{-\tau\lambda_t^{-2}}\right] \tag{66}$$

$$\lim_{\lambda_t\to 0}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}\right]=\lim_{\lambda_t\to 0}e^{-\frac{\tau}{\lambda_t}}=0 \tag{67}$$

$$\lim_{\lambda_t\to \infty}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}\right]=e^0=1 \tag{68}$$

$$\lim_{\lambda_t\to 0}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}-e^{-\frac{\tau}{\lambda_t}}\right]=\lim_{\lambda_t\to 0}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}\right]-\lim_{\lambda_t\to 0}e^{-\frac{\tau}{\lambda_t}} \tag{69}$$

$$\lim_{\lambda_t\to 0}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}-e^{-\frac{\tau}{\lambda_t}}\right]=\lim_{\lambda_t\to 0}e^{-\frac{\tau}{\lambda_t}}-\lim_{\lambda_t\to 0}e^{-\frac{\tau}{\lambda_t}} \tag{70}$$

$$\lim_{\lambda_t \to 0} e^{-\frac{\tau}{\lambda_t}} = 0 \tag{71}$$

$$\lim_{\lambda_t \to \infty}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}} - e^{-\frac{\tau}{\lambda_t}}\right] = \lim_{\lambda_t \to \infty}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}}\right] - \lim_{\lambda_t \to \infty} e^{-\frac{\tau}{\lambda_t}} \tag{72}$$

$$\lim_{\lambda_t \to \infty}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}} - e^{-\frac{\tau}{\lambda_t}}\right] = \lim_{\lambda_t \to \infty} e^{-\frac{\tau}{\lambda_t}} - \lim_{\lambda_t \to \infty} e^{-\frac{\tau}{\lambda_t}} \tag{73}$$

$$\lim_{\lambda_t \to \infty}\left[\frac{1-e^{-\frac{\tau}{\lambda_t}}}{\frac{\tau}{\lambda_t}} - e^{-\frac{\tau}{\lambda_t}}\right] = 0 \tag{74}$$

4.2. Analysis Using Different Values of the Model Parameters

4.2.1. Predicted Yield at Different Values of β_1

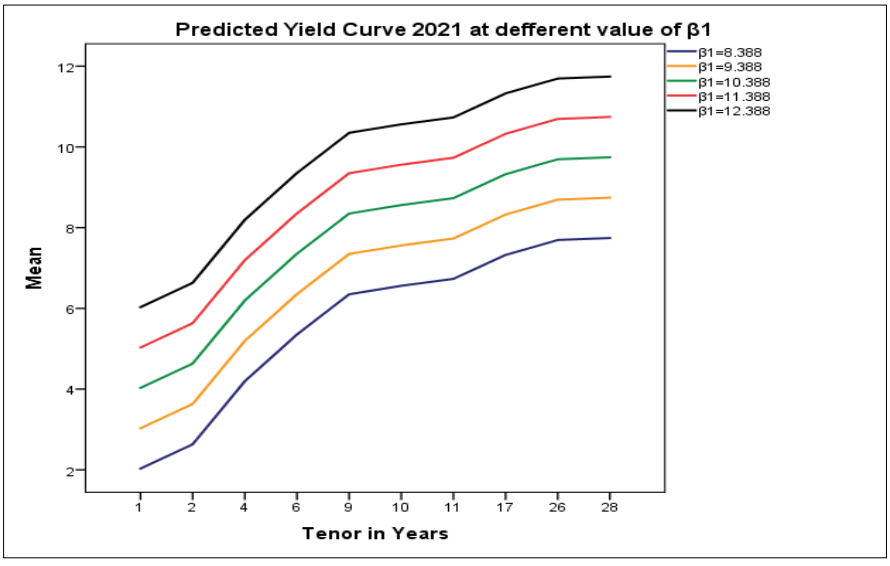

Figure 7: Predicted yield curve for 2021 at different values of β_1

Table 7: Different values of β_1

β_1=8.388	β_1=9.388	β_1=10.388	β_1=11.388	β_1=12.388
2.030682	3.030682	4.030682	5.030682	6.030682
2.633049	3.633049	4.633049	5.633049	6.633049
4.195382	5.195382	6.195382	7.195382	8.195382
5.353794	6.353794	7.353794	8.353794	9.353794
6.349906	7.349906	8.349906	9.349906	10.34991
6.55947	7.55947	8.55947	9.55947	10.55947
6.730821	7.730821	8.730821	9.730821	10.73082
7.325151	8.325151	9.325151	10.32515	11.32515
7.693924	8.693924	9.693924	10.69392	11.69392
7.743513	8.743513	9.743513	10.74351	11.74351

Source: Authors' computation

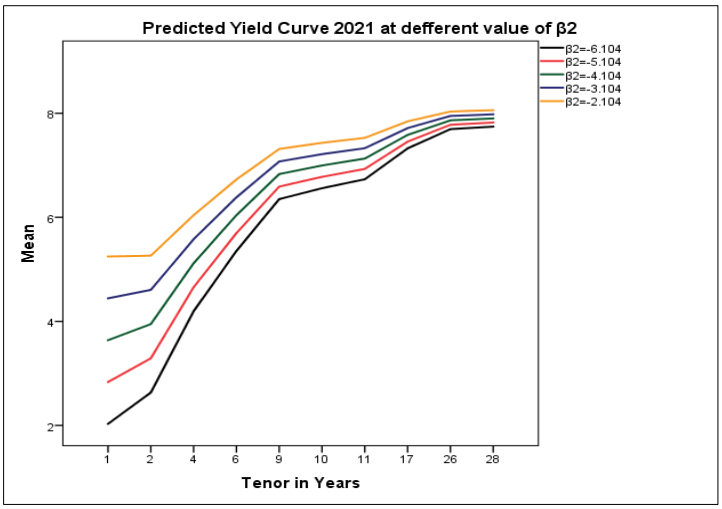

Figure 8: Predicted yield curve for 2021 at different values of β_2

Table 8: Different values of β_2

β_2=-6.104	β_2=5.104	β_2=-4.104	β_2=-3.104	β_2=-2.104
2.030682	2.834703	3.638723	4.442744	5.246764
2.633049	3.290532	3.948016	4.605499	5.262982
4.195382	4.656885	5.118388	5.579891	6.041394
5.353794	5.697206	6.040618	6.384031	6.727443
6.349906	6.590847	6.831787	7.072728	7.313669
6.55947	6.777676	6.995881	7.214087	7.432293
6.730821	6.929975	7.129129	7.328283	7.527437
7.325151	7.454843	7.584534	7.714226	7.843918
7.693924	7.77876	7.863596	7.948432	8.033268
7.743513	7.82229	7.901067	7.979843	8.05862

Source: Authors' computation

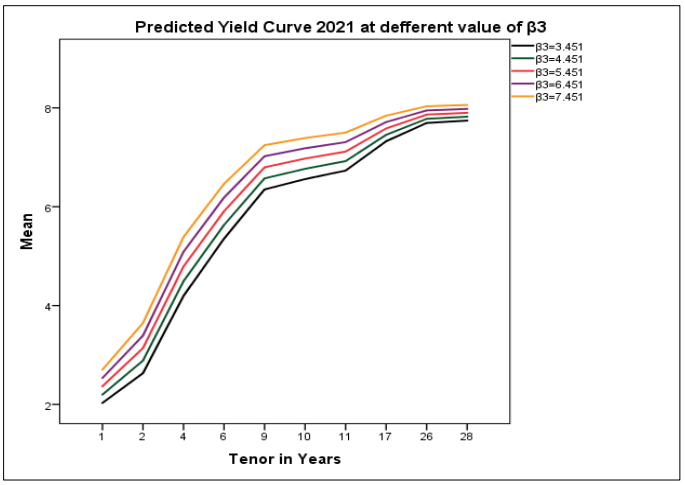

Figure 9:Predicted yield curve for 2021 at different values of β_3

Table 9: Different values of β_3

β_3=3.451	β_3=4.451	β_3=5.451	β_3=6.451	β_3=7.451
2.030682	2.199213	2.367745	2.536276	2.704807
2.633049	2.886685	3.140322	3.393959	3.647596
4.195382	4.493793	4.792204	5.090615	5.389026
5.353794	5.631342	5.90889	6.186438	6.463986
6.349906	6.573943	6.797981	7.022018	7.246056
6.55947	6.766934	6.974398	7.181861	7.389325
6.730821	6.923148	7.115476	7.307804	7.500132
7.325151	7.454393	7.583635	7.712877	7.84212
7.693924	7.778752	7.86358	7.948409	8.033237
7.743513	7.822287	7.90106	7.979834	8.058608

Source: Authors' computation

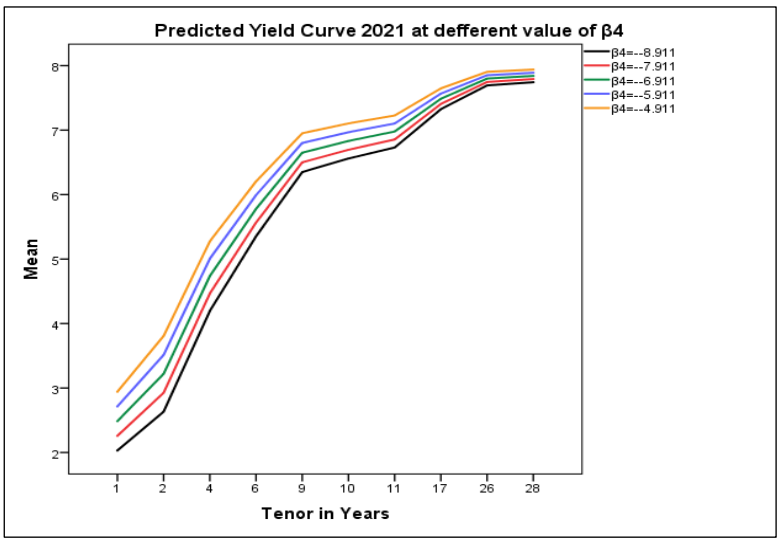

Figure 10: Predicted yield curve for 2021 at different values of β_4

Table 10: Different values of β_4

β_4=-8.911	β_4=-8.911	β_4=-8.911	β_4=-8.911	β_4=-8.911
2.030682	2.258623	2.486563	2.714504	2.942444
2.633049	2.926728	3.220407	3.514086	3.807764
4.195382	4.465321	4.735259	5.005197	5.275135
5.353794	5.566547	5.779299	5.992051	6.204804
6.349906	6.500343	6.65078	6.801217	6.951654
6.55947	6.695544	6.831619	6.967693	7.103768
6.730821	6.854855	6.978888	7.102922	7.226956
7.325151	7.405638	7.486126	7.566614	7.647101
7.693924	7.746553	7.799182	7.851812	7.904441
7.743513	7.792383	7.841254	7.890124	7.938994

Source: Authors' computation

4.2.2. Predicted Yield at Different Values of β_1

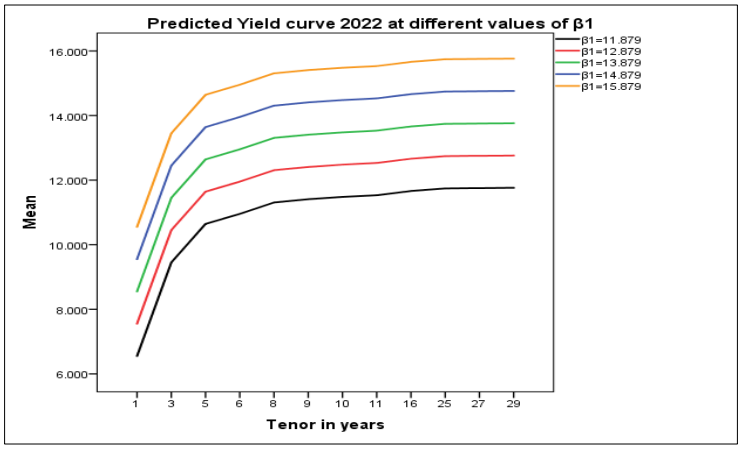

Figure 11: Predicted yield curve for 2022 at different values of β_1

Table 11: Different values of β_1

$\beta_1$1=1.879	$\beta_1$1=2.879	$\beta_1$1=3.879	$\beta_1$1=4.879	$\beta_1$1=5.879
6.553608	7.553608	8.553608	9.553608	10.55361
9.450829	10.45083	11.45083	12.45083	13.45083
10.64366	11.64366	12.64366	13.64366	14.64366
10.95505	11.95505	12.95505	13.95505	14.95505
11.30789	12.30789	13.30789	14.30789	15.30789
11.40816	12.40816	13.40816	14.40816	15.40816
11.47989	12.47989	13.47989	14.47989	15.47989
11.53248	12.53248	13.53248	14.53248	15.53248
11.66316	12.66316	13.66316	14.66316	15.66316
11.74339	12.74339	13.74339	14.74339	15.74339
11.75347	12.75347	13.75347	14.75347	15.75347
11.76214	12.76214	13.76214	14.76214	15.76214

Source: Authors' computation

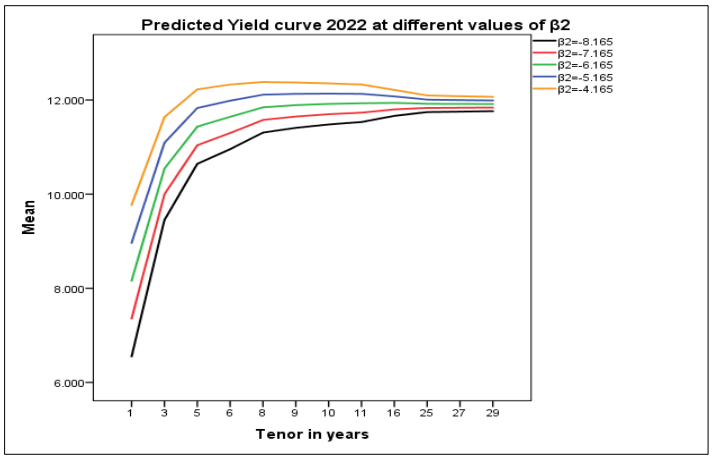

Figure 12: Predicted yield curve for 2022 at different values of β_2

Table 12: Different values of β_2

β_2-=8.165	β_2-=7.165	β_2=-6.165	β_2-5.165	β_2-=4.165
6.553608	7.357629	8.161649	8.96567	9.76969
9.450829	9.997385	10.54394	11.0905	11.63705
10.64366	11.03909	11.43451	11.82994	12.22537
10.95505	11.29846	11.64187	11.98529	12.3287
11.30789	11.57627	11.84466	12.11304	12.38143
11.40816	11.6491	11.89004	12.13098	12.37193
11.47989	11.69809	11.9163	12.1345	12.35271
11.53248	11.73164	11.93079	12.12995	12.3291
11.66316	11.80093	11.93869	12.07645	12.21421
11.74339	11.83162	11.91985	12.00808	12.09631
11.75347	11.83516	11.91686	11.99855	12.08025
11.76214	11.8382	11.91426	11.99032	12.06638

Source: Authors' computation

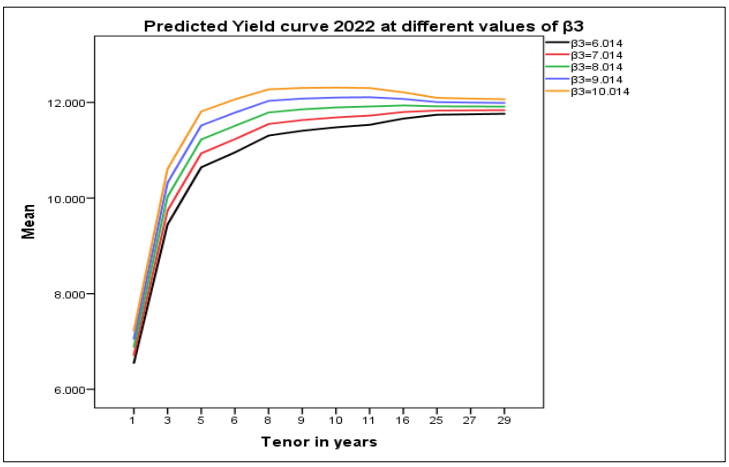

Figure 13: Predicted yield curve for 2022 at different values of β_3

Table 13: Different values of β_3

β_3=6.014	β_3=7.014	β_3=8.014	β_3=9.014	β_3=10.014
6.553608	6.72214	6.890671	7.059202	7.227733
9.450829	9.740745	10.03066	10.32058	10.61049
10.64366	10.93544	11.22723	11.51901	11.8108
10.95505	11.2326	11.51015	11.78769	12.06524
11.30789	11.54967	11.79146	12.03325	12.27503
11.40816	11.6322	11.85624	12.08027	12.30431
11.47989	11.68735	11.89481	12.10228	12.30974
11.53248	11.72481	11.91714	12.10947	12.30179
11.66316	11.80022	11.93727	12.07433	12.21138
11.74339	11.83161	11.91982	12.00804	12.09626
11.75347	11.83516	11.91685	11.99854	12.08023
11.76214	11.8382	11.91426	11.99032	12.06638

Source: Authors' computation

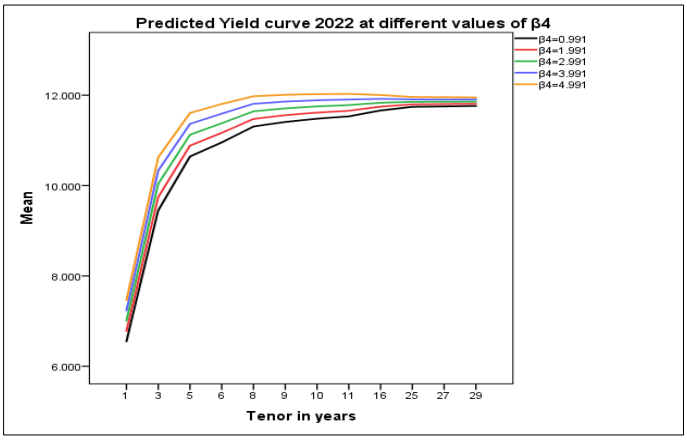

Figure 14: Predicted yield curve for 2022 at different values of β_4

Table 14: Different values of β_4

β_4 =0.991	β_4 =1.991	β_4 =2.991	β_4 =3.991	β_4 =4.991
6.553608	6.781549	7.009489	7.23743	7.46537
9.450829	9.744377	10.03792	10.33147	10.62502
10.64366	10.88436	11.12506	11.36576	11.60646
10.95505	11.1678	11.38056	11.59331	11.80606
11.30789	11.47555	11.64321	11.81087	11.97853
11.40816	11.5586	11.70904	11.85947	12.00991
11.47989	11.61596	11.75204	11.88811	12.02418
11.53248	11.65652	11.78055	11.90458	12.02862
11.66316	11.74868	11.83419	11.9197	12.00522
11.74339	11.79812	11.85286	11.90759	11.96233
11.75347	11.80415	11.85483	11.90551	11.95619
11.76214	11.80933	11.85651	11.9037	11.95088

Source: Authors' computation

5. CONCLUSION

The application of forward interest rates serves to be a benchmark financial tool in pricing new market instruments. Though the adoption of yield curves is recognized in monetary policies, its use in financial analysis is yet to be discovered in Nigeria market. Motivated by the central role assumed by the term structure of interest rates in the Nigerian economy, we examined the forward rate function of the extended Nelson-Siegel parsimonious function through comprehensive mathematical analysis when applied to the Nigerian Eurobond. The forward rate function then becomes the instantaneous interest rate locked at a previous time ξ for a subsequent investment decision. In this paper, the analysis was conducted under the following key result areas (i) the discount function and applied on the present value of benefits (ii) the yield function. From the parsimonious perspectives, we explained the use of time varying exponentially decay terms to ascertain more flexible parsimonious parameters so as to obtain accurate estimating results and to reflect the market operators' views on interest rate levels in a forward looking dimension. Obviously, the efficacy of the extended Nelson-Siegel model is a function of how precise the model fits the yield curve at each date and on how well the factors can be forecast from their resulting time series. Consequently, we highlight the following weaknesses. The extension is challenging as there are two λ's that were estimated and the analytical form suffers from the problem of degeneracy where the factors λ_1 and λ_2 are equivalent. Furthermore, when $\lambda_1 \neq \lambda_2$, the specified functional form results in an underlying parameter estimation difficulty which is no longer mathematically convenient because it will hence involve many dimensional minimization. Despite the weakness observed, the extended Nelson-Siegel model is notably distinguished through its empirical analysis of the parameters which change with time. The straight forward analysis of its few parameters estimation seems consistent with the illiquid and under developed markets such as Nigeria. Relatively, in this study, it has been used for the construction of a smooth surface curve and for the modelling of different deformations of the curve. From the computed results of the highly flexible estimation technique, we emphasized the in-sample potential of the extended Nelson-Siegel in the Euro-bond market and recommend that the parsimonious model can be presented as an interventionist investment tool during volatile market conditions.

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THE IMPACT OF DIGITAL FINANCIAL INCLUSION ON BANKING SECTOR STABILITY: EVIDENCE FROM DEVELOPING COUNTRIES

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Abstract

The research explores the transformative impact of Digital Financial Inclusion on banking sector stability in developing countries, where advanced technologies reshape financial services. With a focus on FinTech, E-wallets, and digital transactions, the study addresses a critical gap in the existing literature by examining the impact of digital Financial Inclusion indicators, such as ATMs and mobile money accounts, on developing countries banking stability. This study contributes valuable knowledge to policymakers and financial professionals in a rapidly evolving digital era. Employing data from 36 developing nations and covering the period of 2011 to 2017, the research establishes a link between digital Financial Inclusion and enhanced banking stability. Z-score is used to measure financial stability, and ATMs and mobile money accounts are used to measure digital financial inclusion, covering the outreach and usage metrics. Macroeconomic variables like gross domestic product and inflation are included to capture broader economic influences on banking stability. A panel regression was used to analyse the data. The study found that digital Financial Inclusion proxies significantly impact the banking sector's stability. The attention for enhancing digital financial services in improving and maintaining the banking sector stability is reconfirmed from this study based on a larger data set of developing countries.

Keywords: Banking Sector Stability, Digital Financial Inclusion, Developing Countries, Mobile Money Account

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1. INTRODUCTION

Digital Financial Inclusion (DFI) closely aligns with the concept of financial inclusion, representing the evolutionary stage where the integration of cutting-edge technologies comes into play. This facet of financial inclusion has obtained significant attention on the global stage, as evidenced by extensive discussions in recent years (Ozili, 2018). Digital financial inclusion is the process of providing underserved and unbanked populations with access to financial services through the use of digital technologies, including mobile banking, digital payment platforms, and online financial services (Hannig & Jansen, 2010).

Presently, inventive digital financial services accessible through mobile phones and comparable devices have been introduced in a minimum of 80 nations. (GSMA, 2014). As per the Global Findex index, by 2017, only 18.83 percent of individuals had access to bank accounts via mobile phones in developing countries. However, the index in 2021 reports that due to the impact of COVID-19, about 40 percent of adults in developing economies had used digital payment modes such as mobile banking and card payments and one-third of adults in developing economies made their first direct utility bill payment from an account after the pandemic began. However, digital financial inclusion still needs significant attention due to the gap that exists in global financial inclusion (Pazarbasioglu et al., 2020). Moreover, as per the Global Findex database, the adults who owns a credit cards is around 8 percent in low income economies compared to 43 percent of high income economies, the percentage of adults owns debit cards are 25 percent and 75 percents in low-income and high-income economies, respectively, and adults who use a mobile phone or the internet to make payments, buy things, or to send or receive money using a financial institution is about 34 percent and 70 percent in low-income and high-income economies respectively. Thus, these data imply that there is a considerable gap between DFI in developed and developing economies. However, most developing countries are now improving digital financial services to achieve global financial advancement (Demirgüç-Kunt et al., 2017) over the recent past. Thus, the objective of this study is to examine the effects of DFI on the stability of the banking sector in developing countries given the importance of achieving financial stability due to the rapid technological changes. Furthermore, Pazarbasioglu et al., (2020) reported that a significant portion, 65 percent, of adults in the poorest developing nations still do not have access to a traditional bank account, with merely 20 percent utilizing formal financial institutions for savings. However, considering the importance and the target of achieving SDGs by 2030, many countries have initiated digital financial services around the world, for example, in Sub-Saharan Africa (Chinoda & Kapingura, 2023). Moreover, financial institutions can provide convenient and accessible financial services to those with limited access to traditional banking services by using digital platforms to overcome geographical constraints and reduce the cost of transactions (Hannig & Jansen, 2010). On the other hand, broader digital financial inclusion supports banks in achieving stability (Demirgüç-Kunt et al., 2018; Ahamed & Mallick, 2019). The rationale for conducting the current study rests on the premise that a more extensive embrace of digital financial services holds the potential to act as a catalyst for positive transformations within the financial landscape, ultimately

influencing the path of the banking sector in developing countries. In the context of the banking sector, the impact of digital financial inclusion is significant. DFI enables financial institutions to expand their reach and provide convenient and accessible financial services to underserved populations. By leveraging digital platforms, such as mobile banking, digital payment platforms, and online financial services, banks can overcome geographical constraints and reduce transaction costs, thus enhancing financial access and efficiency.

Several empirical studies have examined the relationship between financial inclusion (FI) and bank stability (Li et al., 2020; Neaime & Gaysset, 2018; Ahamed & Mallick, 2019). Despite the widespread acknowledgement of the significance of DFI, a critical observation emerges from the current literature. The issue has been tested in several regions, such as Sub-African region (Chinoda & Kapingura, 2023), European region (Danisman & Tarazi, 2020), and Asian region (Banna & Alam, 2021). Banna and Alam (2021) examined the effect of DFI on the banking sector stability of ASEAN countries during the post-Covid period by taking seven emerging Asian Countries. Ozili (2018) stressed the importance and challenges of the DFI, and Banna, Hassan and Alam (2020) examined the effect of digital financial inclusion on Islamic banking stability and sustainable economic growth. There are a few studies which have examined the DFI status in emerging and developing countries (for example, Khera et al., 2021); and the nexus between DFI and economic growth (for example, Ahmad, et al., 2021), however, no studies have been conducted to examine the effect of DFI on the banking sector stability based on the developing countries, and thus, the implications of the extant literature cannot be generalized to the developing country context as they possess several different institutional characteristics.

The current study focuses on the effect of DFI on the banking sector stability, particularly in developing countries. Thus, it has extended the scope by selecting developing countries on the basis of financial and technical assistance received from the World Bank to enhance the DFI. Thus, the study provides a much wider scope and view of the impact of DFI on banking sector stability. The current study provides a significant contribution to the banking sector of developing nations as they are in the process of using modern technology to offer financial services. As these countries increasingly adopt digital financial services such as FinTech and E-wallets, the study seeks to comprehend the impact of this shift on the stability of their banking systems.

This study recognizes DFI as a game-changer and emphasizes its capacity to address the changing needs of consumers in an era dominated by digital technologies. This suggests that DFI is not just a passing trend but a deliberate and strategic response to the expectations of a contemporary and technology knowledgeable population. And this seeks to offer tangible insights for policymakers and professionals in the financial sector. Through the application of empirical analysis, the study not only arrives at conclusions but also extends policy recommendations grounded in the identified findings. Section 2 reviews the extant literature on digital financial inclusion and banking sector stability. Section 3 explains the methodology, section 4 presents the analysis and discussions, and section 5 concludes the paper.

2. REVIEW OF LITERATURE

2.1. Theoretical Background

Digital Financial Inclusion refers to financial services conducted remotely in a cashless environment through various electronic devices (Klapper, 2017). Digital technologies should be utilized to broaden access to financial services for underserved populations, especially in developing economies. Thus, several theories help explain and guide efforts in this area. Financial inclusion theory highlights that access to financial services is essential for economic development and poverty alleviation, and digital technologies can significantly reduce barriers to financial inclusion, such as high transaction costs and lack of physical infrastructure (Kling et al., 2022). The technology acceptance model suggests that perceived usefulness and ease of use determine users' acceptance and usage of technology. Thus, financial services providers can focus on designing user-friendly and beneficial digital financial products to enhance acceptance among potential users thereby achieving financial system stability.

2.2. Digital Financial Inclusion

Digital financial inclusion is the process of providing underserved and unbanked populations with access to financial services through the use of digital technologies, including mobile banking, digital payment platforms, and online financial services (Hannig & Jansen, 2010). The adoption of digital financial inclusion has gained increasing recognition for its potential impact on financial inclusion and inclusive economic growth. Manyika et al. (2016) reveal that digital finance has the capacity to provide financial access to 1.6 billion people in emerging economies, with a particular emphasis on empowering women. They further project that widespread adoption and usage of digital finance could lead to a 6% increase in the GDP of emerging economies by 2025, amounting to USD 3.7 trillion. To put this into perspective, this economic growth is equivalent to the size of Germany's economy. The report also suggests that the implementation of digital finance has the potential to generate 95 million new jobs across various sectors worldwide.

Siddik and Kabiraj (2020) demonstrate that the influence of digital finance on financial inclusion (FI) is substantial. They argue that the effective implementation of digital financial inclusion (DFI) has the potential to stimulate sustainable economic growth by eliminating poverty. According to Gomber, Koch and Siering (2017), Digital Financial Services (DFS) encompass cutting-edge financial products, finance-related software, and effective methods of interacting and communicating with customers facilitated by FinTech and other service providers in the financial sector, including prominent entities like BigTech firms. Many countries, including over 80 nations, are embracing digital financial services through mobile phones to bring welfare benefits to their populations (Pénicaud & Katakam, 2019).

Financial innovation, particularly within the banking industry, plays a crucial role in enhancing efficiency and improving services for both banks and the overall financial system (Frame & White, 2004). Banks, among various businesses, are genuinely

interested in innovation to serve their customers better and improve efficiency (Alalwan et al., 2017). ATMs have emerged as a highly accepted innovation that performs vital functions such as deposits, withdrawals, printing mini statements, and bill settlements. Their adoption has reduced operational costs for bank branches (Akhisar et al., 2015). Mobile banking, another strategic change in retail banking, enables customers to access their bank accounts through mobile devices for financial and non-financial transactions (Shaikh & Karjaluoto, 2015). Internet banking, facilitated through internet portals, provides customers with a range of banking services, from bill payments to investments (Pikkarainen et al., 2004). Debit cards, linked to checking accounts, offer customers the ability to engage in banking transactions both online and offline (Frame & White, 2004). The attributes of debit cards, including acceptance, security, portability, time costs, and payment features, resemble those of credit cards (Zinman, 2008).

Digital financial inclusion, particularly in the form of electronic banking, has become increasingly important for providing customers, partners, and employees with secure access to information. However, ensuring the security of electronic banking systems remains a challenge. While software and hardware vendors claim to build secure products, it is crucial for e-banking institutions to have assurance regarding the security of these products (Freixas & Rochet, 1998). Independent security evaluations based on internationally established criteria can provide the necessary assurance of vendors' security claims.

The development of new payment methods, such as smart cards and software-based products for online payments, known as electronic money (e-money), has been facilitated by advancements in information technologies (Frame & White, 2004). However, the degree of adoption of these revolutionary e-money systems in the future remains a subject of debate. In the meantime, mixed products and emerging experiences of pure digital cash are being introduced to coexist with traditional payment mechanisms. Theoretical banking literature, as suggested by Bhattacharya and Thakor (1993), highlights the essential role of banks and financial intermediaries in allocating capital within the economy. Financial intermediation theory, focusing on information asymmetries, explains how banks operate in the presence of asymmetric information (Freixas & Rochet, 1998). Asymmetric information leads to adverse selection and moral hazard problems. Adverse selection occurs before a transaction and relates to the lack of information about lenders' characteristics, while moral hazard occurs after a transaction and involves incentives for lenders to behave opportunistically (Freixas & Rochet, 1998).

2.3. Financial Inclusion, Digital Financial Inclusion, and Banking sector stability

The connection between DFI and banking sector stability is limited in the literature and required further investigation. The empirical studies in the area of financial inclusion has focused on the nexus between financial inclusion and; economic growth (for example, Sarma & Pais, 2011), financial stability (for example, Hannig & Jansen, 2010), country-specific practices of financial inclusion (for example, Mitton, 2008), and the role of financial technology (for example, Ozili, 2018). The development of electronic devices then expands the boundary of financial inclusion to digital

financial inclusion. Thus, the scholars have focused on digital financial inclusion by connecting with areas such as, DFI and sustainability (for example, Uzoma et al., 2020), DFI and bank profitability (for example, Ozili (2018), DFI and financial growth (for example, Beck et al., 2014). Further, many studies on the level of DFI in developing countries (for example, Li et al., 2020). Naumenkova et al., 2019) and developed countries (for example, Huang et al., 2021) perspectives.

García and José (2016) highlight the parallel relationship between Financial Inclusion (FI) and financial stability, with financial stability serving as an indicator of banking stability. Beck, Senbet, and Simbanegavi (2014) emphasize that FI should be viewed as a crucial driver of financial growth and stability in the banking sector. Ozili (2018) suggests that the proper application of DFI can increase bank profitability, contributing to financial growth and stability. They highlight the importance of inclusive finance in promoting the stability of financial institutions. Moufakkir and Mohammed (2020) highlight the strong nexus between financial inclusion and DFI, with DFI filling the gaps of traditional financial inclusion through the implementation of technological innovation. They argue that DFI strengthens its functions, contributing to enhanced banking sector performance. These theoretical perspectives shed light on the interplay between FI, DFI, and banking stability.

Several empirical studies have examined the relationship between financial inclusion (FI) and bank stability, highlighting the positive influence of FI on financial sustainability. Li, Wu, and Xiao (2020), in their study of 31 Asian countries from 2004 to 2016, found that FI has a significant positive impact on financial stability. Neaime and Gaysset (2018) demonstrate a close association between FI and bank stability in MENA countries. Ahamed and Mallick (2019) also observe a significant impact of FI on bank stability. These studies provide empirical evidence of the positive relationship between FI and bank stability. A recent study (Banna & Alam, 2021) examined the impact of digital financial inclusion on banking sector stability in Southeast Asian countries and focused particularly on the post-Covid period. Covering both the supply and demand side of DFI, Banna and Alam (2021) used the data relating to a number of mobile money agent outlets, mobile money accounts and mobile and internet banking transactions for the demand side and number of mobile money accounts per 1,000 adults, Number of mobile and internet banking transaction (during reference year) per 1,000 adults and Value of mobile and internet banking transaction have been taken for the supply side. Their findings suggest that DFI increases the stability of the banking sector of ASEAN countries. Compared to the extant literature, the current study focuses on the stability of the DFI and banking sector, particularly from developing countries' perspectives. Although significant attention has been given to promoting digital financial inclusion in several parts of the world, developing countries still lack certain areas of development. For example, financial inclusion is not similar in all countries, where developed countries tend to have a high level of satisfactory financial inclusion. Most of the developing countries fall under the category of low income, and they remain unbanked (Banna and Alam (2021), and they lack the infrastructure facilities to reach the target level of DFI (eg. high-speed internet connection). Moreover, the institutional quality of the developing countries is far below that of the developed countries. Thus, the role of the

governments of these developing countries is massive in promoting ICT platforms to achieve higher levels of DFI. Thus, given the above facts, this study warrants a new perspective on the DFI on the banking sector stability of developing countries.

2.4. Hypotheses Development

Based on the extant literature, a significant impact of financial inclusion on banking sector stability is established. Banna (2020) considered the number of active mobile money agents, the number of active mobile money accounts, and mobile money transactions per 1,000 adults to be the proxies of the DFI. He found a positive and significant association of these variables with bank stability. Banna and Alam (2021) used the same variable and developed an index to examine the effect of DFI on banking sector stability on the basis of DFI access and usage covering the period of post-Covid era. They found that both the access and usage of DFI positively influence the banking sector stability and could reduce the default risk and upturn financial mobility.

Thus, most of the extant literature confirmed DFI's significant and positive effect on banking stability (for example, Banna and Alam, 2021), indicating that digitalized financial services such as debit cards, credit cards, and mobile banking enhance the convenience of banking transactions. Thus, it assumes that due to convenience, people tend to increase their savings, thereby increasing their banking stability. However, there are negative aspects of DFI due to card hacking, card jamming and privacy insecurity. By considering both positive and negative effects, the current study assumes the positive impact of DFI outperforms the negative impact. Thus, the hypotheses of the study are;

H1: The number of ATMs per 1,000 km2 has a significant effect on the banking sector stability.

H2: The number of ATMs per 100,000 adults has a significant effect on banking sector stability.

H3: The number of mobile money accounts per 1,000 adults has a significant effect on banking sector stability.

H4: The number of mobile money transactions has a significant effect on banking sector stability.

3. RESEARCH METHODOLOGY

3.1. Population, Sample and Data

The population of this study is based on developing countries that obtained financial and technical assistance from the World Bank Group to promote DFI over the period of 2011-2017. Thus, it includes 36 countries, and the relevant data were drawn from reputable sources such as the Financial Access Survey of the International Monetary Fund, the Global Financial Development Database, and the World Development

Indicators provided by the World Bank Group. The data were winsorized at 1 and 99 percentiles to remove the outliers.

3.2. Empirical Model

Equation 1 shows the empirical model used to test the hypotheses of the study. The operationalization of the variables is given in Table 1. The variables were recognized based on the averages of the banking industry of each country.

$$BZ_{it} = \alpha + B1DFI1_{it} + B2DFI2_{it} + B3DFI3_{it} + B4DFI4_{it} + B5DPGR_{it} + B6INF_{it} + U_{it} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Study uses four proxies to measure the DFI, namely Number of ATMs per 1,000 km2 (DFI1); Number of ATMs per 100000 adults (DFI2); Number of mobile money accounts per 1,000 adults (DFI3); and Number of mobile money transactions (during the reference year) per 1,000 adults (DFI4). The first two variables measure the geographical outreach penetration and represent the supply side of the DFI. The latter two variables measure the usage of digital financial services penetration and represent the demand side of the DFI. The variable selection was developed by following Banna and Alam (2021). Banking sector stability was measured by taking the natural logarithms of Bank Z-score (BZ), which is measured by dividing the ROA+(Equity/assets) by standard deviation of ROA. Additionally, the annual GDP growth (GDPGR) and annual inflation rates (INF) were used as the control variables.

4. ANALYSIS AND DISCUSSION

4.1. Descriptive Statistic

Table 1 presents a comprehensive overview of the descriptive statistics, encompassing mean values, standard deviations, and the range of minimum to maximum, skewness and Kurtosis values for each variable within the sample. Notably, the, z-score, the measure of banking sector stability exhibited an average of 2.671 with a corresponding standard deviation of 0.488. This suggests that, on average, a decrease in bank stability is equivalent to 2.67 times their standard deviation. Moving on to the supply-side variables, The number of ATMs per 1,000 km^2 (DFI1) displaying a mean of 12.495 and a notable variability with a standard deviation of 16.25. The number of ATMs per 100,000 adults (DFI2), shows a mean of 15.872 with a standard deviation of 16.453. The number of active mobile money accounts (DFI3) and transactions per 1,000 adults (DFI4) reveal mean values of 271.337 and 324.223, accompanied by considerable variability.

Transitioning to macroeconomic controls, GDP growth maintains an average of 4.428 with 3.132 of variability with a minimum value of -4.85 and a maximum value of 14.05. while annual inflation registers an average of 5.651 with a standard deviation of 3.993. These descriptive statistics offer a comprehensive portrayal of the central tendencies, variabilities, and distributions within the dataset, laying the groundwork for a thorough understanding and subsequent analyses in the ongoing research

inquiry. The normality test helps to determine how likely it is for a random variable underlying the data set to be normally distributed.

Table 1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Bank z-score (BZ)	231	2.671	.488	1.611	3.33	-.739	2.695
Number of ATMs per 1,000 km2 (DFI1)	252	12.495	16.27	.122	52.881	1.34	3.524
Number of ATMs per 100,000 adults (DFI2)	252	15.872	16.453	.721	54.731	1.15	3.126
Number of active mobile money accounts per 1000 adults (DFI3)	252	271.337	324.223	-1.063	1088.987	1.34	3.663
Number of Mobile Money transactions per 1000 adults (DFI4)	196	101.347	152.187	-22.959	518.729	1.673	4.637
Annual GDP Growth (GDP)	252	4.428	3.132	-4.851	14.047	-.049	4.349
Annual Inflation (INF)	244	5.651	3.993	.223	15.49	.858	3.208

4.2. Correlation analysis

Table 2 shows the correlations among the study variables. Accordingly, the banking sector stability (Z-score) with the Number of ATMs per 1,000 km2 and Number of ATMs per 100,000 adults show a positive and moderate correlation, suggesting that increases in ATMs per 1000 Km^2 increase the banking sector stability due to the convenience and the availability of the facility. The correlation between Bank z-score, Number of active mobile money accounts per 1000 adults and Number of Mobile Money transactions per 1000 adults shows a negative moderate correlation, suggesting an inverse relationship between mobile money accounts and mobile money transactions and banking sector stability.

Table 2: Correlation analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) BZ	1.000						
(2) DFI1	0.300	1.000					
(3) DFI2	0.305	0.624	1.000				
(4) DFI3	-0.239	-0.100	-0.039	1.000			
(5) DFI4	-0.227	-0.033	0.064	0.751	1.000		
(6) GDPGR	-0.087	0.058	-0.143	-0.079	-0.040	1.000	
(7) INF	-0.007	-0.202	-0.328	0.113	-0.029	0.050	1.000

Note: Table 3 presents the correlations among BZ= Natural Logarithms of Bank Z score; DFI1= Number of ATMs per 1,000 km2; DFI2= Number of ATMs per 100,000 adults; DFI3=, Number of active mobile money accounts per 1000 adults; DFI4= Number of Mobile Money transactions per 1000 adults; GDPGR= Annual GDP Growth; INF=Annual Inflation

Table 3 presents the results of the Variance inflation factor in measuring the multicollinearity issue. Accordingly, no multicollinearity is found among the independent variables, as the VIF values are less than 10.

Table 3: VIF test results

Variable	VIF	1/VIF
DFI1	4.02	0.249026
DFI2	3.97	0.251917
DFI3	1.90	0.526990
DFI4	1.74	0.575845
GDPGR	1.17	0.851385
INFL	1.07	0.934887

Note: Table 4 presents variance inflation factor results for DFI1=Number of ATMs per 1,000 km2; DFI2= Number of ATMs per 100,000 adults; DFI3= Number of active mobile money accounts per 1000 adults; DFI4= Number of Mobile Money transactions per 1000 adults; GDPGR= Annual GDP Growth; INFL, Annual Inflation.

4.3. Regression Analysis

The regression analysis conducted in this study aims to explain the empirical impact of DFI on the stability of the banking sector. Table 4 provides regression estimates of the equation (1) coefficients, highlighting the impact on the dependent variable when an independent variable undergoes a one-percentage-point change, also shedding light on their standard errors and statistical significance. The model estimation was done using different models: panel fixed effect (Model 1), panel random effect (Model 2), pooled regression (Model 3) and panel with cluster option (Model 4).

As per Table 4, the coefficient for the Number of ATMs per 1,000 km2 (DFI1) is estimated at -0.007 with a standard error of 0.004. The t-value is -1.85 with a p-value of 0.066, indicating that the variable is statistically significant at 10% significance level. Similarly, the Number of ATMs per 100,000 adults (DFI2) shows a coefficient of 0.005, a t-value of 0.71, and a p-value of 0.481, suggesting a lack of statistical significance. The number of active mobile money accounts per 1000 adults (DFI3) exhibits a significant association with a coefficient of 0.0002, a t-value of 2.34, and a p-value of 0.021. The number of Mobile Money transactions per 1000 adults (DFI4) has a coefficient of -0.0002 with a p-value of 0.205, indicating a non-significant impact on banking sector stability. Moving to the control variables, GDP growth also lacks statistical significance with a coefficient of 0.005, t-values of 1.60 and p-values of 0.112. However, inflation shows statistical significance with a coefficient of 0.009, t-values of 2.44, and p-values of 0.016. The constant term has a coefficient of 2.561, indicating the expected value of bank stability.

The fixed effect results provide insights into the hypotheses examining the impact of various factors on the natural logarithm of the Bank Z score. The hypothesis suggesting a significant impact from the number of ATMs per 1,000 km² (DFI1) on the Bank Z score (H1) is supported, as the coefficient is negative and statistically significant at the 10% level (p-value = 0.066). However, this result is not consistent

with the initial expectation and is quite like most previous studies by Banna and Alam (2021). And the hypothesis regarding the impact of the number of ATMs per 100,000 adults (DFI2) on the Bank Z score (H2) is not substantiated, with a positive coefficient but a non-significant p-value (0.481).

Conversely, the hypothesis involving the number of mobile money accounts per 1,000 adults (DFI3) (H3) is supported, as the positive coefficient is statistically significant at the 5% level (p-value = 0.021). This result is consistent with the initial expectation and with the previous study by Banna and Alam (2021). However, the hypothesis pertaining to the number of mobile money transactions per 1,000 adults (DF14) (H4) is not supported, as the negative coefficient lacks statistical significance (p-value = 0.205). In summary, only the variable representing the number of mobile money accounts per 1,000 adults exhibits a significant positive impact on the Bank Z score, while the other variables do not demonstrate statistically significant effects. However, note that Banna and Alam's study utilized only four emerging Southeast Asia countries compared to 36 developing countries on which the current study focused.

As per model 1, the R-squared value of 0.124 suggests that the model explains approximately 12.4% of the variability in BZ, and the F-test p-value of 0.000 indicates that the overall model is statistically significant. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) provide measures of model fit, with lower values indicating better fit. In this case, the AIC is -293.314, and the BIC is -271.488.

Table 4: Model Estimation

Bank Z-Score	**Model 1**	**Model 2**	**Model 3**	**Model 4**
DFI1	-.007* (.004)	-.005 (.004)	.007**(0.003)	-.007*(.004)
DFI2	.005 (.007)	.007 (.006)	.007* (0.004)	.005 (.008)
DFI3	.0002** (.00013)	.0001** (.0008)	-.0001 (.0002)	.0002 (.0001)
DFI4	-.0002 (.0005)	-0.0002 (0.00021)	-.0005 (0.0005)	-.0002 (.0003)
GDPGR	.005 (.003)	.004 (0.0033)	-.01(0.116)	.005(.004)
INFL	.009** (.004)	.009*** (0.003)	.015*(0.009)	.009*(.004)
Constant	2.561*** (.063)	2.517*** (0.116)	2.51*** (0.0977)	2.561*** (.068)
R-squared	0.124	0.117	0.179	0.124
F-test	3.231***	17.008***	5.877***	4.56***
Akaike crit. (AIC)	-293.314		215.282	

Note: This table presents the results of the panel fixed effect model (Model 1), panel random effect (Model 2), Pooled regression (Model 3) and Panel with cluster (Model 4). Where; BZ,=Natural Logarithms of Bank Z score; DFI1= Number of ATMs per 1,000 km2; DFI2= Number of ATMs per 100,000 adults; DFI3= Number of active mobile money accounts per 1000 adults; DFI4=Number of Mobile Money transactions per 1000 adults; GDPGR=Annual GDP Growth; INFL, Annual Inflation. The table reports the coefficients and the standard errors (in parentheses), and*** p<.01, ** p<.05, * p<.1 indicates the significant levels of 1%, 5% and 10% respectively.

The results given in Table 4 for model 2 report the Number of active mobile money accounts per 1000 adult's variable as the only significant variable proxied for DFIs with a r-squired value of 0.117. The number of ATMs per 1,000 km2 and the number of ATMs per 100,000 adults are significant under model 3 with an r-squired value of 0.179. Under model 4, the Number of ATMs per 1,000 km2 is the only significant variable proxied for DFI with a 0.124 r-squired value. Control variables are significant under each model. Overall, the results suggest that DFI significantly affects the banking sector stability.

5. CONCLUSION

In the realm of contemporary finance, the symbiotic relationship between digital financial inclusion (DFI) and the stability of the banking sector has become a focal point of scholarly exploration. Throughout this research, various significant analyses were conducted to explore the relationship between Digital Financial Inclusion on Banking Sector Stability in Developing Countries over the period from 2011 to 2017. The study employed a fixed panel data model to assess the impact of digital financial inclusion on banking sector stability.

To operationalize study objectives, proxies were employed as analytical tools. The number of ATMs, serving as a traditional financial infrastructure component, was compared against the growing landscape of mobile money accounts and transactions, representative of cutting-edge digital financial services. These proxies aimed to capture the essence of digital financial inclusion and its potential impact on the stability of the banking sector.

One of the noteworthy revelations was the significant positive impact of the number of mobile money accounts per 1,000 adults on the natural logarithm of the Bank Z score. This result highlights the transformative potential of mobile money services in bolstering the stability of banks. The positive correlation suggests that as the prevalence of mobile money accounts increases, so does the stability of the banking sector. This finding aligns with the global trend where mobile money has emerged as a powerful force in financial inclusion, particularly in regions with limited access to traditional banking services. The convenience, accessibility, and versatility of mobile money services seem to have a positive influence on the overall stability of the banking sector.

Importantly, a negative impact from the Number of ATMs per 1,000 km2 (DFI1) on the Bank Z-score level is also accepted at a minimum significant level. This scenario prompts an exploration of several potential contributing factors to this less significant yet negative impact. The uneven spatial distribution of ATMs, variations in the quality of digital financial inclusion implementation, and local consumer behaviour favouring traditional banking services are conceivable influences on this outcome.

Financial institutions, on the other hand, need to recalibrate their strategies, recognizing the evolving landscape where digital services play a pivotal role. The non-significant effects observed for ATMs signal the need for a strategic reevaluation of the role and distribution of traditional banking infrastructure. Furthermore, the

study contributes to the ongoing dialogue on the global stage about the significance of digital financial inclusion in achieving broader economic development goals. It underscores the role of digital financial services not only in fostering financial access but also in fortifying the very foundations of the banking sector. This study implies that the necessity of having mass awareness on the digital financial services throughout the country and providing them the hand on experience at the branch level to promote these facilities. The study's findings also warrant exploration of policy implications and regulatory best practices, offering guidance to policymakers in creating an enabling environment for digital financial services.

The study's reliance on a limited set of proxies, namely the number of ATMs, mobile money accounts, and transactions, is indicative of the challenges posed by data unavailability. The inability to incorporate the most current data may limit the study's relevance and applicability to the present financial environment. However, future research endeavors in this domain should strive for more comprehensive datasets, encompassing a broader array of DFI indicators and accounting for the latest developments, to provide a more robust understanding of the evolving dynamics between digital financial inclusion and banking sector stability. Incorporating qualitative research methods, such as interviews and surveys, can delve into user experiences, perceptions, and challenges associated with digital financial services. By embracing these recommendations, future research endeavors can contribute to a more comprehensive and dynamic understanding of the interplay between digital financial inclusion and the stability of the banking sector.

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THE IMPACT OF REMOTE WORK ON EMPLOYEE JOB SATISFACTION AND WELL-BEING: A POST-COVID-19 PANDEMIC QUANTITATIVE STUDY ON THE BANKING INDUSTRY IN SRI LANKA

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Abstract

Remote work systems have been introduced to the world due to the pandemic by the WHO in 2019. With this new system, the lives of people changed a lot and different industries introduced this differently. The banking industry has encountered obstacles and prompted firms to use remote working methods. The main objective of this study was to examine the impact of remote working on employee Job satisfaction and well-being within the banking industry in Sri Lanka in the post-COVID-19 period. The study uses primary data to answer the research problem from 210 respondents in different banks in the Colombo district in Sri Lanka. The deductive approach was used to investigate the relationship between the variables and the purposive sampling technique was used for selecting the respondents. Survey strategy was used to collect data and collected data were analyzed using SPSS software, employing descriptive Analysis and inferential Statistical techniques to analyze the data and figure out the results of the research study objectives. Data Analysis is divided into five parts to analyze the results obtained. It includes Descriptive statistics, reliability analysis, correlation analysis, Regression analysis, and hypothesis testing. The results showed that there is a positive relationship between Infrastructure facilities, Work-life integration, Organisational Support, Organisational Culture, and Leadership with Employee job satisfaction and well-being. The findings of this study are extremely beneficial insights to understanding challenges faced by remote working employees in the banking sector in Sri Lanka and the recommendations that are provided aim to assist employees in overcoming these challenges.

Keywords: Banking Industry, Employee job satisfaction and well-being, Organisational Culture, Remote Working, Work-life integration, Sri Lanka

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1. INTRODUCTION

1.1. Background of the study

COVID-19 has spread rapidly throughout the world as a pandemic. Due to the global pandemic situation, the lives of people changed drastically. It changed the day-to-day life and work environments of employees by changing the working method to remote working. When remotely working, employees can work from anywhere apart from the office. The outbreak of COVID-19 worked as a catalyst and companies had to shift to the remote working method (Muralidhar et al., 2020). Raišienė et al.(2020) described that, remote work, also known as 'teleworking' or 'telecommuting,' denotes an employee's capacity to work away from the office, leveraging technology for workplace communication. Furthermore, Gómez et al.,(2020) stated that to uphold competitiveness and prioritize employee well-being, organizations are encouraged to formulate novel strategies, embracing automation, digitalization, robust technological support, and adaptable structures. Prasad et al., (2020) pointed out that while smart technologies facilitate remote work, the effective management of work and family concurrently poses a substantial concern for workers, regardless of family status. Anticipated outcomes post-pandemic include potential stress among individuals and the discovery of inner strengths with expressions of gratitude (Prasad et al., 2020). Therefore, the challenges employees may face, impact their psychological well-being, a concern likely to persist in the future. Pradhan and Hati (2019) defined employee well-being as the "quality of work-life; it is the employee's well-being that is affected by workplace interventions and includes all about the psychological, physical, and emotional health of employees" (Juniper et al., 2011). In other words, employee well-being consists of psychological, physical, and emotional health. Happiness is tied to a mental state where an individual feels joy, satisfaction, positive thoughts, and a sense that life is meaningful and worthwhile (Jalali & Heidari, 2016). However, the current study focused on the commercial banking industry, Sri Lanka.

The Banking industry is the backbone of the economy. During the COVID-19 pandemic situation, the Banking industry underperformed and had a multi-faceted impact on operations due to the twin shocks that combined with the global pandemic and oil war (KPMG, 2020). Twin shocks impact three areas of the banking sector. Strategy, business and model, Risks and Audit, financing reporting and tax are the three major areas that impact on banking industry. The pandemic situation propelled the banking industry to enhance digital transformation. As a result of that digital assets with higher demand challenged the banks but were beneficial to the mature banks. Moreover, the most challenging aspect for the banks is offering products and services through online banking without operating physically at branches and creating mechanisms to protect customers from fraudsters. Therefore, the banking industry adopted the new normal method to mitigate the COVID-19 pandemic situation and most of the employees started to face problems such as becoming stressed with unrealistic deadlines, High workloads, work-life and family-life imbalances, job insecurity, etc (World Happiness Report,2021). These stressors lead to mental breakdowns. Therefore, when remotely working, job satisfaction and well-being are crucial factors that can influence the employees (Caligiuri et al., 2020). In

addition to that, when adjusting with the pandemic situation Sri Lankan banking sector has faced multiple factors from customer behavioural changes to technological disruptions. On the other hand, achieving cost efficiencies while maintaining cyber security is inherently complex and the pandemic situation worsens this challenge. Moreover, employees who were remotely working often use less secure systems, which increases the cyber security threats (KPMG, 2020).

Based on previous research studies, there are some studies in different countries and regions related to the banking industry after the pandemic, which help to evaluate the existing research gap. According to Al-madadha et al., (2022), Jordan's banking industry highlights the impact of Covid-19 on pushing organizations toward flexible remote work. The findings suggest that employees' perceptions of digital technologies influence their attitude toward telecommuting, especially in terms of job satisfaction. Ultimately, the study concludes that employees' satisfaction and perceived work-life balance significantly influence their behavioral intentions towards telecommuting in the banking industry of Jordan and it was focused on work-life balance and behavioral intentions. As well, Hafshah et al., (2022), stated that in the Indonesian banking industry, how remote work affects the performance, motivation, and engagement of millennials and banking professionals. They investigated the impact of remote work on millennial employees' performance, motivation, and engagement on employee performance and their remote working. According to the findings of this research remote working has a significant positive effect on employee performance, employee engagement and employee motivation. Moreover, findings show the mediating impact of online working on employee performance through employee engagement and motivation. However, the only failure is some employees do not have a proper workspace at their homes.

Amiri et al., (2023) found out that Iranian banking employees had a positive impact indirectly on life satisfaction during the COVID situation and after the pandemic. In the Sri Lankan context even though there are research studies on different industries related to remote working, there are not sufficient research studies specifically related to the banking industry. Some researchers, Kaldeen and Nuskiya (2020) investigated on working from home's impact on work, health, and family. They have focused on Health-related factors in the higher education industry and not covered Employee Job satisfaction and well-being. As well, the research of shafeena and Shahid (2020) focuses on employee perceptions and experiences of remote working, but they have not focused on employee job satisfaction and well-being. Some studies (KPMG Sri Lanka, 2020; Sahni, 2020) have concluded the negative impact of the COVID 19 and the performance of the banks. KPMG (2020) revealed the pandemic situation negatively impacts the banking industry in Sri Lanka. Due to many work meetings during the pandemic period, employees might get screen fatigue with too much exposure to the screen. As well, Sahni (2020) points out that according to some respondents, during the work-from -home period, employees might lack physical and mental well-being. When employees face these challenges, it affects their well-being.

Therefore, it is important to understand remote work's impact on employee job satisfaction and well-being. The unexpected and extensive disruptions caused by the

COVID-19 pandemic have necessitated a shift in work dynamics, making the work-from-home (WFH) format the rule rather than the exception (Yasmin et al., 2022). Since the new normal method came with the COVID -19 pandemic situation, there has been a dearth of research articles on this problem. Most of the research studies were based on the usage of remote working before the pandemic situation. Hence there is a difference between remote working after the pandemic era. When assessing these research studies, it is very challenging to find similar research relating to this research in Sri Lanka relating to the impact of remote working on employee work contentment and well-being in banking industry. It emphasized that originality of this research positioned in the limited research studies related to remote working and employee job satisfaction and well-being in banking industry of Sri Lanka. Since there is a dearth of research studies relating to Sri Lankan banking industry on remote working and factors that can affect employee job satisfaction and well-being which were selected to explore in this research study.

To probe the gap in the Sri Lankan context, the study has carried out preliminary interviews with a manager of a leading state bank and a manager from a commercial bank in the Colombo district. According to the state bank manager, sometimes it is felt that some employees work better at home and furthermore employees are doing operational functions at home but handling original documentation that used authenticated verification processes is very difficult. To do that employees should go to offices even in pandemic situations. Apart from that, some employees face connectivity problems which cause them to work long hours. Moreover, some faced the hindrances coming from the home side and for some employees' lack of good IT skills made it difficult. On the other hand, commercial bank managers implied that they could handle all the functions at home except for customer care services, granting loans, and clearing cheques since these services cannot be completed remotely. Consequently, according to the previous research studies and interviews, there is an existing research gap within the Sri Lankan context in the banking industry.

1.2. Problem Statement

The current research focuses on the impact of remote working on employee Job satisfaction and well-being in the Banking industry of Sri Lanka. Implementing Remote working is a new system in Sri Lankan banking industries. Hence when compared to working at the office, with the remote working situation, employees began to face some problems like extended working hours, stress, psychological well-being, physical problems, inability to disconnect from work, social isolation, and screen fatigue etc. According to cross sectional survey data on working population of Sri Lanka, which extracted from the "Daily FT" newspaper on 30th April 2020, 45% of respondents faced connectivity issues while working from home, 30% of respondents were distracted from their work due to Television and other electrical modes and 29.41% of respondents are maintaining a work-life balance, but others are unable to maintain a proper work-life balance while working from home. Although remote working has improved productivity, and decreased the spreading of disease, it causes a lot of mental traumas in employees (Pathirana, 2020). Loneliness at home

and intermittent changes from work to domestic responsibilities decreased the employee's well-being (Smith, 2021). Sharma (2020) stated that due to low human interactions, employees feel isolated in their working area at home, and employees might feel anxious and worried mindset with stress during uncertain times like pandemic situations. Therefore, this research is essential because if employee well-being is not looked after properly, organization cannot grow in the future. Additionally, this research recognized the challenges that employees face during remote working and search for possible measures to overcome the problems. Hence, this research is crucial to conduct to search for new techniques to deal with these problems when remotely working. This research study is needed as it investigates solutions for the aforementioned gap. Hence, the study aims to investigate the factors and problems related to remote work that impact employee Job satisfaction and well-being and use the findings of the research to analyze effective methods to enhance Job satisfaction and well-being in the banking industry in Sri Lanka as it needed to investigate solutions for the gap. According to the research problem, the following research questions have been identified for the study. Firstly, what kind of factors are affecting to the remote working in the banking industry in Sri Lanka after the COVID-19 pandemic? Secondly, what are the recommendations and plans that banks can incorporate to improve job satisfaction and well-being after the COVID-19 pandemic?

Addressing above issues are important as most of the research articles were done in developed countries and are still being researched in this area since the pandemic situation is a new problem that occurred in the world. According to the research gaps mentioned above, those research papers separately focus on remote working impact on industries such as Education, IT and Media in Sri Lanka and other countries and how researchers conducted research only relating to the happiness of employees in Sri Lanka without focusing on Employee well-being. It is evident that in Sri Lanka there is a dearth of research articles relating to remote working focused on the Banking industry. Hence, this research focused on filling the gap by thoroughly investigating factors relating to remote working and its impact on employee job satisfaction and well-being. This study has a big impact on theoretical implication as this study covers various remote working models and employee well-being models with various factors that can impact on remote working. Therefore, this study is extremely beneficial to understand challenges faced on remote working and recommendations to overcome them. Moreover, due to the current pandemic situation a lot of people are remotely working. Therefore, most of the Banks and Financial Institutions have been under a lot of stress and depression due to overwork. Therefore, financial organizations employee well-being is not looked at. Even the company does not take care of the employees and the Human Resource Department also does not meet their employees' needs and loses contact with them and lacks training opportunities. Concerning the practical implications, it is very crucial to analyse factors that effect on remote working and implement solutions to overcome them. Therefore this research study gives suitable inputs to the banking industry, to improve their employee well-being by using the right practices in working from home with remote performance monitoring applications and giving solutions to overcome their

problems and struggles while remotely working during the pandemic and more practical implications further described in the recommendations.

The main objective of this research study is to investigate the impact of Remote work on employee job satisfaction and well-being in the Banking industry of Sri Lanka. In order to attain the main objective, this research study has developed and articulated two distinct objectives, which can be derived as follows:

I. To identify the factors affecting remote working in the banking industry in Sri Lanka after the COVID-19 pandemic.

II. To regulate the recommendations and strategies-plans that banks can incorporate to improve job satisfaction and well-being after the COVID-19 pandemic.

2. LITERATURE REVIEW

2.1. Theoretical Frameworks

2.1.1. Technology Acceptance Model (TAM)

According to Al-madadha et al. (2022), the Technology Acceptance Model examines the significant linkages between quality, work life balance, telecommuting systems, Infrastructure, organisational support, and the perceived utility and ease of use of telecommuting. Employees are more likely to embrace this work settings, if they believe that telecommuting technologies are simple to use and if employees receive guidance and training in doing so. The findings related to TAM Model have important theoretical and managerial ramifications for how employees will behave when they are remotely working. Therefore, Al-madadha et al. (2022) implied capturing fundamental factors such as work-life balance, supervisor support, system quality, employee self-efficacy, and organisational support connected with the "acceptance" of digital technologies and platforms. In addition, findings related to Jordan banking sector shows that employee behavioural intentions and flexible remote work arrangements in Jordan were found to be positively impacted by job satisfaction. Jordan banking sector used this model during the pandemic to enhance the effectiveness of their employees and to increase their job satisfaction.

2.1.2. Remote work competency model

The remote work competency model is a recently developed framework that can be used for the banking sector. This framework focuses on skills that need to be learned when remote working. This model can identify competencies that employees should grow and make them progress through different levels (Workplaceless, 2020). Hertel et al. (2006) stated that the remote work competency model can be used as an evaluation matrix when doing screening in the hiring process for candidates who are not familiar with remote working, can be used as a succession plan to improve the skills of the team members to develop career progression into next level (Workplaceless, 2020). This model has identified that competencies need to improve from the starting point of career and it should be improved on various professional levels.

2.1.3. Unified Theory of Acceptance and Use of Technology (UTAUT).

Stamos and Kotsopoulos (2024) stated that Venkatesh et al. created the UTAUT model to predict how consumers will adopt information technology. Based on empirical investigation, this theory concludes that the primary elements influencing a user's adoption are performance expectancy, effort expectation, social influence, and facilitation conditions. Therefore, the relative benefit and perceived utility are comparable to the performance expectation. Expected effort is identical to perceived complexity and ease of usage. Similarly, the underlying norm is comparable to social influence. UTAUT Model described the various information technology users. In summary, UTAUT states that consumers' intentions to adopt a solution ultimately decide whether or not they actually do so. The UTAUT Model was used by the Greek banking organizations to develop banking IT systems to utilize remote working.

2.1.4. Remote framework

Beerda (2020) stated that Yu-kai chou developed the REMOTE framework recently to engage remote workers to increase their effectiveness, make them more productive and increase their team culture and bonds. This framework consists of 6 steps that help employees in their right place with the involvement of leadership and culture. Responsiveness, Expression, Momentum, Openness, Team play, and Enjoyment are the six steps of the REMOTE Framework. This framework helps remote workers to use the right technology, increase team culture, changes in leadership, keep morale in the workplace.

2.1.5. Seligman's PERMA model and ASSET Model

Johnson et al. (2018) stated that Seligman's PERMA model is a multidimensional employee assessment. It consisted of five dimensions, which are Positive emotion, Engagement, Positive Relationships, Meaning, and Accomplishment. Therefore, PERMA model is very useful to understand the well-being of the employees and this model can be used to develop a policy. Sandilya & Shahnawaz (2018) implied that the ASSET Model is a comprehensive model based on the internal and external components that influence the well-being of the employees or individuals who are working at the office. This Model is known as the (A Shortened Stress Evaluation Tool, which is an ASSET. Hence, this model is to evaluate and understand well-being at work. Biswal (2021) implied that these models can be used to have a secure financial well-being to meet financial obligations.

Out of these particular frameworks and Models, this research study used the Technology Acceptance Model (Al-madadha et al.,2022) to achieve the study's main objective.

2.2. Effect of Remote working factors

2.2.1. Infrastructure

The infrastructure factor plays a crucial role as it is directly involved with the working from home setting. FastLane (2020) stated that although the workers were favourable to working from home early, there were problems that needed to be solved. Difficulty

in getting access to official documents was one such problem. Castellanos-Redondo et al. (2020) point out that employee happiness has a great impact on the living environment and work. Organizational ethics which is the company's social responsibility at work will lead to greater happiness. Remote working changes the structure of an organization as it allows work to be carried out of the office and outside normal working hours (Campbell & Heales, 2008). Increased productivity has the largest positive impact and will contribute to the upward trend of remote working policies even after post-pandemic. Wulida, Artatanaya, and Burgess, (2021) implied that Organizational functions and employee performance are supported by hardware and software systems that are incorporated by digital infrastructure. This research explores the existence of a technology-based-systems of organizations that enables the core business of the organization. Increased productivity has the largest positive impact and contributes to the upward trend of remote working policies even after post-pandemic. These negative effects will be eradicated with user-friendly teleworking arrangements (Fana et al., 2020). Therefore, this study proposed the following hypothesis.

$H1_1$: Infrastructure has a significant relationship with employee Job satisfaction and well-being.

2.2.2. Work-life Integration

During the pandemic, organizations decided to work remotely, which led to the boundaries between work and life becoming mixed due to technology. Mostafa (2021) stated that conflict between family-related matters and work-life could be smothered using technology. Technology helps to develop a concept such as work-life integration. Baker et al. (2007) stated that working from home not only enhances productivity but also gives greater flexibility to work arrangements and ushers a higher level of work-life balance. Stevens (2019) implied that organizations tend to make effective work life balance to increase the productivity of the company employees. Purawanto et al. (2020) opined that working from home enhanced flexible time to carry out work and save transport costs for employees. There is a strong positive relationship between remote working and work-life integration, with an average correlation (Bedford,2019). Wang and Parker (2021) indicated that workload and monitoring which are normal procedures may apply negative impacts on employees' work-life integration during working from home. The interruptions caused by the pandemic situation created a huge opportunity for remote working employees to redesign the organisational and leadership protocols while voicing out concerns regarding their demands and necessities (Bierema,2020). Accordingly, this research study proposed the following hypothesis.

$H2_1$: Work-life Integration has a significant relationship with employee Job satisfaction and well-being

2.2.3. Organizational Support

Organizations provide facilities and support to employees, especially in a pandemic situation and provide the latest technology, connections, and equipment to their employees. Oakman et al. (2020) Stated that support from colleagues has an impact

on well-being. Perceived organizational support has a positive impact on well-being (Mihalache & Mihalache, 2021). Rasool et al.(2021) stated that organisztional support is the organization's concern for employee well-being. This has been examined with various other variables and almost all these agree that organizational support helps to soothe employees' stress. Organizational support had a significant and positive relationship with employee engagement. Wang and Parker (2021) indicated that work independence allows employees to have the liberty to decide how and when to carry out their work. Accordingly, employees who have high work independence can balance their responsibilities. Hence, the following hypothesis is proposed:

$H3_1$: Organizational Support has a significant relationship with employee Job satisfaction and well-being.

2.2.4. Organizational Culture

Organizational culture is a social force that supports internal integration and adapts to external environment situations (Daft, 2008). Grant et al. (2019) indicated remote working would increase job satisfaction, productivity, flexibility, work-life balance, and decrease work-life conflicts and transport costs. Purwanto et al.(2020) stated employees having to bear the cost of electricity and the Internet hurts/has a negative impact on working from home. Top managers played a decisive role in culture changes in the organization. When remote working enhances the positive impact, then eventually it leads to the openness of employees to accept culture changes (Raghuram, 2021). Therefore, the following hypotheses were developed.

$H4_1$: Organizational culture has a significant relationship with employee Job satisfaction and well-being.

2.2.5. Leadership

According to Meiryani et al. (2022), in the pandemic situation, a leader’s style has a positive effect on performance of the employees , while transformational leadership has no such relationship.In addition to that, Hutaluju (2021) emphasized that there is a favorable correlation between working from home and motivation at work, as well as favorable effects on job performance. According to Kelvyn et al., (2021), work motivation and job satisfaction have a positive impact on work performance, which lends support to their claims. Work performance is significantly influenced by the job satisfaction factor. Additionally, Mitchell and Brewer (2022) stated that in order to achieve effective communication in a remote work setting, leaders should first comprehend the needs and desires of their team members. In order to create a cohesive team, managers should be approachable and encouraging to their subordinates. Trust is the main component when it comes to leadership. Kelloway et al., (2012) highlighted the significance of trust in the leader as the mediator between the leadership style and psychological well-being. Gajendran and Harrison (2007) stated that there is a positive impact on employee and supervisor relationships when remotely working. Oakman et al., (2020) indicated that communication and support from co-workers are two key factors that can establish successful remote working with the balance of psychological well-being. Newman and Ford (2021) stated that

when working remotely, leaders find many ways to balance the team culture and to encourage members on fulfilling their shared goals of the organisation by giving them feedback on company expectations. Therefore, this research study proposed the last hypothesis as follows.

$H5_1$: Leadership has a significant positive relationship with employee Job satisfaction and well-being.

2.2.6. Employee job satisfaction and well-being

Pandemic situations negatively impact employees' psychological well-being due to loneliness, frustration, fear, and financial losses, etc (Meyer et al., 2021). Prasad et al. (2020) stated remote working impacts psychological and physiological aspects in a mixed manner. The experience of the inability to disconnect from work mentally and physically leads to increased stress in the long run and affects well-being negatively. Purwanto et al. (2020) show that there is a negative impact on employee motivation when remotely working as some employees have to bear the costs related to remote working. Pirzadeh and Lingard (2021) point out that there is a negative relationship between remote working and the work-family conflict. Work-life balance has a positive relationship and significant relation with openness, communication, etc. Oakman et al., (2020) stated that the inability to disconnect from work has a positive relationship with job stress which increases work-family conflict. This impact is more negatively for women than men. Integration of work into the family is positively related to job stress. This effect impacts men more than women greatly.

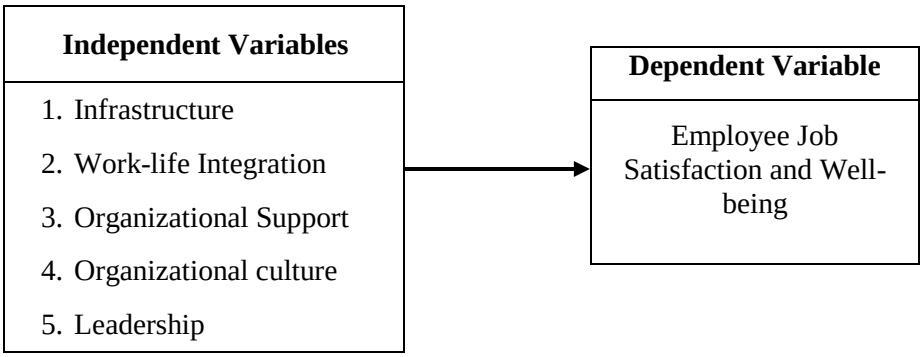
3. METHODOLOGY

3.1. Population and Sample

This research is based on the employees who are working in commercial Banks, which consist with State-owned banks and Private banks that are situated in the Colombo city limits and currently working remotely. The reason to select the Colombo district is because the largest bank branches with headquarters are situated in the Colombo district. Sri Lanka has 24 Licensed commercial banks. There are 984 branches of licensed commercial banks within the Colombo district (Central Bank of Sri Lanka, 2023). Out of these banks this study selected 10 banks in the Colombo district. Therefore, the target population of the study was 1500 banking employees at the management level whose salary scale is between Rs 50000 to above Rs.200 000. (Krejcie and Morgan ,1970) sample size for the research study was 306, which was determined by using Krejcie and Morgan table. Based on the conceptual framework, a structured questionnaire was designed depending on the literature context. The questionnaire was distributed online as a Google form through emails and social media, which was structured with demographic questions and five-point Likert scale questions. The study distributed questionnaires among 350 banking employees and out of that this study collected data through 210 respondents from commercial banks in the Colombo district of Sri Lanka. Due to time constraints and limitations, this study was conducted using a non-probability sampling technique, which is convenient (Sekaran & Bougie, 2013). As this research selected the Banking industry

employees, the Purposive sampling technique was used to collect data to fulfil the purpose (Saunders et al., 2019). Similarly, Lakmal and Fernando (2023) chose the purposive sampling technique and Morgan table to do quantitative research in Kurunegala district Sri Lanka.

3.2. Conceptual Framework



Source: Author's Work

Figure 1: Conceptual framework

The factors of Remote working and Employee Job Satisfaction and Well-being were elected and developed after analysing findings of empirical research and theoretical frameworks. Therefore, Technology Acceptance Model (Al-madadha et al., 2022) and research studies related to remote working in the banking sector, such as (Wulida et al., 2021; Mostafa, 2021; Wang and Parker, 2021; Raghuram, 2021; Kelvyn et al., 2021; Meyer et al., 2021) to examine the relationship indicated in the independent and dependent variables.

3.3. Data Collection

The research study gathered data by using primary and secondary research sources. Initially, the research study accumulated secondary data by using literature and gathered primary data through distributing questionnaires. Preliminary research data was collected through the local and international context literature in order to gain more knowledge on Remote working and Employee Job satisfaction and well-being and factors affecting these main key elements of the study and also to find out the research gaps to establish a good background to the research study. Based on that the research developed a conceptual framework to gather data through questionnaires as primary data. This questionnaire is structured with demographic questions and five-point Likert scale questions.

3.4. Hypothesis Development

Table 1, indicates the hypothesis which was designed to measure the relationship between Independent and Dependent variables and constructed according to the literature review and Theoretical Frameworks and Models which have been used for this research study.

Table 1: Hypothesis table

Hypothesis 1	H11: Infrastructure has a significant relationship with employee Job satisfaction and well-being
Hypothesis 2	H21: Work-life Integration has a significant relationship with employee Job satisfaction and well-being
Hypothesis 3	H31: Organizational Support has a significant relationship with employee Job satisfaction and well-being
Hypothesis 4	H41 : Organizational culture has a significant relationship with employee Job satisfaction and well-being
Hypothesis 5	H51: Leadership has a significant relationship with employee Job satisfaction and well-being

Source: Author's Work

4. DATA ANALYSIS

The research explains the analysis of the collected data by using the IBM SPSS software version 26. Data Analysis is divided into five parts to analyze the obtained data. It includes Descriptive statistics, reliability analysis, correlation analysis, Regression analysis and hypothesis testing. Descriptive analysis was performed to provide a basic overview of independent variables and dependent variable. To evaluate the feasibility of the research study questionnaire, reliability analysis was used. Correlation analysis was conducted to determine the relationship between two or more variables that move together. To investigate the cumulative impact of independent factors on dependent variables, Regression analysis was performed. Hypothesis testing was used to measure the link between the independent and dependent variables. These analytical techniques were mainly used to achieve the main objective of the study and to examine the distinct objective of identifying the factors affecting remote working in the Banking industry during the pandemic. The pilot test was done by using data collected from the 50 respondents. For the main study, data was collected from 210 respondents who are currently working in the Banks in Colombo Sri Lanka.

4.1. Demographic Profile

This research study utilizes demographic variables such as age, gender, marital status and salary scale to characterize the sampled population. In this research, 58.6 % of respondents were male and 41.4 % were female. Most of the respondents are between the age of 26- 35.

4.2. Reliability and Validity Analysis

4.2.1. Reliability Analysis

The reliability analysis illustrates the integrity of the variables by indicating the applicability of the results of the investigation (Sekaran and Bougie, 2013). Reliability analysis accepted the adequate threshold for Cronbach's Alpha is more than 0.7 (Shelby, 2011). As per table 1, it is visible that all the variables are above

0.7. Thus each variable has been identified as a reliable variable. This denotes the higher internal consistency of the variables that have been validated in the main study.

Table 2: Reliability results of the Main study

Variable	Reliability (Cronbach's Alpha)
Acceptable Level	**>.7**
Independent Variable	
Infrastructure	0.875
Work-life Integration	0.795
Organizational support	0.748
Organizational culture	0.844
Leadership	0.897
Dependent Variable	
Employee Job satisfaction and well-being	0.794

Source: Authors Calculations based on SPSS Output

4.2.2. Validity Analysis

4.2.2.1. Convergent Validity

Convergent validity can be measured by using KMO, Bartlett's P-value Test and Average Variance Extracted tests. The threshold rule of each test is given in Table 3.

Table 3: Validity results table of the main study

Variable	Validity		
	KMO	**Bartlett's P value Test**	**AVE**
Acceptable Level	**>.5**	**sig<.05**	**>.5**
Independent Variable			
Infrastructure	0.792	0.000	0.61
Work-life Integration	0.500	0.000	0.82
Organizational support	0.774	0.000	0.52
Organizational culture	0.796	0.000	0.56
Leadership	0.833	0.000	0.66
Dependent Variable			
Employee Job Satisfaction and Well-being	0.765	0.000	0.51

Source: Authors Calculations based on SPSS Output

In the validity analysis, all the variables are at the acceptance level. KMO and AVE values of each variable are above 0.5. Bartlett's value test values of each variable are less than 0.05. As per the above table 3, which elaborates KMO value which should be higher than 0.5, Barlett's P-value test should be less than 0.5 and the AVE value should be higher than 0.5 for each independent and dependent variable. Hence this

main study meets all the acceptable levels of convergent validity. Only three questions from the work-life integration variable were eliminated to get the reliability and validity at an acceptable level. Therefore, convergent validity is confirmed for this study as all the variables are at the acceptance level.

4.2.2.2. Discriminant Validity

In discriminant validity, the squared correlation value should be less than the AVE value to gain discriminant validity at an acceptable level. According to Table 4, the AVE value of each variable is greater than 0.5, and the squared correlation of each variable is less than the AVE. This implies that these variables have discriminant validity.

Table 4: Test for Discriminant Validity

Correlations						
		Work-Life Integration	**Infrastructure**	**Organizational Support**	**Organizational culture**	**Leadership**
Work-Life Integration	Pearson Correlation	AVE=.82				
	Squared Correlation					
Infrastructure	Pearson Correlation	.331**	AVE=.61			
	Squared Correlation	.109				
Organizational Support	Pearson Correlation	.388**	.669**	AVE=.52		
	Squared Correlation	.150	.447			
Organizational culture	Pearson Correlation	.208**	.647**	.708**	AVE=.56	
	Squared Correlation	.043	.418	.501		
Leadership	Pearson Correlation	.176*	.590**	.549**	.644**	AVE=.66
	Squared Correlation	.030	.348	.301	.414	

**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)

Source: Authors calculations based on survey data

As the values surpass the reliability and validity of the threshold rules, the data set can be considered reliable and valid to proceed further to do a thorough analysis.

4.3. Descriptive Analysis

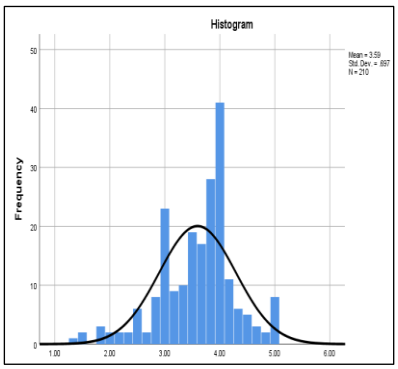
4.3.1. Univariate Normality Testing

This testing measures the independent variable and dependent variable. This can measure central tendency which includes mode, mean median, standard deviation, Skewness, Kurtosis, Minimum, Maximum, and range. In order to understand and analyze histograms were presented as follows. According to Table 5 and Figure 2 graphs, this research analyzed each independent and dependent variable.

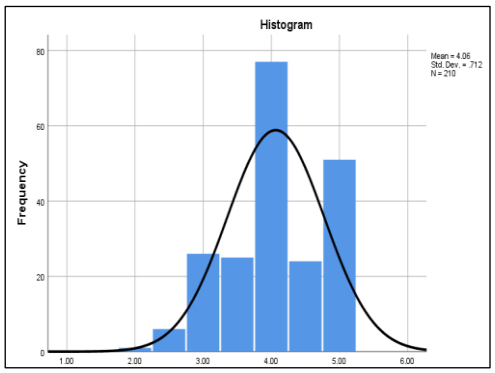
Table 5: Descriptive Statistics

Variables		Infrastructure	Work-life Integration	Organizational Support	Organizational Culture	Leadership	Employee Job Satisfaction & Well-being ((Dependent Variable)
N	Valid	210	210	210	210	210	210
	Missing	0	0	0	0	0	0
Mean		3.5944	4.0643	3.4314	3.5103	3.6159	3.5357
Median		3.6667	4	3.4	3.5	3.6667	3.5000
Mode		4	4	3.60[a]	4	4	3.50
Std. Deviation		0.69665	0.71177	0.70212	0.69614	0.72899	0.63912
Skewness		-0.599	-0.32	-0.443	-0.331	-0.451	-.139
Std. Error of Skewness		0.168	0.168	0.168	0.168	0.168	.168
Kurtosis		0.786	-0.551	0.549	0.718	0.325	.816
Std. Error of Kurtosis		0.334	0.334	0.334	0.334	0.334	.334
Range		3.67	3	3.6	3.5	3.67	3.67
Minimum		1.33	2	1.4	1.5	1.33	1.33
Maximum		5	5	5	5	5	5.00

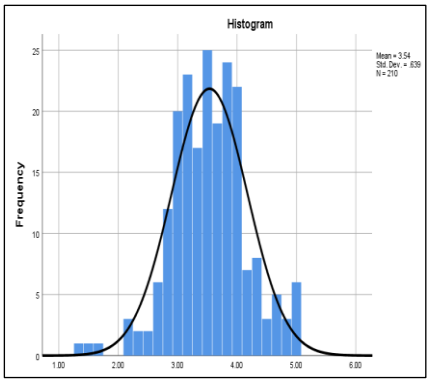
Source: Authors Calculations based on Survey data



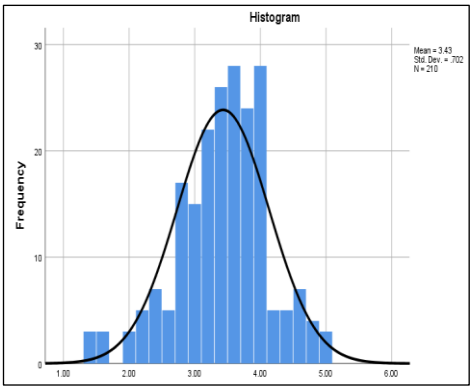
Infrastructure



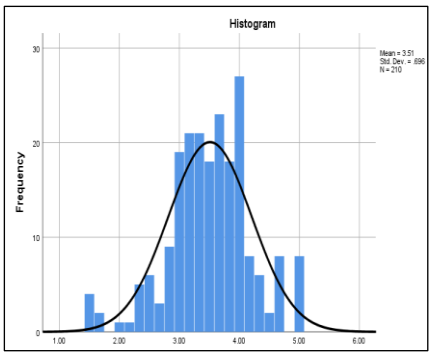
Work life Integration



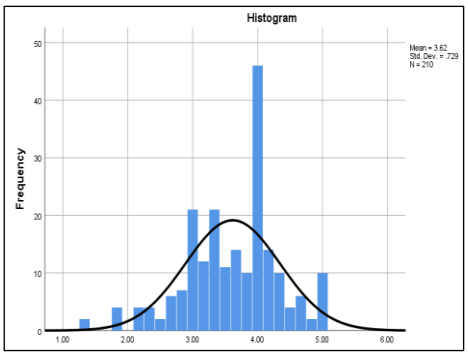
Organisational Support



Organisational Culture



Leadership



Employee Job satisfaction and wellbeing

Source: Authors Calculations based on survey data

Figure 2: Descriptive Statistics Graphs

Table 5 and Figure 2 charts show the descriptive statistics of infrastructure, Work-life Integration, Organizational Culture, Organizational Support, Leadership variables and Employee Job satisfaction and well-being variable. If these variables obtained scores between 1 to 2.49, 2.50 to 3.49 and 3.50 and above, then it indicates low, Moderate and high respectively. The mode value of Infrastructure, Work-life Integration, Organizational Culture and leadership variables are 4.00. This means a large proportion of the respondents accord positively with the statements of these variables. The Mode value of Organizational Support is 3.60. This means most of the respondents corresponded positively with the statements of the Organizational Support variable. The negative skewness of these variables indicates that most of the responses are below the agreed level 4. If the mean value is higher than the standard deviation, it shows participants' responses are close to the mean value. This means Mean, Median, and Mode values are close to each variable. According to the above table, the mean, mode and median of these variables" scores are between 3 to 4. Which means values are close to each variable. Most responses are in between the scale 3 and 4. This indicates respondents have a positive perception and significant

impact on these variables. Furthermore, the Dependent variable shows that the respondents have a marginal positive on the Employee job satisfaction and well-being variable. Thus it can be concluded that Sri Lankan Banking industry employees are positive about these variables in the aspect of Employee job satisfaction and well-being.

4.4. Hypothesis Testing and Correlation Analysis

Hypothesis testing measures the relationship between the independent variable and the dependent variable. The researcher has identified five hypotheses based on the conceptual framework of the research study. These hypotheses were developed by using a quantitative approach. Table 6 indicates the test results of the Hypotheses testing.

Table 6: Hypotheses Testing Results

Hypothesis	Pearson Correlation	Significance or Correlation	Significance Regression Coefficient	Conclusion
Hypothesis 1	0.626	0.000	0.574	$H1^1$: Accepted
Hypothesis 2	0.317	0.000	0.285	$H2^1$: Accepted
Hypothesis 3	0.649	0.000	0.591	$H3^1$: Accepted
Hypothesis 4	0.722	0.000	0.663	$H4^1$: Accepted
Hypothesis 5	0.670	0.000	0.588	$H5^1$: Accepted

Source: Authors Calculations based on SPSS Output

Correlation analysis is a statistical tool that measures the relationship between two or more variables that move along with the other variable. This analysis can illustrate the strength and direction of the linear relationship between two variables. If the correlation is significant, then the hypothesis will be accepted. Criteria for Correlation analysis is that, if the significance value for each variable is less than 0.05 then there is a significant relationship. According to Table 6, each variable has a significant relationship with the Dependent Variable with different levels of strength and relationships. According to the research findings output, The Pearson correlation between the dependent variable (Employee Job satisfaction and well-being) and independent variable (Infrastructure) is 0.626. This means that as Infrastructure increased by 1%, Employee Job satisfaction and well-being increased by 0.626%. This indicates that there is a positive strong relationship between infrastructure and Employee Job satisfaction and well-being.

The study found a moderate positive relationship with Work-life integration as the Pearson correlation between independent and dependent variable is 0.317. In addition, research revealed the Pearson correlation between the dependent variable (Employee job satisfaction and well-being) and independent variable (Organizational support) is 0.649. The research showed that the Pearson correlation between Organizational culture and Employee job satisfaction and well-being is 0.722, which indicates a strong positive relationship. Similarly, Pearson's correlation between leadership and Employee job satisfaction and well-being is 0.670, which indicates a positive relationship. Therefore, all the null hypotheses were rejected. All the

independent variables demonstrate that each independent variable has a positive relationship with the dependent variable (employee job satisfaction and well-being). According to the results, the null hypothesis of each variable was rejected.

4.5. Regression Analysis

Multiple Regression analysis is a statistical technique that is used to examine the cumulative strength of the Independent Variables on Dependent variables. This understands changes in the independent variable impact the Dependent variable. According to the general acceptance rule, the variable should have a significance value of less than 0.05 to correlate with the variables.

Table 7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.796[a]	.633	.624	.39174

Predictors: Constant, LS, WLI, OS, IN, OC

Source: SPSS Output

Table 7 Model summary table R square describes how variance in the dependent variables is explained by Independent Variables collectively. In general R square value should be more than 50%. This R square value indicates all five Independent Variables of Remote working collectively explained, Dependent Variable Employee Job satisfaction and well-being by 63%. Hence, the soundness of the regression model is at a significant level. According to acceptance values, this shows a moderate relationship between Employee Job satisfaction and well-being and the combined Independent Variables (Remote working).

Table 8: Multiple Regression Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	.332	.199		1.675	.096
WLI	.098	.042	.109	2.332	.021
IN	.095	.058	.103	1.635	.104
OS	.115	.062	.126	1.855	.065
OC	.325	.063	.355	5.171	.000
LS	.256	.051	.292	5.026	.000

Dependent Variable: JSW

Source: Authors Calculations based on SPSS Output

When compared individually, Work-life integration, Organisational culture and Leadership variables showed a significant impact with values less than 0.05 with the dependent variable. When all the Independent variables are expressed together, due to some influence made by the independent variable on another independent variable, the significance relationship can be changed. According to Table 8, some dependent variables are at a significant level beyond the threshold rule. Infrastructure and Organizational support variables produce 0.104 and 0.065 respectively. Therefore, these variables should be excluded. This is called the multi-collinearity effect. The

multiple regression was performed after excluding Infrastructure and Organizational support variables. This re-performed multiple regression results can be shown as follows.

Table 9: Model Summary Excluding the Infrastructure and Organizational Support Variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.786[a]	.618	.612	.39809

a. Predictors: Constant, LS, WLI, OC

Source: SPSS Output

Table 10: Multiple Regression Coefficient Excluding Infrastructure and Organizational Support

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	.361	.201		1.800	.073
WLI	.144	.040	.160	3.626	.000
OC	.431	.052	.470	8.280	.000
LS	.298	.049	.340	6.022	.000

Dependent Variable: JSW

Source: SPSS Output

Table 11. Excluded Variables

Model	Beta In	t	sig.	Partial Correlation	Collinearity Statistics Tolerance
IN	.139[b]	2.286	.023	.158	.494
OS	.160[b]	2.451	.015	.169	.427

a. Dependent Variable: JSW
b. Predictors in the Model: Constant, LS, WLI, OC

Source: SPSS Output

The revised multiple regression coefficient results show a significant value of less than 0.5 after excluding the Infrastructure and Organizational support variable. Although Infrastructure and Organizational support variables were excluded, when remotely working these two variables play important roles. Based on the re-performed Multiple Regression, the following model can be produced.

Employee Job satisfaction and well-being= 0.361+ 0.144 (Mean of Work life Integration) + 0.431 (Mean of Organizational Culture) +0.298 (Mean of Leadership)

The banking industry can facilitate the aforementioned model to preserve life satisfaction and psychological resilience to attain job satisfaction and the well-being of their employees by understanding the factors of work-life integration, organizational culture and leadership. This model can be used to understand the remote work effectiveness impact on employee job satisfaction and well-being.

4.6. Discussion

The current study aims to investigate the impact of remote working on employee job satisfaction and well-being within the banking industry of Sri Lanka after the pandemic situation. Based on the present analysis, the findings show that remote work has a significant positive impact on employee job satisfaction and well-being. In addition, R square of this research study is 63% whereas for Jordan banking industry, R square was 52.9% on employee satisfaction during the pandemic. Therefore, the research study shows significant relationship between independent and dependent variables. This indicates Infrastructure, Work life Integration, Organizational support, Organizational culture, and Leadership variables have a positive relationship with Employee job satisfaction and well-being. This supports the prior research on remote working factors. Purwanto et al. (2020) show that there is a negative impact on employee motivation when remotely working as some employees have to bear the costs related to remote working.

Analysis results show that Infrastructure has a significant relationship with employee job satisfaction and well-being. This supports the prior research on infrastructure. Bezzina et al., (2021) point out that ICT infrastructure is essential for people to adapt to remote working and new environmental situations effectively. Ford et al. (2017) stated that organizational policies, and procedures enhance the trust between remote working employees. Moreover, Castellanos-Redondo et al., (2020) mentioned employee happiness in the working environment and comfortability.

The research shows that Work-life integration has a significant relationship with employee job satisfaction and well-being. According to the previous research findings, Bedford (2019) indicated that work-life integration had voiced the requirement to integrate work and life to find the right balance for those who are working from home. However different research studies give different views. According to Mostafa (2021), there is a positive relationship between remote working and well-being but there is a negative relationship between remote working and emotional exhaustion. Grant et al. (2019) elaborate that Work-life balance has a great impact on remote working. However, some studies show some negative impacts such as, for some remote workers it is difficult to maintain the boundaries between their private life and work life. Arntz et al. (2019) found a positive impact on unmarried and childless male workers' life satisfaction. Besides work-life integration has a good relationship with office life and family life (Vyas and Butakhieo, 2021). According to Lodovici et al., (2021) working from home has a positive effect on work-life balance as employees can spend more time with their families and more than men, women positive with the work-life balance factor. On the other hand, this current research study illustrates that 58.6% of respondents are male and 41.4% are female. There is a fair share of male and female employees who work remotely. Moreover, the current study research findings are based on the Marital status of the respondents, 41.9% of the respondents are married and have children while 25.7 % and 32.4% of respondents are married and single respectively. Therefore, Marital status is an important factor in getting results because the respondent's perception of remote working can change based on different Marital status.

Based on the findings of this research study Organizational support has a positive relationship with employee job satisfaction and well-being. This finding is in accordance with the previous research studies as follows. Perceived organizational support has a positive impact on well-being (Mihalache, 2021). Rasool et al, (2021) point out that organizational support for the employees is the organization's concern for the employee's well-being.

The current analysis shows a positive relationship between Organizational culture and employee job satisfaction and well-being. Similarly, Ficarra et al., (2020) stated that a positive organizational culture increases the happiness of employees. Harrington and Santiago (2006) pointed out that organisational culture has a favourable impact on remote working. Which depicts that organizational culture has a positive impact on job satisfaction and the well-being of the employees.

The current study findings show that leadership has a positive relationship with employee job satisfaction and well-being. According to the previous research findings, Johnson, Robertson and Cooper (2018) implied that leadership style has a positive impact on psychological well-being. Additionally, Gajendran and Harrison (2007) stated that there is a positive impact on employee and supervisor relationships when remotely working. Therefore, it is observed that based on the research findings infrastructure, Work-life integration, Organizational support, and organizational culture have a positive relationship with employee job satisfaction and well-being after the pandemic era.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Remote working in the Banking sector increased significantly as a result of the COVID-19 pandemic. The purpose of this research study is to explore the Remote work effectiveness impact on employee Job satisfaction and well-being in the banking industry in Sri Lanka. Infrastructure, Work-life integration, Organizational Support, Organizational Culture, and Leadership are identified as the independent variables while Employee Job satisfaction and well-being are identified as the dependent variable. After testing and analysing the data collected from 210 respondents by using SPSS Statistical software. This quantitative research used the Purposive sampling technique as the data collection method. According to the result of the analysis, all the independent variables have a positive and significant relationship with the dependent variable. Therefore, the research study found that, in the multiple regression analysis, the R-square value of 63% depicts the five independent variables related to remote working collectively indicating 63% of the variation in employee job satisfaction and well-being. Hence, the study discovered a moderate relationship between employee Job satisfaction and well-being and the combined independent variables.

This research was carried out to investigate remote work effectiveness impact on employee well-being in the Banking sector in Sri Lanka. Furthermore, this study evaluates remote working impact by using five independent variables. Future studies can extend this research and analysis by including other factors impacting employee

Job satisfaction and well-being when remotely working. Further studies can extend the geographical areas to get good results. Therefore, future research can use other research designs and future studies can increase the sample size as it was limited to 210 respondents from the Colombo district.

5.2. Recommendations

Based on the research implications, the below recommendations are made to improve the productivity of remote working for both organizations and employees. Employers should provide relevant infrastructures such as laptops, dongles, VPN clients, Tablets, smartphones and software that are in good condition. Employers need to create a new code of conduct, processes and structures relating to how employees conduct their work when remotely working according to the normal working hours. They should give clear guidelines to employees about the work that they are expected to deliver. Setting up protocols to run virtual meetings. Employers should introduce a system to motivate employees who excel in performance with financial rewards. Employers should introduce a system to motivate employees who excel in performance with financial rewards. Invest in remote management tools such as EmpMonitor to evaluate performance and cyber security infrastructure. Employees should design a separate home office space. Employees should take their regular breaks. Employees should take a break from the laptop at a specific time. Employees should incorporate exercise breaks into their daily routine. After finishing office work for the day, employers should refrain from contacting employees on official matters unless it is paramount. Letting employees have their normal sleep in the pandemic situation would enhance their psychological well-being.

Organizations should cover the expenses of remote working. Organizations should acknowledge the concerns of employees and all the uncertainties. Organizations should use data analytics to operate accurate strategies to measure the well-being of the employees. Companies can do this by using Pulse Survey data by doing this in every week to understand teams, departments and organization situations. This will showcase different areas where the employees need support when remotely working during the pandemic. Organizations should plan on doing work-life programs and mindfulness techniques to maintain their psychological and mental balance.

Employers should be honest and transparent in their interactions with their employees and discuss challenges openly. Employers should show their faith, trust and confidence in their employees and reinforce the culture of remote working by giving flexibility to employees to work remotely. Organizations should add their values to their websites. Organizations should start a Slack channel to use during meetings. Should implement an agile culture that quickly adapts to maintain and deliver the needs of employees and customers. Leaders should be empathetic to give emotional support to their employees and respect the effort extended. Leaders should set realistic objectives, adjust the workload of the employees and they should make work schedules that have start times and end times. Leaders should create balance by sustaining normal operations and providing sufficient support to team members by guiding and advising them while communicating regularly. Leaders can set virtual coffee breaks to create a collaborative environment. Leaders should encourage their

employees to sharpen their skills by using new learning opportunities and training. Leaders should use tools like Basecamp, Linkedin, and Microsoft Teams to outline tasks and deadlines.

5.3. Limitations of the study

Even though the study produced significant results, the research study shows some limitations. Since this research study is limited to the employees in the Banking sector in the Colombo district of Sri Lanka. It is difficult to be certain that other industries will get the same results as this research. Moreover, there is a dearth of research studies relating to the remote work impact on employee well-being during the pandemic in the local context as it is a new situation faced by the people. The sample size of the study was 210 respondents and the sample of the study was limited only to the Colombo district. Which covered only a small proportion of the population. In addition, the study did not cover all the factors that affect remote-working employees. These can be addressed in the future research.

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FACTORS INFLUENCING BEHAVIORAL INTENTION TO ADOPT MOBILE BANKING: WITH SPECIAL REFERENCE TO GAMPAHA DISTRICT, SRI LANKA

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Abstract

Mobile phones have created a platform to expand commercial transactions and it has created a wide array of business opportunities. With the emerge of mobile commerce, the concept of mobile banking has emerged. Mobile banking offers ubiquitous and hassle-free access for banking customers. Nevertheless, it has been observed that Sri Lankan banking customers are sometimes cautious to conduct their financial activities through mobile devices. Therefore, this research study has been carried out with the objective of identifying the factors influencing behavioral intention to adopt mobile banking with special reference to Gampaha district, Sri Lanka. The dependent variable of this research study is the behavioral intention towards mobile banking adoption and the dimensions of the independent variable includes perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility. 310 mobile banking users in the Gampaha district has been utilized as the sample for this study and data collection has been performed through an online questionnaire. Both quantitative method and deductive approaches were utilized to identify the determinants that influence on behavioral intention. Regression analysis has been conducted to analyze data and the results indicate that perceived usefulness, perceived ease of use, relative advantage and compatibility depicts a positive and significant impact on behavioral intention towards mobile banking adoption of customers. On the contrary, perceived risk depicts a negative and significant impact on behavioral intention. Therefore, banks should align their product offerings to the needs of their customers in the process of developing mobile banking products. It will be much more convenient to provide banking customers with a service in order to deliver a superior value and retain them in the long run.

Keywords: Behavioral Intention, Compatibility, Mobile Banking, Perceived Risk, Relative Advantage

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1. INTRODUCTION

1.1. Background of the Study

The progress in devices and technology has made it easier for banking customers to access services at any time and, from anywhere. Numerous banks globally have launched apps that enable users to conveniently access financial information and carry out transactions directly from their smartphones. Mobile banking has been a concept which intends to offer rapid and interactive banking services (Gu et al., 2009). Mobile banking can be defined as a channel whereby a consumer communicates with a bank via a mobile device (Barnes & Corbitt, 2003). Using a mobile portable device and a mobile service, mobile banking is an application of mobile computing that gives users the assistance they need to conduct financial transactions anywhere and at any time (Kahandawa & Wijayanayake, 2014).

With the advent of mobile banking, banks have improved their efficiency by reducing operational expenses and time, while also offering consumers a great deal of convenience by enabling them to execute financial transactions at any time and location (Alalwan et al., 2016). The growing popularity of mobile banking suggests that the banking sector has a great deal of potential. By integrating a new technology (mobile banking) with their old systems, banks may keep their current customer base while still having the chance to attract new customers. But nevertheless, it may be difficult to keep current mobile banking customers and win over new ones (Devaraj et al., 2002).

Throughout the past decades, there has been a rapid development in the field of mobile banking services. The research community has recently focused on customer penetration in mobile banking (Rogers, 2003). The widely recognized TAM has focused on a number of factors to explain how technology is being adopted by corporate organizations. TAM provides the theoretical framework for comprehending online customer behavior about the adoption of cutting-edge technologies. TAM was created for forecasting the adoption and use of new information technologies and systems by taking into account the variables that influence an organization's information systems' success and their adaptation to work (Davis, 1989). TAM highlights that a user's decision to utilize a system depends on his or her behavioral intention, which is determined by two factors: perceived usefulness and perceived ease of use (Priya et al., 2018).

An invention that offers clients more value when compared to its predecessors is also known as relative advantage. According to Karayanni (2003), if a customer perceives that buying online will benefit more than shopping in a physical store, the customer always prefers this online method of purchasing and it will fuel the concept of mobile banking. In the study of innovation dissemination and adoption, perceived risk was initially presented as an external variable, and it is claimed that the rate of adoption is inversely correlated with the magnitude of perceived risk (Frambach & Schillewaert, 1999). According to the Innovation Diffusion Theory, the major sources for developing a theoretical framework to determine the impact of such technological

platforms on commercial applications are compatible with user lifestyle and current needs (Rogers, 2003).

1.2. Research Problem

Establishing strong relationships with consumers through the provision of innovative services that are high-quality and secure helps commercial banks to maintain their competitive position in the domestic market (Kahandawa & Wijayanayake, 2014). According to Ayoobkhan (2018), banks must reinvest in and expand their information technology projects in order to win over the trust and satisfaction that customers want from mobile banking services. Commercial banks in Sri Lanka have launched a number of solutions to promote mobile banking. The key benefit of this service is that customers can conduct transactions and carry out banking tasks whenever and wherever they want. While there are 27.38 million smartphone users in Sri Lanka, only 20% of banking customers use mobile banking services (Kahandawa & Wijayanayake, 2014).

This indicates that Sri Lankan consumers do not still rely heavily on the technology of mobile banking. The effectiveness of mobile banking is demonstrated by the use of several mobile banking channels to determine what mobile technologies will be required to make mobile banking the preferred option for all banking activities.

Furthermore, in practice, convincing banking customers to change their behavior from utilizing traditional banking channels to mobile banking is not a simple task, especially given that this issue is not well understood from the customers' perspective (Dwivedi & Irani, 2009). Therefore, knowing the potential causes of the slow acceptance of mobile banking could aid banks in accelerating the use of such technology. The Sri Lankan context has yet to undergo an empirical examination of mobile banking related concerns due to the fact that this concept is still in its early stages (Kahandawa & Wijayanayake, 2014).

The researcher has selected Gampaha district for the current study due to the customers who are in the Gampaha district are more knowledgeable than the other customers regarding mobile banking activities (Hettiarachchi, 2014). Therefore, this study is intended to fill the gap of less dependency on mobile banking services by experimentally identifying the what are the factors which is influencing behavioral intention to adopt mobile banking from the perspective of Sri Lankan commercial banking customers with special reference to Gampaha district.

1.3. Objectives of The Study

The general objective of this study is to identify the factors influencing behavioral intention to adopt mobile banking with special reference to Gampaha district, Sri Lanka. Specific objectives are as follows,

I. To identify the impact of perceived usefulness on behavioral intention towards mobile banking adoption.

II. To analyze the impact of perceived ease of use on behavioral intention towards mobile banking adoption.

III. To investigate the impact of relative advantage on behavioral intention towards mobile banking adoption.

IV. To determine the impact of perceived risk on behavioral intention towards mobile banking adoption.

V. To demonstrate the impact of compatibility on behavioral intention towards mobile banking adoption.

2. LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. Technology Acceptance Model

There are many models out there that have been utilized to look into technology adoption. TAM, which Davies first developed in 1986, is at the foundation of a number of research examining mobile service acceptance (Lules et al., 2012). The model was initially created to forecast user adoption of information technology and utilization in an organizational setting and the TAM, which focuses on the attitude justifications of intention to use a certain technology or service, is now a frequently used paradigm for user acceptance and usage. Several meta-analyses on the TAM have shown that it is a reliable, strong, and effective model for forecasting user acceptance (Bertrand & Bouchard, 2008). According to TAM, people's acceptance and use of a technology are influenced by two basic ideas: perceived usefulness and ease of use (Davis, 1989).

2.1.2. Innovation Diffusion Theory

According to the IDT, adopting an innovation by customers is a complicated process. This theory discusses the significance of comprehending the limitations and advantages of mobile services, as well as the functional distinctions amongst mobile service bundles which helps to effectively and successfully employ these bundles in the present and the future (Bouwman et al., 2007). The IDT, which is proposed by Rogers in 1962, explains how an innovation spreads across users over time and according to the theory, people can be categorized into five categories based on how innovative they are (Liu & Li, 2010). The adoption or rejection of an idea is better understood with the aid of the innovation diffusion theory (MacVaugh & Schiavone, 2010).

2.1.3. Mobile Banking

Mobile banking is the usage and delivery of banking and financial services via portable telecommunications devices, such as smartphones or tablets (Goyal, 2012). Customers can access their banking services through mobile banking on their mobile devices as an additional channel. Banks have offered a new delivery channel to current bank customers and most mobile banking offerings have become much more addictive once customers start experiencing the service. Populations who do not have

bank accounts are integrated into the financial system using transformative models (Mostafa, 2010). Financial institutions have been able to replace where possible a portion of the traditional in-person banking transactions with automated services thanks to the facilities supplied by mobile banking services. When electronic banking systems start offering effective automated banking services through wireless networks, mobile banking will totally revolutionize how customers do financial transactions (Lee & Chung, 2009).

2.1.4. Behavioral Intention

The time and physical circumstances that allow for a given behavior to be carried out are referred to as facilitating conditions. It directly affects how conveniently users see online stores, as well as how consumers intend to behave while using banking services and retail electronics (Venkatesh et al., 2003). Due to the internet's and e-commerce's explosive expansion in the 2000s, TAM studies are now concentrating on another crucial behavioral intention construct. TAM has been expanded to include determinants of the major components, as well as additional key construct of behavioral intention across a wide spectrum of IT, in order to more thoroughly explain users' acceptance (Gu et al., 2009).

2.2. Empirical Review

2.2.1. Impact of Perceived Usefulness on Behavioral Intention

In response to a question about the utility of mobile banking, the respondents' responses are clear evidence that most of them believed that using a mobile device to conduct banking activities helps them complete their chores more quickly, in general, and makes doing so easier (Ravichandran & Madana, 2016). The usefulness of mobile banking in enhancing effectiveness or efficiency will favorably affect perception of that application (Aboelmaged & Gebba, 2013). Customers are more likely to use mobile banking services if they find them beneficial (especially now that electronic banking is readily available) (Karjaluoto et al., 2010). Perceived usefulness is a significant driver of customer satisfaction (Marinkovic & Kalinic, 2017).

2.2.2. Impact of Perceived Ease of Use on Behavioral Intention

When users see that there are circumstances for learning how to use mobile banking service, even though they cannot use it skillfully, they will believe it to be simple to (Gu et al., 2009). Consumers are more likely to use mobile banking services if there are user-friendly mobile banking applications and fundamental application abilities (Kazi & Mannan, 2013). The increased complexity of using a tiny device to perform financial transactions is thought to influence ease of use, and if a mobile device is easier to use for banking transactions, the higher the intention to adopt or use it (Karjaluoto et al., 2010).

2.2.3. Impact of Relative Advantage on Behavioral Intention

Consumer adoption of mobile banking services was significantly influenced by relative advantage (Yunus, 2014). The researcher discovered that the antecedents of attitude toward mobile banking differ between potential and recurrent consumers, and

that relative advantage has a positive effect on behavioral intention to use mobile banking (Lin, 2011). The relative benefit of using mobile banking services increases, increasing the likelihood that mobile banking will be used (Hettiarachchi, 2014). Customer satisfaction with mobile banking services is positively impacted by relative advantage, and banks are under pressure to compete on both the quality of their services and their administrative effectiveness (Yu & Fang, 2009).

2.2.4. Impact of Perceived Risk on Behavioral Intention

When there was a feeling of unease about their safety, people were hesitant to adopt mobile banking, and as the level of unease rose, people were more risk-aware. A dynamic component in forecasting a person's attitude and intention to utilize mobile banking is known as perceived risk (Deventer et al., 2017). Consumer attitudes and intentions toward mobile banking would decline as the perceived level of risk rose (Rehman & Shaikh, 2020). Perceived risk is the degree of uncertainty surrounding the security of the innovation or the outcome of its application (Gerrard & Cunningham, 2003). Particularly, the views of customers toward mobile banking were adversely correlated with perceived risk (Roy et al., 2017).

2.2.5. Impact of Compatibility on Behavioral Intention

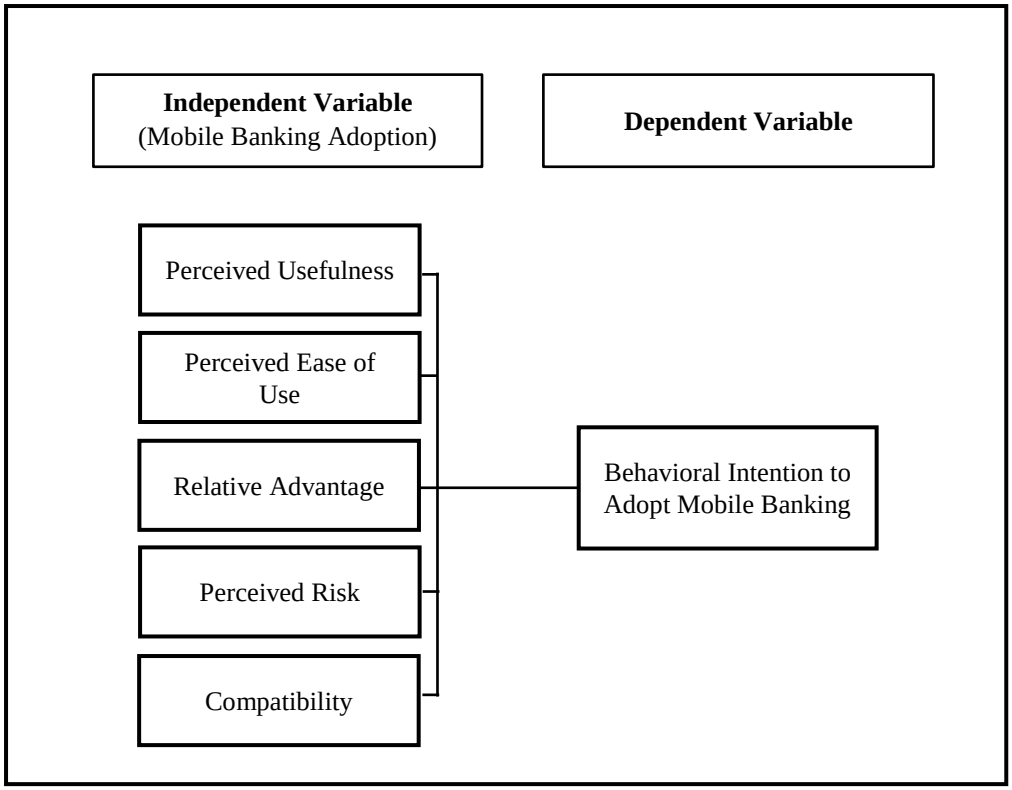
The adoption of and attitude toward mobile banking services among consumers are significantly influenced by compatibility. The most important factors that explained the uptake of mobile banking were found to be adoption with lifestyle (Kumari, 2015). The most important factor influencing intents to use mobile banking services in both developed and developing nations is compatibility (with lifestyle and device) (Shaikh & Karjaluoto, 2015). Despite widespread acceptance of its utility, contemporary banking is incompatible with Pakistan's rural population's way of life due to cultural influences (Mazhar et al., 2014).

3. RESEARCH METHODOLOGY

To explore the factors influencing behavioral intention to adopt mobile banking, the quantitative method and deductive approaches were utilized. For this research study, primary data was obtained from respondents through a questionnaire, and the gathered data were analyzed using the SPSS.

The dependent variable, behavioral intention towards mobile banking adoption has been identified in previous literature and the dimensions of the independent variable include perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility. The Summary of the variable links can be established and it depicts the support of the variables for the study.

The following conceptual framework can be developed based on the identified independent and dependent variables.



Source: Researcher Constructed (2024)

Figure 01: Conceptual Framework

The following hypotheses can be constructed for testing purposes based on the conceptual framework.

H1: Perceived usefulness could have a positive and significant impact on behavioral intention towards mobile banking adoption.

H2: Perceived ease of use will have a positive and significant impact on behavioral intention towards mobile banking adoption.

H3: Relative advantage would have a positive and significant impact on behavioral intention towards mobile banking adoption.

H4: Perceived risk could have a negative and significant impact on behavioral intention towards mobile banking adoption.

H5: Compatibility will have a positive and significant impact on behavioral intention towards mobile banking adoption.

The indicators of the dimensions of the independent variable and dependent variable can be operationalized as follows,

Table 01: Operationalization Table

Variables	Dimensions	Indicators	Source	Question No.
Independent Variable (Mobile Banking Adoption)	Perceived Usefulness	Useful	Davis (1989)	01
		Beneficial	Davis (1989)	02, 03, 04
		Practical	Davis (1989)	05
	Perceived Ease of use	Ease of operation	Davis (1989)	06, 07, 08
		Easy to skilled	Davis (1989)	09
		Ease of remembering operation	Davis (1989)	10
	Relative Advantage	Effectiveness	Kahandawa & Wijayanayake (2014)	11, 12
		Increased Productivity	Kahandawa & Wijayanayake (2014)	13, 14
		Task Completion	Kahandawa & Wijayanayake (2014)	15
	Perceived Risk	Safety	Hettiarachchi (2014)	16, 17
		Privacy	Hettiarachchi (2014)	18, 19, 20
	Compatibility	Fitness	Davis (1989)	21, 22, 23
		Personal Satisfaction	Davis (1989)	24, 25
Dependent Variable (Behavioral Intention towards Mobile Banking Adoption)	Quantitative and Qualitative Dimensions	Reliability	Hettiarachchi (2014)	26, 27
		Accessibility	Kahandawa & Wijayanayake (2014)	28

Source: Researcher Constructed (2024)

The target population consists of banking customers who use the mobile banking of four of the top commercial banks in the Gampaha district. In order to represent both the public and private sectors, the study has focused on four commercial banks including two state banks and two private banks. Since these banks have initially introduced mobile banking services, researcher has selected these four banks to represent the target population (Kahandawa & Wijayanayake, 2014). Furthermore, the customers who are in the Gampaha district are more knowledgeable than the other customers regarding mobile banking activities (Hettiarachchi, 2014). Based on the Krejcie and Morgan table, the sample for this research study consists of 310 respondents from the total population of 1600 mobile banking customers. The banking customers of four commercial banks were chosen using the convenience sampling method.

Purposive sampling is adopted utilized to collect information from respondents with superior knowledge and expertise of mobile banking services, which is appropriate for achieving the research objective. An online questionnaire was used to gather

primary data on determinants of behavioral intention towards mobile banking adoption and this strategy allowed researcher to obtain first – hand information from the respondents. Twenty-eight (28) questions altogether, constructed based on independent and dependent variables, made up the questionnaire for this study and there were seven sections to the online questionnaire using five – point Likert scale method. After the collection of data, the study was focused towards conducting an analysis of the data that was in line with the study's predetermined purpose. The secondary data was gathered from the results of earlier studies that were looked into in reference to this research study.

4. RESULTS

Reliability analysis, frequency analysis, descriptive statistics, correlation analysis, and regression analysis were performed for the data which has been gathered. Normality test measures the distribution of the data set and this has normally distributed with zero mean value and one standard deviation and with a symmetric bell-shaped curve.

4.1. Reliability Analysis

Reliability testing evaluates the questionnaire's validity and makes the assumption that the questionnaire is reliable if the Cronbach's Alpha value is greater than 0.7. According to the analysis of this research study, Cronbach's Alpha value of perceived usefulness, perceived ease of use, relative advantage, perceived risk, compatibility and behavioral intention towards mobile banking remained as 0.757, 0.839, 0.760, 0.935, 0.895 and 0.787 respectively. It demonstrates that, the questionnaire that has employed by the researcher was a reliable one. As a matter of fact, according to the reliability analysis, Cronbach's Alpha values for all dimensions of independent variable and the dependent variable were higher than 0.7.

4.2. Examining the Respondents' Profile

Out of 310 respondents, 60% were men and 40% were women, as per the data analysis. As a result, men made up the majority of the respondents and this indicates that male respondents are more inclined than female respondents to use mobile banking services.

The respondents, comprising 71.5%, were employed, while 11.2% were students and 17.3% were business owners. The largest age group among respondents was those aged 21 to 30 years, accounting for 54.8% of the total. Smaller proportions were represented by individuals under 20 years (2.2%), those between 31 and 40 years (22.3%), those between 41 and 50 years (19.7%), and those above 50 years (1%). These findings suggest a preference among younger demographics for utilizing mobile banking services compared to older age groups.

3.1% of respondents hold a postgraduate degree, while 25.5% have a bachelor's degree, 19.6% possess a professional qualification, 13.8% have a diploma, 34.1% hold an Advanced Level (A/L) pass, and 3.9% have an Ordinary Level (O/L) pass. As a matter of fact, the majority of respondents hold an Advanced Level qualification,

with fewer holding post-graduate qualifications. Notably, 55.5% of mobile banking users have engaged with the bank for 1 to 5 years. Only about 1.5% of customers have never interacted with the bank, approximately 11.3% have been customers for more than 5 years, and about 31.7% have interacted with the bank for less than a year. Regarding frequency, 4.5% use mobile banking daily, 6.1% twice weekly, 21.2% once weekly, 66.5% once a month, and 1.7% not at all. It is worth mentioning that the majority of users utilize mobile banking services once a month.

4.3. Descriptive Analysis

As depicted in Table 03, the mean value of perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility were 4.115, 4.103, 3.725, 3.430 and 4.164 respectively. Perceived risk has the highest standard deviation and that variable was highly dispersing from the mean value. Perceived usefulness has the lowest standard deviation value and it implies that perceived usefulness of the data set has been dispersed close to the mean value.

Table 02: Descriptive Analysis

Variable	Mean	Standard Deviation
Perceived Usefulness	4.115	0.597
Perceived Ease of Use	4.103	0.652
Relative Advantage	3.725	0.674
Perceived Risk	3.430	0.907
Compatibility	4.164	0.702

Source: SPSS Data (2024)

4.4. Correlation Analysis

Pearson Correlation can be used to determine the type and degree of the relationship between the dependent variable and the independent variables. Pearson Correlation values of perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility were 0.733, 0.720, 0.552, 0.153 and 0.796 respectively. That indicates that all independent variables have a positive correlation with behavioral intention towards mobile banking adoption at 0.01 significance level.

Table 03: Correlation Analysis

Variable	Pearson Correlation	Significance Value (p Value)
Perceived Usefulness	0.733	0.000
Perceived Ease of Use	0.720	0.000
Relative Advantage	0.552	0.000
Perceived Risk	0.153	0.006
Compatibility	0.796	0.000

Source: SPSS Data (2024)

Correlation analysis revealed that all independent variables had significance values of 0.000, while the perceived risk had a significance value of 0.006. Because all p values were lower than 0.01 (At 0.01 significance level), it suggests that all

independent variables (perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility) were statistically significant variables.

4.5. Regression Analysis

Based on the analysis findings, the R value for this research was determined to be 0.845, while the R Square value stood at 0.724. This indicates that 72.4% of the variance in behavioral intention towards mobile banking adoption is accounted for by the independent variables, including perceived usefulness, perceived ease of use, relative advantage, perceived risk, and compatibility. The remaining 27.6% of variance is attributed to factors beyond the scope of this study. Additionally, the adjusted R square value was calculated to be 0.709. The Durbin-Watson value in this study was 1.889 and it implies that there is no first order linear auto correlation between variables as it was in between 1.5<d<2.

Table 04: Regression Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.845[a]	0.724	0.709	0.36432	1.889

a. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use, Relative Advantage, Perceived Risk, Compatibility
b. Dependent Variable: Behavioral Intention towards Mobile Banking Adoption

Source: SPSS Data (2024)

Table 05: ANOVA

Model	Measurement	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	99.961	5	19.992	150.531	.000[b]
	Residual	40.375	304	.133		
	Total	140.335	309			

a. Predictors: (Constant), Perceived Usefulness, Perceived Ease of Use, Relative Advantage, Perceived Risk, Compatibility
b. Dependent Variable: Behavioral Intention towards Mobile Banking Adoption

Source: SPSS Data (2024)

According to Table 05, the significance value is lower than 0.05 and therefore, researcher conclude that, at the 5% of significance level, the overall model is statistically significant. It means the model is fit of the regression model.

Table 06: Coefficients

Model	Coefficient	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	Constant	0.317	0.161		1.955	0.050
	Perceived Usefulness	0.285	0.055	0.252	5.110	0.000
	Perceived Ease of Use	0.136	0.052	0.129	2.480	0.013
	Relative Advantage	0.135	0.042	0.135	3.347	0.001
	Perceived Risk	-0.036	0.014	-0.041	-1.836	0.048
	Compatibility	0.446	0.050	0.460	9.105	0.000

Source: SPSS Data (2024)

The following model can be derived for the behavioral intention towards mobile banking adoption as revealed in Table 06.

$$BIMBA = 0.317 + 0.285(\text{PU}) + 0.136(\text{PEU}) + 0.135(\text{RA}) - 0.036(\text{PR}) + 0.446(\text{C}) + \mu$$

According to the regression analysis results, perceived usefulness exhibited a positive relationship with behavioral intention towards mobile banking adoption, with a coefficient of 0.285. Similarly, perceived ease of use also showed a positive relationship with behavioral intention, with a coefficient value of 0.136. The coefficient for relative advantage was 0.135, indicating a positive correlation with behavioral intention towards mobile banking adoption. Conversely, perceived risk demonstrated a negative relationship with behavioral intention, with a coefficient value of -0.036. On the other hand, compatibility had a coefficient value of 0.446, suggesting a positive relationship with behavioral intention towards mobile banking adoption.

The significance values of perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility were 0.000, 0.013, 0.001, 0.048 and 0.000 respectively. According to the results of regression analysis, all the dimensions of independent variable such as perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility can be considered as statistically significant variables which affected the behavioral intention towards mobile banking adoption since the p values of all dimensions were less than 5% significance level.

4.6. Testing of the Hypotheses

Table 07: Testing of the Hypotheses

Variable	Hypothesis	p Value	Impact	Accept / Reject
Perceived Usefulness	Perceived usefulness could have a positive and significant impact on behavioral intention towards mobile banking adoption.	0.000	Positive and Significant	Accept
Perceived Ease of Use	Perceived ease of use will have a positive and significant impact on behavioral intention towards mobile banking adoption.	0.013	Positive and Significant	Accept
Relative Advantage	Relative advantage would have a positive and significant impact on behavioral intention towards mobile banking adoption.	0.001	Positive and Significant	Accept
Perceived Risk	Perceived risk could have a negative and significant impact on behavioral intention towards mobile banking adoption.	0.048	Negative and Significant	Accept
Compatibility	Compatibility will have a positive and significant impact on behavioral intention towards mobile banking adoption.	0.000	Positive and Significant	Accept

Source: SPSS data (2020)

5. DISCUSSION

Based on the results of the reliability study, the questionnaire used for the study was deemed reliable, as evidenced by Cronbach's Alpha values exceeding 0.7 for both the dependent variable and dimensions of the independent variable. Upon examining various factors, it was observed that the majority of respondents were male, suggesting a higher propensity among males for mobile banking adoption compared to females. Additionally, most respondents were single and employed. Furthermore, a significant proportion fell within the 21-30 age bracket, indicating a preference for mobile banking adoption among younger demographics. Moreover, respondents with A/L qualifications constituted the majority, whereas those with postgraduate degrees were in the minority. It is noteworthy that the majority of mobile banking users have been using the service for between one and five years, with most users utilizing mobile banking services only once a month.

According to the results of the descriptive analysis, compatibility exhibited the highest mean value at 4.1638, while perceived risk had the lowest mean value at 3.4296. This indicates that perceived risk displayed the highest dispersion from the mean value, as evidenced by its highest standard deviation. Conversely, perceived usefulness had a dataset that was dispersed closely around the mean value, as indicated by the lowest standard deviation.

According to the results of the correlation analysis, perceived usefulness, perceived ease of use and compatibility have a high positive correlation with the behavioral intention towards mobile banking adoption. Further, relative advantage shows a moderate positive correlation and perceived risk shows a weak positive correlation on behavioral intention towards mobile banking adoption. Moreover, perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility were statistically significant variables at 0.01 significance level since the p values of all independent variables were less than 0.01.

In accordance with the regression analysis, the R square value was 72.4% and it indicates that, the changes in behavioral intention towards mobile banking adoption can be explained by the dimensions of the independent variable such as perceived usefulness, perceived ease of use, relative advantage, perceived risk and compatibility. The rest of 27.6% of behavioral intention towards mobile banking adoption depends on other variables which has not been covered by the current research study.

Perceived usefulness depicts a positive and significant impact on behavioral intention towards mobile banking adoption due to using a mobile phone would help you avoid the restrictions when performing banking activities and mobile banking makes it simple to find the information and perform transactions. This has been validated by the researchers Ravichandran & Madana, 2016; Marinkovic & Kalinic, 2017 and others. Perceived ease of use also has a positive and significant impact on the behavioral intention towards mobile banking adoption and this as proved by the studies of Kazi & Mannan, 2013; Gu et al., 2009. Since the time and space restrictions that would ordinarily apply to physically conducting banking transactions using a

mobile device would be removed, relative advantage also has a positive and significant impact on behavioral intention towards mobile banking adoption and this has proved by the researchers of Hettiarachchi, 2014; Yunus, 2014 and so on. Perceived risk shows a negative and significant impact on behavioral intention towards mobile banking adoption with the reason of banking via a mobile device is dangerous because it is simple to lose or misplace the device. This can be verified using the studies carried out by Deventer et al., 2017; Rehman & Shaikh, 2020. Since utilizing mobile banking services has a significant impact on one's quality of life, interpersonal relationships, and other personal gains, compatibility also explicit a positive and significant impact on behavioral intention towards mobile banking adoption. This can be confirmed by the scholarly work performed by Kumari, 2015; Shaikh & Karjaluoto, 2015.

6. CONCLUSION

With the emergence of mobile banking, banks have enhanced their efficiency by reducing operating costs and time, while offering consumers unprecedented convenience to conduct banking transactions anytime, anywhere. Despite significant advancements in mobile banking services, recent research has focused on customer adoption. However, the effectiveness of mobile banking remains a topic of debate, particularly in Sri Lanka, where banking customers are still hesitant to use mobile phones for banking activities. Therefore, this research aims to identify the factors influencing behavioral intention towards mobile banking adoption, specifically in the Gampaha district of Sri Lanka. The dependent variable in this study is behavioral intention towards mobile banking adoption, with independent variables including perceived usefulness, perceived ease of use, relative advantage, perceived risk, and compatibility. Data were collected via an online questionnaire, with a sample comprising 310 mobile banking customers within the Gampaha district.

Reliability testing, frequency analysis, descriptive statistics, correlation analysis, and regression analysis were conducted as part of this research study. The results of the reliability analysis indicated that the questionnaire used to collect data was reliable. Descriptive statistics revealed that compatibility had the highest mean value, while perceived risk had the lowest mean value. Correlation analysis showed that all independent variables were positively correlated with the dependent variable and were statistically significant predictors of behavioral intention towards mobile banking adoption at a 1% significance level. Regression analysis served as the primary data analysis technique, revealing that perceived usefulness, perceived ease of use, relative advantage, and compatibility positively impacted behavioral intention towards mobile banking adoption, while perceived risk had a negative impact. Furthermore, all dimensions of the independent variable were statistically significant predictors of behavioral intention towards mobile banking adoption at a 5% significance level.

Hence, it can be inferred that commercial banking customers have embraced mobile banking for several reasons, overcoming initial reluctance towards utilizing such services. Some of these reasons include the ability of mobile banking to overcome constraints associated with traditional banking activities, such as limitations in time

and space. Additionally, mobile banking simplifies the process of accessing necessary information and learning how to conduct banking operations using a mobile phone, thereby enhancing convenience. Moreover, the use of mobile banking services can significantly improve the quality of life for individuals.

The study suggests that banks should tailor their mobile banking products and services to align with the preferences and needs of their customers, taking into account all dimensions of the independent variable. By doing so, banks can ensure that their services are successful and meet customer satisfaction. Given that all dimensions of the independent variable significantly influence behavioral intention towards mobile banking adoption, this approach is likely to yield positive outcomes. Additionally, since perceived risk has a negative impact on behavioral intention, banks can take proactive measures to mitigate risks. For instance, banks can monitor mobile banking transactions regularly, implement new and robust security policies to safeguard customers' interests, and prevent instances of fraud or injustice associated with mobile banking services. Such actions can help reduce the perceived risk level and enhance trust and confidence among customers.

This study focused solely on customers residing in urban regions, thereby limiting its generalizability. Future research could address this limitation by including a more balanced representation of both rural and urban populations. Additionally, the study exclusively targeted consumers of domestic, licensed commercial banks, suggesting an opportunity for future researchers to explore behavioral intentions towards mobile banking adoption among customers of commercial banks, including both domestic and foreign institutions. Furthermore, the study utilized only five dimensions of independent variables, such as perceived usefulness, perceived ease of use, relative advantage, perceived risk, and compatibility. To address this limitation and provide avenues for future research, additional variables such as perceived cost of use, need for interaction, and trust could be considered. These suggestions highlight the limitations of the current study and offer valuable insights for future research endeavors in this field.

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