

Review the Behavior of Cashless Transactions Regarding Economy of Sri Lanka (2010-2020)

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Abstract

The technological evolution has encouraged electronic payment methods, which allow for the exchange of goods and services without the usage of physical cash. The digital economy of Sri Lanka, projected to be worth USD 3.47 billion of Gross Domestic Product (GDP), is now steadily growing & COVID-19 pandemic with unexpected decline in the use of physical cash could have influenced this growth. In the Sri Lankan context, there is a tendency of expanding the use of cashless transaction methods among people. Therefore, the research problem of this study was that whether Credit & Debit Card Consumption, Currency in Circulation, Internet Based Financial Transactions, influence the economic growth of Sri Lanka. The main purpose of this study is to identify the factors related to cashless transactions, which affect the GDP of Sri Lanka. Required data were gathered from the Central Bank of Sri Lanka. To evaluate the impact of COVID-19 on the digital economy, purposive sampling was done by the researcher & obtained a sample of 44 data units, which covered the first quarter of 2010 to the fourth quarter of 2020. Vector Error Correction Model was implemented to determine the impact of above factors on the GDP of Sri Lanka. Moreover, the study revealed, Currency in Circulation & Credit and Debit Card Transactions will have a positive impact on economic growth of Sri Lanka, while the Internet-Based Financial Transactions will have a negative impact on economic growth in Sri Lanka for 2010-2020 by Impulse Response Function. However, the government should raise public awareness about the importance of digital literacy, and economic policymakers should address the country's advanced economic concerns associated with cashless transactions and boost the digital economy via new solutions to make the system more accountable and efficient in the long run.

Keywords

Credit Card Transactions, Cashless Economy, Debit Card Transactions,

Gross Domestic Product, Currency in Circulation

1. Introduction

Thousands of years ago, before cash, existed; humans relied on the assistance of the Barter system. During this system, individuals exchanged goods and services for other goods and services in return. Eventually, people began to carry small tokens (200 Before Christ) representing the items they wished to trade. Then the coin was invented and later paper physical cash was invented by the Chinese in 700 AD (700 Anno Domini). After passing several turning points, the world's first CHARGEIT card was introduced in 1946. It was absolutely limited compared to modern Credit Cards and it headed to the bank of America very soon, now known as Visa and Master Card. Cash finally entered the digital age in the 1980s with the initiation of Automatic Teller Machines (ATMs). Then with the utilization of the World Wide Web, Electronic money services have emerged allowing people to quickly and efficiently transfer cash to countries all over the world. Afterward, Bitcoin was launched in 2009 and it functions as decentralized Electronic money that we can purchase, sell and trade without the need for an intermediary such as a bank.

Inside any economy, money is a unique commodity that operates as a generic equivalent and performs specialized activities such as payment, accumulation, circulation, and value measurement. This money consists of special characteristics such as durability, uniformity, portability, limited supply, divisibility, and acceptability, etc. to make it unique. According to (Wijesiriwardane, 2021), Sri Lanka has also taken continuous steps to society's dependency on carrying cash notes. The mission of countries attempting to transition to a cashless society is to reduce the risk of robbery, cash theft, counterfeit money while simultaneously lowering security expenses, bank withdrawal, and calculation expenses. A Cashless Economy is an economy where transactions are performed by applying electronic payment methods instead of using cash in hand. There are two major non-cash payment instruments called paper-based instruments and electronic payments used in Sri Lanka (Central Bank of Sri Lanka, n.d.). But this study mainly focuses on electronic payments such as credit cards and debit card payments which happening in Sri Lanka.

As a foundation, Automatic Teller Machines (ATMs) were first introduced to Sri Lanka in 1986, for the purpose of cash withdrawals. Gradually, with technological advancement, people got used to these cashless payment methods rather than doing cash payments within society. Going moneyless not only makes life easier but also helps to authenticate and formalize transactions. This assists in the reduction of corruption, increasing economic growth. Mieseigha & Ogbodo (2013) discovered that, Electronic transactions are necessary for transparency, accountability, and the decrease of cash-related fraud, all of which are key com-

ponents of economic growth and development. Based on that, we can be certain that moneyless payments will have an impact on the economic growth or decline of any country. Volumes of cashless payments are expanding twice as fast in developing economies as they are across the world. As an Asian country, we have a lot to improve to reach there and various factors may be hidden as barriers.

Academicians and experts have discovered that insufficient infrastructure in suburban and rural regions, as well as a lack of Point of Sale (POS) terminals, block up the installation of a Cashless Economy in India (Basu, 2018). Simply, a POS (point of sales) terminal is a piece of hardware used to accept credit cards at retail businesses. This hardware includes software that reads magnetic strips from credit and debit cards as well. Sri Lanka also has major problems related to this infrastructure, mainly Digital Literacy and it may also cause strongly the growth of the Cashless Economy in Sri Lanka.

According to Central Bank of Sri Lanka, number of POS terminals in use and total volume of transactions has a considerable increment within the second quarter of 2021 compared to the first quarter of 2019. But when it comes to the total value of POS transactions, when compared to the first quarter of 2019, the second quarter of 2021 has a lesser value of transactions that have occurred.

According to *Moody's Analytics* (n.d.), from 2008 to 2012, higher use of electronic card payments products increased the Gross Domestic Product (GDP) of 56 nations they investigated by \$983 billion in real US dollars. GDP is a measurement of the economic growth of a country which means if GDP is increasing; the growth of the economy is increasing. So based on that, we can presume that the consumption of electronic payments (transactions) may cause the growth of an economy. Considering the GDP implicit price deflator from the first quarter of 2019 to the second quarter of 2021 in Sri Lanka, this value measures the changes in prices of goods and services produced in a country, including those exported to other countries, while prices of imports are excluded. However, the banking sector is included under the service sector and this presented GDP implicit price deflator includes the cashless transactions as well. According to the data published by CBSL, when compared to the first quarter of 2019, the first quarter of 2021 has a considerable increment in price deflator but in the second quarter of 2021, it again decreased a little amount.

According to *Saraswati & Mukhlis* (2018), In Indonesia, debit and credit card transactions have a major negative impact on currency in circulation. On the other hand, debit card transactions have little effect on CIC in the short term. In the long run, credit card transactions have a considerable positive influence on CIC in Indonesia, although Credit card transactions have very little effect on currency demand in the short term as well. On the other hand, decreasing the control of the money supply of the Central Bank depends on the degree of substitution of Currency in Circulation with E-money as well. Anyhow, by entering into a Cashless Economy can expect huge growth in the whole economy in Sri Lanka in a positive manner.

Research Problem and Objective

In the Sri Lankan context, there is a tendency of growing the use of cashless transaction methods among people. Based on the above understanding, the study formulates the research problem as: whether some factors like Credit & Debit Card Consumption, currency in circulation, Internet Based Financial Transactions influence the behavior of Gross Domestic Product (GDP) in Sri Lanka. The main objective of this study was to identify the factors related to cashless transactions, which affect the GDP of Sri Lanka.

2. Literature Review

2.1. Nature of a Cashless Society

A cashless society is an economic concept in which financial transactions are carried out electronically rather than through the use of physical currency. Each party in a cashless society will have an electronic card or device that will be needed to complete the transaction. Moneyless alternatives to real notes and coins have been out for a long time and have grown in parallel with payment technologies and customer financial awareness. According to [Awuku \(2019\)](#), a Cashless Economy is a critical element for transparency, accountability, reducing cash-related frauds, and most importantly economic growth and development. [Basu \(2018\)](#) also discovered that the Cashless Economy has the potential to eliminate tax evasion, lower the cost of physical cash issuances, such as printing storage, shipping and improve vigilance and transparency. Further, a close examination of his study reveals that the benefits of a moneyless Economy are mainly attributed to the government. On the other hand, consumers should no longer be concerned about theft, duplicate notes, and changes of coins or payments of a balance system as well.

Observing the study of [Yakean \(2020\)](#) there can be a variety of downsides, just as there can be a variety of benefits of a cashless society. Enhance the cybercriminals' ability to enter the e-payment systems, since many people who live in the rural areas cannot access a smartphone or a tablet and as result, are unable to conduct financial transactions using e-payment tools such as QR-code, Prompt-Pay, or e-Wallet are some of those downsides. Also because of a lack of technological understanding, they are hesitant to accept a cashless system and prefer traditional cash transactions. By the way, some industrialized countries have overcome these obstacles and are rapidly transitioning into a cashless society right now.

2.2. The Behavior of Cashless Transactions in Sri Lanka

The global banking sectors' digital transformations are pressuring Sri Lankan institutions to quickly implement cashless payments transactions procedures. These important policies will restrict the usage of physical cash in the economy and impose a new control mechanism. With this rapid transition towards digital payment choices in recent years, the payment ecosystem also has been swiftly

expanding. However, In Sri Lanka, we can see many cashless-based transactions methods like Internet banking, Mobile banking, Point of Sales (POS) terminals, etc. For all these transactions we use Master cards, Visa cards, Debit cards, Credit Cards, eZcash, mCash. Virtual Wallets and many more started being supplied by Sri Lankan banks.

With the rapid usage of mobile phones, the internet, also the spread of the COVID-19 virus, it is visible that the usage of mobile devices created a credible argument for a transformative, great platform for cashless payments. As specified by the [Telecommunications Regulatory Commission of Sri Lanka \(2019\)](#), active mobile devices have increased from 96% in 2012 to 131% in 2017 in Sri Lanka. Thus, they are using a device, we can see people are not much aware of cashless transactions methods and there can be many other reasons for not using these methods. In accordance with the [Central Bank of Sri Lanka \(n.d.\)](#), a major amount of cash-based transactions in Sri Lanka are low valued; over 1 trillion worth of transactions are conducted island wide each month, and low-value transactions are those that are less than Rs.2000 and consist of payments for simple goods and services. However, to provide cash services to customers, Sri Lankan banks and other institutions must spend a lot of money to put up ATMs, kiosks machines and branches, etc. Therefore, based on the above circumstances, it is clear that Sri Lanka's payment ecosystem is unequally distributed across multiple layers.

2.3. Global Perspective on Cashless Transactions

The global perspective on cashless transactions is somewhat different. Based on a variety of considerations, Forex Bonuses posted a list of the most cashless economies.

Observing [Table 1](#), it shows the countries which have almost near to having a Cashless Economy in the world. Here can be seen an important factor, which is all these countries are almost developed countries in the world. It means they are having the fundamental infrastructure for using cashless transaction methods within their country. Another special aspect which can be seen is although Sweden & France has the maximum proportion of transactions using cashless methods (59), the people awareness about that is 47% & 38% consecutively. But in China, peoples' awareness about cashless transactions is 77% but their usage is 10% and that is a unique finding.

If consider India, it is one of the neighboring countries of Sri Lanka. India is one of the southern Asian Emerging and Developing countries in the world. It is both the world's largest democracy and has one of the fastest-growing economies ([Case Study—Emerging and Developing Country—India, 2021](#)). Examining the study of [Basu \(2018\)](#), even though India could not find a place in the above list in [Table 1](#), it is moving towards a Cashless Economy in terms of cashless transactions. Digital payments in India have increased 55% in volume and 24.2% in value in the financial year 2016-2017. Also, the NEFT (National Electronic

Table 1. Most cashless economies.

Overall Ranking	Country	The proportion of cards in issue with contactless functionality	Debit Cards per Capita	Credit Cards per Capita	Transactions Using Non-Cash Methods (%)	Growth of Cashless Payments over past 5 years	People Awareness (%)
1	Canada	26	0.70	2.16	57	16	39
2	Sweden	25	0.98	1.04	59	13	47
3	UK	41	1.48	0.88	52	15	47
4	France	39	0.65	0.10	59	14	38
5	USA	23	0.94	2.90	45	12	48
6	China	56	3.28	0.33	10	100	77
7	Australia	39	1.75	1.00	35	10	39
8	Germany	26	1.25	0.06	33	10	48
9	Japan	26	3.30	0.67	14	12	27
10	Russia	18	1.35	0.22	4	22	57

Fund Transfer) volume in July 2018 was more than 18 corers, with a large transaction value of 17,321 billion.

When concerning Sri Lanka, this has made enormous economic and social improvements after the end of its 26 years conflict in 2009, also the economy expanded at a quick pace. In 2018, the real GDP increased by 3.2 percent, compared to its previous year. With a per capita GDP of USD 4.103, Sri Lanka is categorized as a lower middle-income country due to its quick economic growth. In less than 10 years, the poverty rate was reduced by more than half to 6% as well in Sri Lanka (Tabassum, 2019). According to the data published by World Bank, the Gross Domestic Product of Sri Lanka has an increasing trend from 2010 to 2018. But after the year of the pandemic occurred (2019), it began to decrease eventually. But then again when comparing Sri Lanka and India as still developing countries, it is visible that Sri Lanka has the potential to move into a Cashless Economy in near future as India because, Sri Lanka had higher GDP per capita in 2020 (3682.04 USD) compared to India (1900.71 USD) comparably (Tradingeconomies.com, n.d.).

2.4. Factors Related to Cashless Transactions

Nowadays many people use debit and credit cards to conduct their financial activities all over the world. Often both of these cards are carried by some people at the same time. According to Humphrey et al. (2006), the growth of electronic payments is linked to a significant increase in bank performance. Also, while viewing the latest figures of The Central Bank of the People's Republic of China

(n.d.), financial institutions' total assets reached 318.69 trillion yuan at the end of 2019, with banking institutions accounting for 91%. This demonstrates that the banking industry contributes to economic growth and prosperity by providing credit and financial services to other sectors of the economy.

The many methods by which individuals and businesses doing business online, collect money from their customers in exchange for the goods and services they provide are referred to as "Internet-based Payment Systems". Treiblmaier et al. (2008) concluded that, due to the high costs of making payments in person, many businesses attempt to get their clients to pay their bills online. But at the same time, concern about privacy and security, weaken the faith in online payment systems as well. According to Aldaas (2021), when the interactions between economic growth (GDP) and cashless transactions were examined, it was shown that the correlations were low and negative for India, but high and favorable for Saudi Arabia. It could be assumed that when an economy leads to increases from a developing to a developed stage, cashless transactions and electronic payments usage will increase as well. As a result, it may be inferred that electronic payments, as well as other types of Internet Based Financial Transactions, have a bright future, particularly in growing economies such as India.

Currency in Circulation means, the amount of Currency in Circulation in a country, in the form of paper notes or coins—that is physically utilized to make transactions between consumers and businesses. This Currency in Circulation represents part of the overall money supply, with a significant portion of it held in checking and savings accounts. The amount of physical cash in circulation is monitored by Central Bank monetary authorities since it is one of the most liquid asset classes. Because the quantity of Currency in Circulation is less flexible than other types of monetary (such as bank reserves), it is less important to central banks' monetary policy.

2.5. Consumer Perception on Using Credit Cards and Debit Cards

The use of cash and cards has created a psychological pattern, which influences peoples' views on spending money. As a result of biological and cultural influences which they utilize to make sense of the world, people developed a set of mental filters. As reported by Soman (2001), consumers who generally pay for purchases with credit cards rather than cheques were more willing to obtain additional discretionary products. Feinberg (1986) in his study, asked participants to join to estimate the goods to see if there was a small cost, and once they agrees, their willingness to pay for each item with cash or credit card was determined. After that, participants were asked to estimate the overall cost of the baskets and it revealed that in high-cost situations, card usage was favored and in low cost situations, cash usage was preferred. According to a survey conducted by Jonker (2005), debit cards are used more frequently in non-food retail: gas, supermarket purchases. Public transportation and fast food transactions are primarily made with cash. Klee (2008) connects the use of a credit card to the

total amount spent on a single supermarket purchase. She noticed that cheques (39%) were used to pay for transactions of \$150 or more, followed by credit cards (25%), debit cards (21%), and cash (15%). This illustrates the United States' preference for debit card use is close to the credit card use

2.6. Impact of Cashless Transactions on Economic Growth Regarding GDP

The term GDP (Gross Domestic Product) refers to the total monetary value of all final goods and services produced (and sold on the market) within a country over a given period (typically one year). This GDP is the most often used indicator of economic activities and it is a measure of the overall health of the economy that is used to estimate its size and rate of growth. As well as the impact of electronic card payments on the global economy will be tremendous. According to Mark (2016), greater usage of electronic card payments added \$983 billion in real USD to the GDP of 56 countries from 2008 to 2012. Also, card payments increased consumption by 0.7% on average in the 56 countries studied. During that period, real global GDP has increased by an average of 1.8% every year as well (Zandi, 2013).

The impact of cashless payments on an economy can be evaluated in many courses of action. Throughout the study of Grzelczak & Pastusiak (2020), they found that payments made with a payment card accounted for the largest share of total payments in Central and Eastern European countries in terms of the number of payments. The key conclusion that can be drawn after examining the data was that there is a positive relationship between the values of payments made via a transfer order, payments card, and economic growth. The study shows that the use of direct debit is declining, mainly in the case of mass payments. Also, these countries show a higher average real GDP per capita than countries in Western Europe, due to far less development. Although expanding payment infrastructure has the potential to bring these countries to a more prosperous future.

By contrast, Tee & Ong (2016) used the Pedroni Residual Cointegration and Panel Vector Error Correlation model (VECM) to analyze the effect of implementing cashless payments in five European countries from 2000 to 2012. Variables of Real Gross Domestic Product, telegraphic transfer, card payment, electronic money, and cheque payments for the period 2004 to 2013 were obtained from the European Central Bank's Statistical Data Warehouse. Furthermore, these findings revealed that in the short run, the implementation of one type of cashless payment affects the adoption of another type of cashless payment, but the economic growth effects of implementing cashless can only be seen in the long run, and also revealed that any policy encouraging cashless transactions may not have an immediate economic impact. But this analysis of the implementation of cashless payments is limited to card payments, cheques, telegraphic transfers, and electronic money.

2.7. Impact of COVID-19 on Usage of Electronic Payment Cards

On March 11, 2020, the highly transmitted Coronavirus illness 2019 (COVID-19) was declared a pandemic. It infected approximately 96 million people and killed over 2 million people between January 2021 and January 2022. This health risk impacted nearly everyone's emotional, social and economic lives around the world, significantly changing people's habits and behaviors ([Coronavirus Disease \(COVID-19\) Pandemic, 2020](#)). At the same time, there has been an unexpected outpour of speculation about the possible link between handling physical cash and COVID-19 infection has emerged ([Auer et al., 2020](#)). According to the [Update on Economic and Monetary Developments \(2020\)](#), almost 40% of respondents in the euro region, reduced their use of cash, with 38% claiming that the main motive for their new payment behavior was the risk of infection from handling banknotes. Along with this issue, it is visible that, a significant portion of the public lowered their transactional use of cash as a result of the pandemic. Also, the research by [Vriesekoop et al. \(2016\)](#) claimed that bacterial survival is shown to be higher on paper banknotes than on polymer bills and coins.

Due to advancements in financial technology, there has been a considerable increase in cashless transactions in recent years. Most consumers are moving away from cash-based purchases to cashless transactions as fin-tech solutions such as e-wallets improved. Locked down in particular Due to the COVID-19 outbreak in Sri Lanka, citizens of the country had little choice but to stay at home. However, the key strategies to escape the COVID-19 virus were social separation and avoiding physical interaction. In every corner of the country, the adoption of digital transactions and electronic currency transfers was encouraged ([Jesuthasan & Umakanth, 2021](#)). When an infected individual touches physical cash, it still acts as a vector for the infection & the WHO recommends using electronic money ([Raaper & Brown, 2020](#)). Also, before the pandemic, cashless payments via smartphones had been more popular in many developing countries ([Andrieu, 2001](#)). As a cashless transaction method, E-wallet payments can also be made by mobile phone. In Sri Lanka, over 95% of all retail transactions are still conducted in cash. As a result, a larger improvement in the country's e-commerce ecosystem would have long-term benefits in terms of expanding the range and coverage of social media-based enterprises. Pandemics provide an opportunity to address various issues, especially those related to adoption, trust, and security. The most difficult task they encountered was getting people to accept a cashless society and COVID-19 had aided in this process by driving people to adapt ([DailyFT, 2020](#)).

Possibly, Bank accounts are held by more than 80% of Sri Lankans. They have 23 million debit cards, 1.7 million credit cards, and over 40% have smartphones, but modernizing the financial system and guaranteeing inclusivity remain challenges. The Central Bank of Sri Lanka named 2020 the "Year of Digital Transactions" to solve this issue and bridge services, costs, and other gaps ([DailyFT, 2020](#)). Banks in Sri Lanka offer several e-wallet choices to their consumers. The

most serious issue is that banks must be cognizant of their goods. Unfortunately, bank workers are not aware of this. Employees must be aware of these services and goods. As a result, personnel must download these apps and use them to discover the problems that clients are having.

Besides that, Sri Lanka has about 40% smartphone penetration, which is high for a developing country and is expected to rise in the future. People must be encouraged to adapt to technology when applications are available and simple to use. The world is heading toward virtual banking, and traditional banking will be phased out. In certain nations, bank branches have been shuttered, and everything is now done digitally (DailyFT, 2020). During this pandemic, several businesses target people of older generations as consumers. Because the majority of them have begun to employ a cashless system, we will have an advantage in terms of adoption.

However, according to the study of Wisniewski et al. (2021), those who believed that cash posed a high risk of viral transmission, cashless alternatives instead. Also, COVID 19's rapid transition to digital payments has the potential to penalize those who are financially disadvantaged, such as immigrants, the elderly, the unemployed, and the disabled as well. Therefore, this is an area of worry that will require more scientific investigations in the future.

3. Methodology

3.1. Conceptual Framework

This research is being carried out in few stages to meet the main two objectives. However, GDP is considered as the dependent variable, and Currency in circulation, Total volume of Internet Based Financial Transactions and Credit & Debit Card Transactions are taken as the independent variables to achieve the main objective of the study. In the light of the preceding circumstance, the below conceptual framework was created for the study (Figure 1).

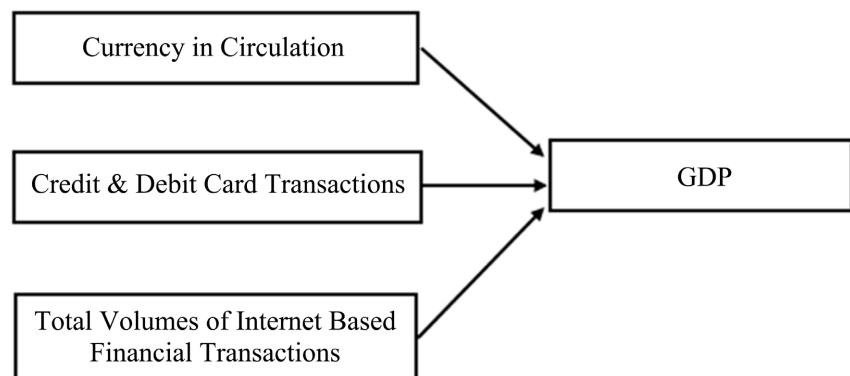


Figure 1. Conceptual framework.

3.2. Data Source and Method of Data Collection

The data sample for the study was obtained from secondary sources. Required data was gathered from the Central Bank of Sri Lanka. To evaluate the impact of

COVID-19 on the digital economy, purposive sampling was done by the researcher & obtained a sample of 44 data units, which covered the first quarter of 2010 to fourth quarter of 2020.

3.3. Method of Data Analysis

As a descriptive analysis technique, time series plots were employed to determine the distribution patterns of variables. Vector Error Correlation Model (VECM) was employed to identify the factors affecting the Gross Domestic Product (GDP) in Sri Lanka for the period 2010 to 2020. “EViews”—version 10 was mainly used to analyze the study.

4. Findings

4.1. Trend Analysis

According to **Figures 2-5**, it is visible; both the Credit & Debit Card Transactions have been on an upward trend separately. When the distributions of debit and credit card transactions are compared, the number of credit card transactions appears to be lower than the number of debit card transactions from 2010 to 2020 in Sri Lanka. Another unique feature that can be apparent is, credit card transactions have an increasing trend from 1st quarter of 2010 to 4th quarter of 2020, while debit card transactions began to decrease after 1st quarter of 2020. Also, within the period 1st Quarter of 2010 to the 4th quarter of 2020 in Sri Lanka, Currency in Circulation has been on an upward trend & it is visible that from the 1st quarter of 2010 the GDP has gradually increased. But in the 2nd quarter of 2020, the GDP has dropped drastically to Rs.1932319.39 million. However, it has been again increased from the 3rd quarter of 2020. From the 1st quarter of 2010 the Total volume of Internet-Based Financial Transactions has gradually increased. But in the 3rd quarter of 2018 and 1st quarter of 2021, the Total volume of Internet-Based Financial Transactions has dropped a little.

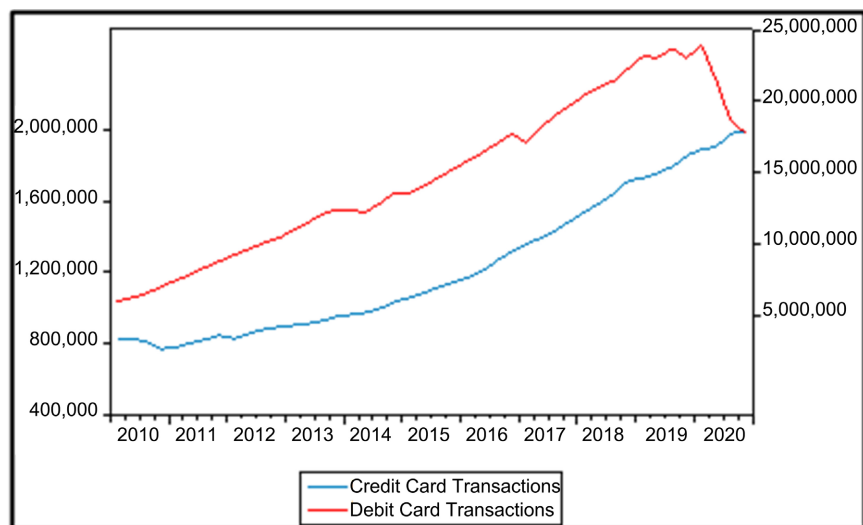


Figure 2. Time series plot of credit vs. debit card transactions.

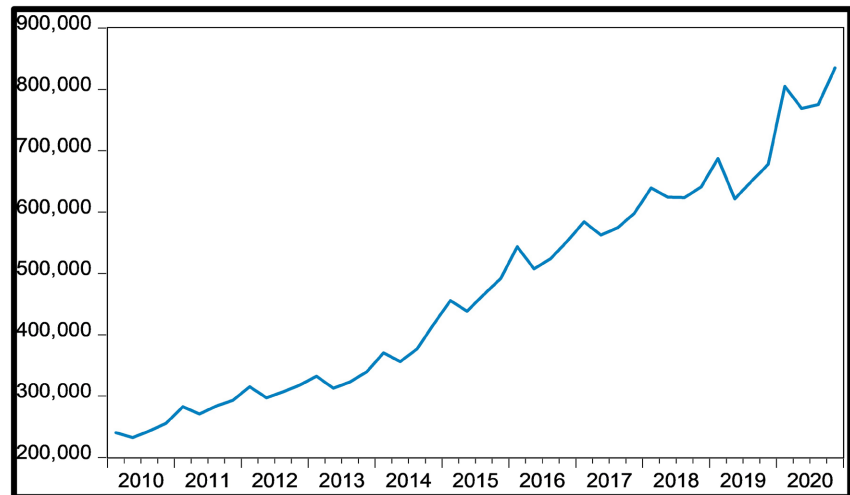


Figure 3. Time series plot of currency in circulation.

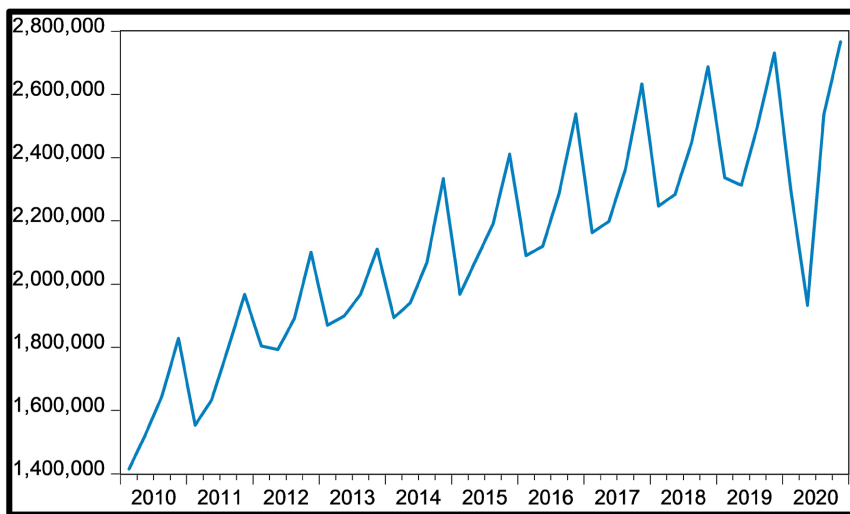


Figure 4. Time series plot of GDP.

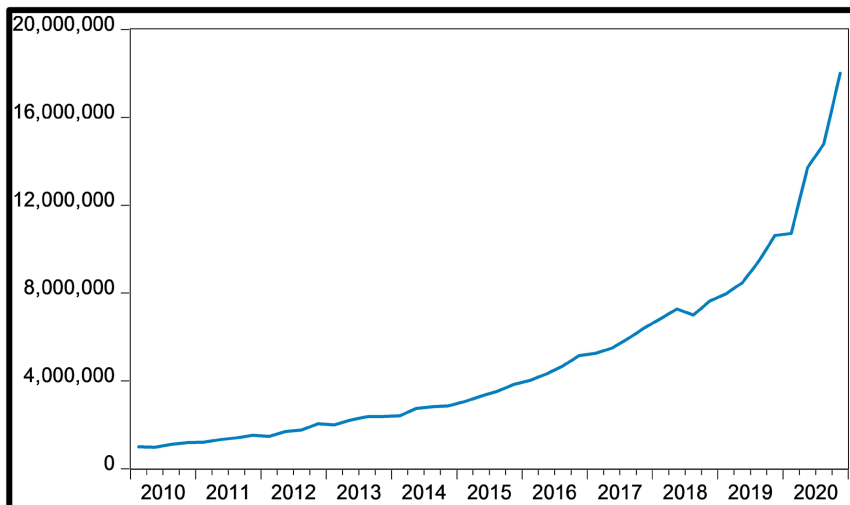


Figure 5. Time series plot of internet-based financial transactions.

4.2. Inspecting Stability by Hypothesis Testing

As per **Table 2**, the P -values (0.5126, 0.0792, 0.9999, and 1.0000) are greater than the significance level (0.05) in the Phillips-Perron test, indicating the null hypothesis is not rejected. As a result, it can be concluded that the time series of Credit and Debit Card Transactions, GDP, Currency in Circulation and Internet Based Financial Transactions, has a unit root respectively, which means these variables are not stationary in terms of mean at 95% of confidence level.

However, after taking the 1st difference, the P -value (0.0065, 0.0000, 0.0000, and 0.0096) of the Phillips-Perron test is lower than the significance level (0.05), the null hypothesis is rejected. Therefore, there is sufficient evidence to claim the fact that Credit and Debit Card Transactions, GDP, Currency in Circulation and Internet Based Financial Transactions series are stationary in terms of mean at the first difference respectively at 95% confidence level.

4.3. Determine Lag Intervals for Endogenous with Lag Length Criteria

According to **Table 3**, since Sequential Modified LR Test Statistic, Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion, and Hannan-Quinn Information all Criterion have suggested that the optimal lag order for the VAR model as 3 which should be chosen by indicating maximum number of star marks (*), based on the comparison of lag length criteria. Therefore, it can be found that the optimal lag order for the VAR Model is 3.

Table 2. Results of unit root test.

Variable	Description	Test Statistic	Probability
Credit and Debit Card Transactions	Phillips-Perron test statistic (LEVEL)	-1.5230	0.5126
	Phillips-Perron test statistic (1 st difference)	-3.7612	0.0065
GDP	Phillips-Perron test statistic (LEVEL)	-2.7183	0.0792
	Phillips-Perron test statistic (1 st difference)	-15.3794	0.0000
Currency in Circulation	Phillips-Perron test statistic (LEVEL)	2.3519	0.9999
	Phillips-Perron test statistic (1 st difference)	-10.5262	0.0000
Internet-Based Financial Transactions	Phillips-Perron test statistic (LEVEL)	6.9361	1.0000
	Phillips-Perron test statistic (1 st difference)	-3.6138	0.0096

Table 3. Results of test of lag length criteria.

Number of Lags	LogL	Sequential Modified LR Test Statistic	Final Prediction Error	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Information Criterion
0	-2392.274	NA	6.85e+45	116.8914	117.0586	116.9523
1	-2191.793	352.0635	8.50e+41	107.8924	108.7282	108.1967
2	-2136.882	85.71586	1.30e+41	105.9942	107.4988	106.5421
3	-2095.797	56.11604*	4.08e+40*	104.7706*	106.9439*	105.5620*

After discovering the lag order of 3, VAR (3rd order) Model is reestablished. Then test stationarities of the VAR Model and mod of AR characteristic root reciprocal of VAR Model are shown in **Figure 6**, which indicates that the mod of reciprocal of each characteristic root is not within the circle, and constructed VAR Model is not stable after going through stability test. Therefore, the differenced series of variables should take to build the model and if go with a VECM Model, the differenced series is automatically generated by the EViews econometric software which was utilized.

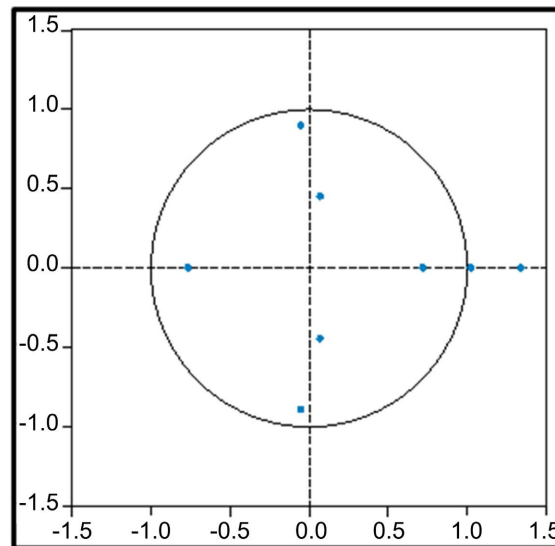


Figure 6. Inverse roots of AR characteristic polynomial.

4.4. Johansen Cointegration Test

According to the results of the Trace test in **Table 4**, it indicated 1 cointegration equation. But Maximum Eigenvalue Test in **Table 5** indicates no cointegration. According to previous literature, if the results of two tests are a mismatch, should do it with the trace test results because they are more appropriate for further study. Therefore, it can be confirmed that 1 cointegrating equation should include. However, the cointegrating equation is can express as follows by **Table 6**.

Table 4. Results of unrestricted cointegration rank test (Trace).

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	<i>P</i> -value
None *	0.473796	49.30788	47.85613	0.0363
At most 1	0.299842	23.62525	29.79707	0.2167
At most 2	0.151958	9.367258	15.49471	0.3325
At most 3	0.067005	2.774235	3.841466	0.0958

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; *denotes rejection of the hypothesis at the 0.05 level.

Table 5. Results of unrestricted cointegration rank test (Maximum Eigenvalue).

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	<i>P</i> -value
None	0.473796	25.68263	27.58434	0.0858
At most 1	0.299842	14.25799	21.13162	0.3442
At most 2	0.151958	6.593023	14.26460	0.5383
At most 3	0.067005	2.774235	3.841466	0.0958

Max-eigenvalue test indicates no cointegration at the 0.05 level.

Table 6. Results of cointegration equation.

Variable	Cointegrating Equation 1
GDP (–1)	1.000000
Currency in Circulation (–1)	1.093607 (0.70052) [1.56113]
Credit & Debit Card Transactions (–1)	–0.115316 (0.01772) [–6.50929]
Internet Based Financial Transactions (–1)	0.142420 (0.02823) [5.04443]
Constant	–1435019.

4.5. Vector Error Correlation Model (VECM) Estimation and Analysis

According to **Table 7**, the *P*-value (0.0000) is less than the significance level (0.05), therefore it indicates that the constructed VECM Model is overall significant at 95% of confidence level.

As per **Table 7**, the adjusted R-squared of 96.08% indicates the goodness of fit of the present VECM model. However, Credit & Debit Card Transactions, Currency in Circulation, and Internet-Based Financial Transactions describe a 96.08% percentage of the total variability of the GDP. Since 96.08% is very close to 100% we can conclude that it is a perfect level to illustrate as a well-fitted model.

4.6. Test of Long-Run Causality

Since the coefficients of GDP (–1), GDP (–3) and Currency in Circulation (–1) are negative in signs (–0.528395, –0.635087, –2.687745) and significant (*P*-values = 0.0028, 0.0001, 0.0005) respectively, it can be concluded that there is a long-run causal relationship in particular models which includes GDP (–1), GDP (–3) and Currency in Circulation (–1).

Table 7. VECM estimation results and test.

Variable	Coefficient	Standard Error	Test Statistic	<i>P</i> -value
Cointegration Equation (1)	-0.208796	0.151393	-1.379162	0.1796
GDP (-1)	-0.528395	0.160204	-3.298271	0.0028
GDP (-2)	-0.294831	0.172284	-1.711306	0.0989
GDP (-3)	-0.635087	0.131018	-4.847336	0.0001
Currency in Circulation (-1)	-2.687745	0.675154	-3.980935	0.0005
Currency in Circulation (-2)	0.568852	0.841573	0.675939	0.5050
Currency in Circulation (-3)	3.444795	0.821544	4.193072	0.0003
Credit and Debit Card Transactions (-1)	0.001114	0.023092	0.048254	0.9619
Credit and Debit Card Transactions (-2)	0.007468	0.028283	0.264033	0.7938
Credit and Debit Card Transactions (-3)	-0.038991	0.029356	-1.328225	0.1956
IBFT (-1)	0.110259	0.054399	2.026866	0.0530
IBFT (-2)	0.013843	0.065075	0.212717	0.8332
IBFT (-3)	-0.085243	0.056254	-1.515302	0.1418
Constant	25397.63	63363.34	0.400825	0.6918
R-squared	0.973892	Mean dependent variability		23444.96
Adjusted R-squared	0.960839	S.D. dependent variability		239729.7
S.E. of regression	47440.65	Akaike info criterion		24.64156
Sum squared residuals	5.85E+10	Schwarz criterion		25.23267
Log likelihood	-478.8313	Hannan-Quinn criterion		24.85529
F-statistic	74.60612	Durbin-Watson statistic		1.760167
Probability (F-statistic)	0.000000			

Since the coefficients of Currency in Circulation (-2), Credit and Debit Card Transactions (-1), Credit and Debit Card Transactions (-2), IBFT (-1), IBFT (-2) and Constant are positive in signs (0.568852, 0.001114, 0.007468, 0.110259, 0.013843, 25397.63) and insignificant (*P*-values = 0.5050, 0.9619, 0.7938, 0.0530, 0.8332, 0.6918) respectively, it can be concluded there is not a long-run causal relationship in particular models which includes Currency in Circulation (-2), Credit and Debit Card Transactions (-1), Credit and Debit Card Transactions (-2), IBFT (-1), IBFT (-2) and Constant.

4.7. Test of Short Run Causality

From Currency in Circulation to GDP

Hypothesis:

H_0 : $C(5) = C(6) = C(7) = 0$ (There is no short-run causality running from Currency in Circulation to GDP).

H_1 : $C(5) = C(6) = C(7) \neq 0$ (There is a short-run causality running from Cur-

rency in Circulation to GDP).

As per **Table 8**, since the P -value (0.0002) is less than the significant level (0.05) the null hypothesis is rejected. Therefore there is sufficient evidence to claim the fact that there is a short-run causality running from Currency in Circulation to GDP at 95% of confidence level.

Table 8. Results of Wald test.

Test Statistic	Value	Degree of Freedom	P -value
F-statistic	9.947603	(3, 26)	0.0002
Chi-square	29.84281	3	0.0000

From Credit & Debit Card Transactions to GDP

Hypothesis:

H_0 : $C(8) = C(9) = C(10) = 0$ (There is no short-run causality running from Credit & Debit Card Transactions to GDP).

H_1 : $C(8) = C(9) = C(10) \neq 0$ (There is a short-run causality running from Credit & Debit Card Transactions to GDP).

Since the P -value (0.6227) is greater than the significant level (0.05) the null hypothesis is not rejected. Therefore there is sufficient evidence to claim the fact that there is no short-run causality running from Credit & Debit Card Transactions to GDP at 95% of confidence level (**Table 9**).

Table 9. Results of Wald test.

Test Statistic	Value	Degree of Freedom	P -value
F-statistic	0.596946	(3, 26)	0.6227
Chi-square	1.790837	3	0.6169

From Internet-Based Financial Transactions to GDP

Hypothesis:

H_0 : $C(11) = C(12) = C(13) = 0$ (There is no short-run causality running from Internet-Based Financial Transactions to GDP).

H_1 : $C(11) = C(12) = C(13) \neq 0$ (There is a short-run causality running from Internet-Based Financial Transactions to GDP).

Since the P -value (0.0209) is less than the significant level (0.05) the null hypothesis is rejected. Therefore, there is sufficient evidence to claim the fact that there is a short-run causality running from Internet-Based Financial Transactions to GDP at 95% of confidence level (**Table 10**).

Table 10. Results of Wald test.

Test Statistic	Value	Degree of Freedom	P -value
F-statistic	3.852291	(3, 26)	0.0209
Chi-square	11.55687	3	0.0091

4.8. Residual Diagnosis

Table 11 indicates P -values (0.4125, 0.1213, and 0.8386) of all the tests are greater than significance level (0.05) there is sufficient evidence to indicate the fact that the following assumptions are satisfied under 95% of confidence level.

Table 11. Test results of residual diagnosis.

Test	Test Statistic	P -value
Jarque-Bera Test	1.7708	0.4125
Heteroskedasticity Test-ARCH	2.5148	0.1213
Breusch-Godfrey Serial Correlation LM Test	0.1774	0.8386

Normality

Randomness

Homogeneity of Variance

Because the above-mentioned three assumptions are met, this model can be used to make future analytical predictions.

4.9. Granger Causality Test

According to the results shown in **Table 12**, except Credit & Debit Card Transactions (P -value = 0.6169), Currency in Circulation, Internet Based Financial Transactions and all three variables together (P -values = 0.0000, 0.0091, 0.0000) Granger cause on GDP.

Table 12. Results of granger causality test.

Dependent variable: D(GDP)				The Null Hypothesis
Excluded	Chi-squared statistic	Degree of Freedom	P -value	
D (Currency in Circulation)	29.84281	3	0.0000	Refuse
D (Credit & Debit Card Transactions)	1.790837	3	0.6169	Accept
D (Internet Based Financial Transactions)	11.55687	3	0.0091	Refuse
All	77.74097	9	0.0000	Refuse

4.10. Impulse Response Functions (IRFs)

According to **Figure 7**, the blue line represents the Impulse Response Function. Considering the 1st graph, in the 1st and 2nd period the shock to Currency in Circulation will have a positive impact on GDP in the short-run. But from the 3rd period, the blue line began to come to the negative area and it indicates that Currency in Circulation will have a negative impact on GDP in the long run.

Observing the second graph shows that the response of Credit & Debit Card Transactions has a positive impact on GDP both in the Short-run and Long-run because the blue line is in the positive area from the 1st period to the 10th.

When it comes to the 3rd graph, since the blue line is in the negative area from the 1st period to the 10th, it indicates that period the shock to Internet-Based Financial Transactions will have a negative impact on GDP both in the Short-run and Long-run.

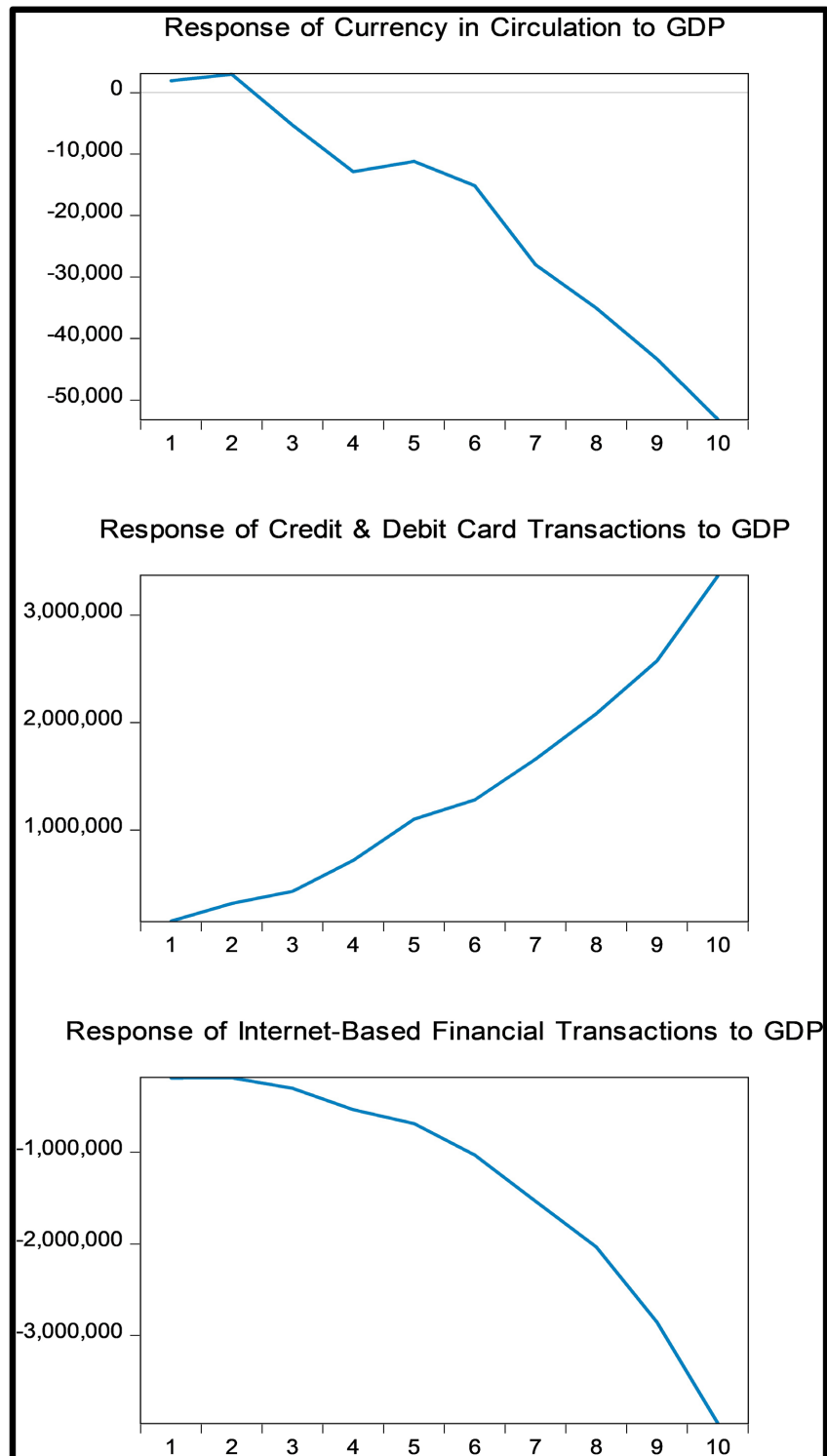


Figure 7. Response to Cholesky one S.D. (d.f.adjusted) innovations.

5. Conclusion

Everything has become more convenient for humans as technology is evolving. When it comes to banking, things have mostly changed for the better. Similarly, cashless transaction techniques such as credit and debit cards have become a necessity among the public. Rather than in rural areas, the demand for cashless transactions has stabilized in urban areas. With the outbreak of the COVID-19 pandemic in 2019, people started to incorporate bank cards rather than cash to avoid spreading the infection. However, in the Sri Lankan economy, cashless transactions have played a vital role from their inception. However, many findings of cashless transactions were uncovered as a result of this research and they can discuss as follows based on the objectives of the study.

GDP is one of the most important indicators of an economy's health. After constructing the VEC Model, the researcher has found that there is a short-run causality running from Currency in Circulation and Internet-Based Financial Transactions to GDP, while there is no short-run causality running from Credit & Debit Card Transactions to GDP. Also, the result shows that there is a long-run causal relationship in particular models which includes GDP (lag 1), GDP (lag 3), and Currency in Circulation (lag 1). Through Granger Causality of The VEC Model, it demonstrates that except Credit & Debit Card Transactions, Currency in Circulation, Internet Based Financial Transactions and all three variables together, Granger cause on GDP. According to impulse response function analysis, it is found that the shock to Currency in Circulation will have a positive impact on GDP in the short-run, and the response of Credit & Debit Card Transactions has a positive impact on GDP both in the Short-run and Long-run and the shock to Internet-Based Financial Transactions will have a negative impact on GDP both in the Short-run and Long-run.

A Trend Analysis assists with comparing the present to the past and assessing our progress through time. The trend analysis conducted in this study revealed some special factual evidence. After January of 2020, the total number of Credit & Debit Card Transactions that happened drastically dropped. But the number of Credit Card Transactions had an increasing trend till the December of 2020, while the Debit Card Transactions has dropped after the 1st quarter of 2020. But GDP is decreased in the 2nd quarter of 2020 as well. Also, Number of POS Terminals Transactions has drastically increased after the 2nd quarter of 2016. Further, Currency in Circulation decreased in the 2nd quarter of 2019, while increased in 2020 4th quarter to the maximum. Similarly, Internet Based Financial Transactions have increased to the maximum in the 4th quarter of 2020 at that point.

According to the above results, there is sufficient evidence to claim the fact that IBFT, CIC, and Credit Card & Debit Card Consumption affect the GDP of Sri Lanka. Therefore IBFT, CIC, and Credit Card & Debit Card Consumption make and influence on Economic Growth or Decline of Sri Lankan Cashless Economy can be verified. Moreover, considering the trend analysis it proved

that after the 1st quarter of 2020, the Number of Debit Card transactions has decreased and at the same time it means after the 2nd quarter of 2020, GDP also decreased. Therefore it can be assumed that these Debit Card Transactions impacted on GDP decrement in 2020 in Sri Lanka is considerable.

Suggestions & Recommendations

Since Internet-Based Financial Transactions make a Negative impact on GDP in Sri Lanka, the most important thing is to make people aware of the necessity of digital literacy. For this, Banks can readily perform this task by alerting customers, especially in the rural areas of Sri Lanka.

Another result was that after the COVID-19 Pandemic, Debit Card Transactions appeared to be on a clear downturn. Consumers acquiring more credit card loans and people not having enough money to spend with debit cards could be the reason for this situation. As a result, policymakers should consider this aspect when addressing the country's advanced economic problems related to cashless transactions as well.

People, businesses, and the government, in particular, gain a lot more benefits from going cashless than just convenience. The use of electronic payments is increasing, which increases consumption and GDP. Therefore the researcher suggested boosting the digital economy by innovative solutions like Mobile wallets, Mobile POS, etc. and it will make the system more accountable and efficient in the long run. Also, the Sri Lankan government should introduce a Cashless Economy Policy because it makes a huge impact on Economic Growth.

However, since the data utilized in this study was limited to ten years (2010-2020), therefore it can be recommended that more years can be included in the study of factors connected to cashless transactions in further researches, also can perform forecasting for coming years as well.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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