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LONG-RUN MONEY DEMAND AND FINANCIAL INNOVATION IN LEBANON

by

MAYA ISSAM BERRO

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MAYA ISSAM BERRO

Approved by:

Dr. Casto Martin Montero Kuscevic, Assistant Professor
Economics

First Reader

On behalf of Dr. Sarah El Joueidi:

Dr. Sarah El Joueidi, Assistant Professor
Economics

Second Reader

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AN ABSTRACT OF THE PROJECT OF

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A model for money demand has been tested for the Lebanese Economy to show the effects of financial innovation. Current research has found mix results that financial development has a positive influence on money demand while others refute this by claiming that innovation makes people hold less cash. We used Autoregressive Distributed Lag Approach with monthly and quarterly data over the period 1997-2017. Our findings show that financial innovation has ambiguous effects depending on the proxy chosen for financial innovation. Furthermore, results asserted the Gurley-Shaw hypothesis in which financial development increases the interest elasticity of money demand.

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CHAPTER I

INTRODUCTION

Nowadays, as you switch from one TV channel to another, you will get surprised by the huge amount of banking commercials each displaying their unique services and new products offered to their clients. The twenty first century is the age of technology and use of computers. Most financial institutions are focusing on technological approaches in their business mainly in transferring payments to facilitate transactions with their clients. Through creative thinking, financial institutions can have higher profits. This is referred to as "financial innovation" which reflects advances in financial instruments and systems. Financial innovation is defined as an instrument that involves any technological advancement in transactions or a policy regulation (Arrau and Gregorio, 1993). It can be grouped as new products (adjustable-rates, mortgage, exchange-traded funds), new services (online security trading, internet banking), new production processes (electronic record-keeping for securities, credit scoring), and new organizational forms (new type of electronic exchange for trading securities, internet-only banks).

Why do people demand money? Some might think that this is a cliché question, yet the answer for this change through time as the role and the ways of using this currency changes. Laurence Ball (2012) states that money demand depends on the returns on near monies, which represent highly liquid assets that are close substitutes for M1. Money has a role as a store of value through time, medium of exchange to facilitate transactions, and unit of account which provides a standard measure for the value of

goods. As there is no East without West, North without South, height without depth, there is no credit without debit. Thus, money is essential for all individuals.

M1 money supply represents the most liquid money which is easily converted to cash; it shows the role of money as a medium of exchange. It includes cash as in paper money and coins, demand deposits, traveler's check, other checkable deposits, and negotiable order of withdrawal account (NOW account). In the case of Lebanon, the central bank measure M1 as currency in circulation and sight deposits in Lebanese currency LBP which are used as a means of payment rather than saving technique.

Until recently, demand deposits form a large part of the M1 money supply. If you have a business, then most likely you will not pay for your transactions by cash but instead through deposit accounts or through checks. Nowadays, people don't hold a big amount of money in their pocket. Households and firms prefer paying through other means rather than cash in their daily life, whether you are buying a laptop, car, paying for your tuition fees or even your restaurant bill.

Here comes the role of banks which are financial intermediaries that people usually deal with as institutions that accept deposits and give loans. Banks can be commercial banks mainly supplying short-term loans or investments banks which focus on giving clients services as Merger and Acquisition (M&A) activities. Clients usually deposit their money in these intermediaries as checking accounts which gives you immediate access to your funds and can be in any currency, savings account to earn interest on, or other types of bank deposits. Banking sector in Lebanon has a major role in fueling the economy. Despite challenges facing Lebanon, this sector has proved its worth with its healthy and enduring performance and stability. Lebanese Banks have been expanding through years to reach a number between 60 to 92 banks over the last

50 years in this small country. The services that financial sector offer are important for economic growth since money is demanded because it facilitates transactions and credit (Rajan and Zingales, 2001),

Banking sector is a main channel for capital inflows into Lebanon and involved in the funding of a huge part of the current account deficit. Better finance encourages more saving and investment and can also lead to better investment decisions, these indirect positive effects from financial innovation add further to its value for an economy. Montero (working paper) shows evidence that technology invention through creating new branches leads to an increase in money demand, only if these branches are allocated for several banks.

How does this phenomenon influence money demand function? Before going any further, it is important to note that in equilibrium money demand is equal to money supply. Therefore, we can use M1 money supply to represent money demand in equilibrium. Berentsen et al. (2015) discuss the influence of financial innovation on money demand and interest rates. Their results show that technological inventions reduce the income elasticity for money demand and cause a downward shift in its curve. Also, Arrau and Gregorio (1993) tackle the importance of financial innovation in determining money demand.

Financial enhancement is an essential phenomenon in all areas of modern economy. Most attention of standard microeconomic theory is given to the issues of static resource allocation and economic efficiency, there is however general appreciation that performance over time is due to a variety of dynamic factors, including inventions.

Financial innovation is when new financial products and services are developed in order to make the financial system more efficient. Yet, financial innovation has a dark side which may lead to financial crises. Mismanagement of financial innovation enables institutions to manage and control credit risks leading to overly risky lending. The roots of a financial crisis are regularly stemmed when an economy creates a new financial product which is known as financial advancement or when countries engage in financial liberalization. In the long run, this promotes economic growth and encourages a well-run financial system that allocates capital efficiently. Though, in the short run, it can prompt financial organizations to borrow money in large amounts, leading to credit boom.

Financial institutions must consider also the safety of these instruments. The more the banking system is efficient and safe, the more it will lead to the growth to our country's GDP. Lebanese policy makers made recent talks concerning ways to improve cybercrime protection system in Lebanon, as they are concerned with creating a digital currency related to Lebanon in the upcoming years. A more developed cybercrime protection system is needed to fight digital fraud and piracy in the banking sector, keeping in mind that data shows that cybercrime attacks as phishing and identity theft are increasing in several countries, including Lebanon. In light of this, an important question arises: How will this new innovation of financial currency have impact on the money demand?

Fischer studied the importance of country size (2007) and found that there is no significant effect of financial sophistication on Canton. Thus, inventions affect large countries more than small ones. But is this case similar for Lebanon? Or will the effect

be opposite? In this paper we will discuss the effects of financial innovation in Lebanon on the demand for money using several proxies.

The rest of the paper is organized as follows. The next section will cover the literature review discussing some papers and other studies concerned with the topic of financial innovation and money demand. Then we will provide the methodology which is later followed by the data part. Section 4 will analyze the results of the regression and will show how and what financial inventions influence the Lebanese currency. Finally, the last section concludes.

CHAPTER II

LITERATURE REVIEW

Many economists argue whether money demand function is stable or not. Ball (2012) shows in his paper not only long-run money demand function is stable, but also short-run. Also, Arize (1990) takes the case of Japan to argue that even by adding the variable financial innovation; the stability of the money demand function is not disturbed.

However, other authors find that the stability of the demand for money is affected when we introduce the financial innovation variable to the equation. The performance of the short-run money demand function improves when appropriate financial innovation was introduced as dummy variables. In the case of US and UK, results indicate that the inclusion of new financial instruments lead to instability of money demand (Hasan, 2009). Similar conclusions were brought by Lee (2004) that the traditional money demand specification with income and interest rates cannot be relied on to determine the money demand function especially when financial innovation as credit cards adoption is included or there is a change in regulation. Sunny (2017) also agreed that instability in the money demand function can be attributed to continuous inventions in the financial system.

Financial innovation variable does not only affect stability, but also the relation of the long-run demand function. It is important to know if there exists a long-run relation between all the variables of the equation before interpreting any results of the regression. Arrau and Gregorio (1993) re-estimate the money demand equation in their paper using Chile and Mexico's quarterly data. They conclude that no co-integration of

traditional long-run money demand function exists, which only includes interest rate and income as independent variables. The failure to have co-integration might be due to an omitted variable which is financial development. Other empirical findings show that there is absence of a long-run co-integration among variables at yearly frequency. However, at biannual frequency variables show co-integration relation (Singh, 2017). Other authors show opposite results that long-run demand equation is co-integrated (Ball, 2012). A main part of our paper's methodology will examine if a long-run relation exists in the money demand equation with and without financial innovation variables.

The traditional money demand function has two variables on which it depends on, the interest rate and income. So, it is important to study the effect of these basic measures on currency as new variables are introduced. High elasticities of interest rate and income in the traditional money demand equation could be driven by the omitted variable problem which is technological advancements (Arrau and Gregorio, 1993). Hasan (2009) examines the effect of financial inventions on interest elasticity of money demand in UK. Unlike previous papers, he uses more recent data that contained changes in financial markets in late 1970s. Results support the Gurley-Shaw hypothesis which suggests that interest rate elasticity increases by introducing financial innovations. This hypothesis says that as new-interest bearing substitutes are available, then holding money will be more sensitive to any change in interest rates which will increase interest elasticity of money demand. This idea is asserted by Singh (2017) who tests the presence of financial technology through the Gurley and Shaw (1960) hypothesis. He finds that improvements in payment technology after 2010 increased deposit-rate elasticity. These payment technologies are through more accessible communication

technology such as internet and mobile applications. Thus, this suggests that there might be a decrease in money demand in the future as the advances in financial products like bankcards, and ATMs are substituting non-cash payments for cash. For example, ATM users are more sensitive to interest rates with interest rate elasticity equal to -0.6 versus -0.3 for non ATM users (Attanasio et al., 2002). Interest rates are influenced in opposite directions by monetary policy and velocity innovations. Short-term monetary shocks lead to excess supply of loans and thus decrease interest rates, while velocity shocks lead to an increase in rates due to excess loan demand (Padrini, 2002).

Other papers focuses on the factors that affect the income variable, as in Woodford (1991) and Canzoneri and Dellas (1998), more income available to buy goods directly implies a more efficient payment system in the economy and thus more financial innovation.

Research shows that there is unitary income elasticity in the traditional money demand equation as in Friedman and Schwartz (1982), Lucas (1988) and Ireland (1995). While, Choi and Oh (2003) extends their data to the post war period in the US (late 1980s) which caused a decrease in the income elasticity of money demand to range from -0.6 to -0.04. They concluded that this difference was due to an omitted variable problem caused by the significance of financial technologies.

There is a debate about the relation between financial advancement and income inequality. Some say that financial improvement reduces inequality to a point, and then as these development proceeds, it leads to higher inequality (Park and Shin, 2017). As a country has more primary schooling and a better law, technological advancements help reduce inequality. Thus, the use of financial innovation is positively related with individual's income and education (Frame et al., 2004). Moreover, through financial

inclusion more services are available for poor people that will lead to lower inequality (Park and Shin, 2017). We will examine the sign of the coefficient of income's estimate in our regression, if it is positive then the analysis above will explain my results. Others might say that financial development will help educated people more than literate ones in accessing and utilizing the services, leading to more inequality. Thus, this is an empirical issue.

CHAPTER III

METHODOLOGY

In this paper, we will study the effect of financial innovation adopted by banks on the Lebanese money demand. We will use as a proxy of financial innovation a set of variables such as the number of ATMs in Lebanon, public claims, Public to total debt ratio, claims on resident private sector, number of internet users as a percentage of population, and money laundry Law.

We will estimate a slightly modified version of a canonical money-demand function as the one used by Ball (2001):

$$\text{Log (M1)} = \beta_0 + \beta_y \log(cc) + \beta_r r + \varepsilon \quad (1)$$

M1 reflects money demand which contains only cash and sight deposits in LBP[1]. GDP is represented by the coincident concentration index, cc, which is an indicator for the current state of the economy in the business cycle and the future expectations on it. This index includes the number of employment in non-farm payrolls, index of industrial production, level of manufacturing and trade sales, and the amount of personal income without transfer payments. We used the average rate on deposits for the values of interest rates. B1 represents the income elasticity of money demand, whereas B2 is the interest semi-elasticity of money demand.

For simplicity, let the equation be:

$$\text{Log}(y) = \beta_0 + \beta_y \log(x_1) + \beta_r (x_2) + \varepsilon$$

Where y, x_1, and x_2 represent M1 money supply, coincident indicator and average deposit rates.

[1] We later introduce checking accounts in USD

The appropriate estimation technique depends on the time-series behavior with monthly data and quarterly data from year 1997 till the end of 2017.

First we have to check if co-integration exists, meaning if there is a long run relation between the variables. Before doing so, we need to test for non-stationarity for each variable since if there is a mix of stationarity in variables Johansen co-integration test is not valid anymore.

Table 1 shows that "average rates on deposits" is stationary, while the other two variables are non-stationary and thus have a unit root. Thus, Johansen co-integration test is not applicable and we must choose the "Autoregressive Distributed Lag Model", known as ARDL method, which is a technique that deals with this problem to test for co-integration among variables that are integrated of different orders.

Under ARDL method, the general form of the error-correction model (ECM) becomes:

$$\Delta\log(y)_t = \beta_0 + \Sigma\, \beta_i \Delta\log(y)_{t-i} + \Sigma\gamma_j \Delta\log(x_1)_{t-j} + \Sigma\delta_k \Delta(x_2)_{t-k} + \varphi z_{t-1} + e_t \ \ldots (2)$$

Where z, the "error-correction term", is the OLS residuals series from the long-run "co-integrating regression"

$$\text{Log}(y)_t = \alpha_0 + \alpha_1 \log(x_1)_t + \alpha_2 (x_2)_t + v_t \ \ldots (3)$$

Or we can write the formula of "unrestricted" ECM as:

$$\Delta\log(y)_t = \beta_0 + \Sigma\, \beta_i \Delta\log(y)_{t-i} + \Sigma\gamma_j \Delta\log(x_1)_{t-j} + \Sigma\delta_k \Delta(x_2)_{t-k} + \theta_0 \log(y)_{t-1} - \theta_1 \log(x_1)_{t-1} - \theta_2 (x_2)_{t-1} + e_t \ \ldots..(4)$$

This model can be used to perform "Bound testing" which shows if there is long run relation or no. The null hypothesis is that H_0: $\theta_0 = \theta_1 = \theta_2 = 0$; Meaning there is no long run relation. We look at the F-stat to reject or not reject the null.

The lower bound is based on the assumption that all of the variables are stationary I(0), and the upper bound is based on the assumption that all of the variables are I(1). Sometimes, the result may be somewhere in between these two extremes.

If the computed F-statistic is below the lower bound we would conclude that the variables are I(0), so no co-integration is possible. If the F-statistic is higher than the upper bound, so co-integration exists. While, if the F-statistic ranges between the bounds, the test is inconclusive.

$\Delta \log(y)_t$ gives us no information about long-run relation. The parameter B denotes the short-run reaction of Log(y) after a change in $\log(x_1)$ and x_2. Here, the concept of co-integration and Error correction form comes useful.

For the short-run we need to focus on the error correction form where we can find the co-integration equation denoted by z. This is essential to know the time needed for money demand to adjust from a period to another after a shock represented by the φ.

From here we can proceed and add the proxies that we have for financial innovation in the ARDL Model.

CHAPTER IV

DATA

The data is collected from the Central Bank of Lebanon Statistics (2018) and Research website and the World Bank website (2018).

The units used for the basic variables are money supply measured in Billions, coincident indicator, and average deposit rate is in percentage.

We must keep in mind that Lebanon is a dollarized economy where most of its citizens deal frequently with the dollar currency in their transactions. M1 money supply that we used is only in LBP since there is no information about M1 in foreign currency as there is the lack of data about the cash in dollar in circulation. However, we have available data for checking and current account in USD. Thus, we will later compare M1 money supply in LBP to M1 with deposits in LBP and USD.

As previously mentioned, we also use six different proxies for financial innovation: number of ATMs in Lebanon, Claims on Resident Private Sector in LBP, ratio of Public debt in local currency to total debt, Public debt in local currency, Internet users as a percentage of population, and finally the law of "Money Laundering" introduced in 2001.

A. ATMs

Automated teller machine known as ATMs, are cash machines spread over all regions that allow people to enjoy banking services and withdraw cash or deposit money at any time instead of going to the bank. After the development of ATMs and

debit cards, they became a part of M1 money supply. Fischer (2007) and Attanasio et al. (2002) use the number of ATMs as a proxy for financial advancements.

We must keep in mind that there is limit for daily withdrawals from ATMs for different currencies. Byblos bank, SGBL, and Banque Libano-Francaise allow their clients to withdraw or make purchases up to: LBP 1,500,000, USD 1,000, and EUR 1000 per day. BLOM Bank allows withdrawal up to USD 5000 per day from its client's current account and depositing checks via ATMS. There are some problems associated with ATMS, one of which is no cash available in the machine. Also, sometimes these machines are out of service or maybe the card used is expired which disables clients to withdraw money from it. However, ATM machines made it more easily for cash to be accessible and frequently circulated in the market. We will use the difference of ATMs as it is a flow variable.

B. Internet

We must take into consideration electronic payments through internet as another measure for financial innovation. Electronic payments are viewed as an easier and cheaper way for consumer to pay, instead of holding cash (AL-Laham et al., 2009).

Electronic money has two forms, either through stored value on the card that reflects a certain money balance or by a software which is internet that allows the transfer of value on computer (Ely, 1996). The first form which can be presented by credit cards, were they are used in ATMs or through the internet (e-banking). The second form is E-banking services like applications on mobiles, and new technological intervention instruments such as NOVO introduced by bank Audi which is an interactive branch that is based on the concept of "Forward Banking".

Researchers argue that this will limit the central bank's ability to control money supply since electronic money is issued worldwide by public and private institutions. Also, this type of currency will decrease reserves and change the money multiplier. Thus, it is important to study its influence on cash and deposit accounts.

C. Legal system

The law of "Money Laundering" was introduced in 2001 by the Lebanese Central bank. Under the provision of this law, illicit funds are those that result from "trading drugs, financing terrorist acts, illegal arm trade, fraud or embezzlement of public or private funds affecting banks or financial institutions, and finally counterfeiting of money, credit or debit cards, and official documents or checks". Money Laundering is usually committed in order to use these funds in investing or purchasing assets. Thus, when this law was introduced it advocated the development of new financial instruments that insure safer trading. As governments control securities market through regulations that encourages corporations to give true information about them, this helps solve the asymmetric information problem which allows investors to have more accurate decisions.

Financial innovation can be a new imposed regulation which is in this case the law of Money Laundering introduced in 2001 and is still used till now. Financial technologies are defined by the ability of a country's legal system to impose financial contracts that reduce idiosyncratic risks when investing (Mendoza et al. 2009). Legal origins as creditors, shareholders and private property rights are significant for financial advancements. A country with a better legal system and thus more financially developed will led to an increase in interest rates (Mendoza et al., 2009). Also, Park and

Shin (2017) use legal origins as a measure for financial development. Countries with different institutional laws do not have similar financial progress since each legal tradition has its own capacity to adapt to new economic conditions (Beck et al., 2003).

D. Loans to the private sector

We will also use the "Claims on Resident Private Sector in LBP" which is a measurement of the size of private loans. Efficient financial system needs greater bank lending scale (Deng, 2014). Also, more enhanced financial markets ensure that individuals and firms have easier access to non-local funds (Guiso, 2004). Thus, openness for innovation helps firms guarantee bank loans as it increases transparency exposure of a company's information to others. More evidence about the positive relation between size of loans and financial innovation is in Cull and Effron (2008). They tested whether countries that were funded from the World Bank had faster growth in financial development. Results show that there is more financial development and growth in M2/GDP ratio for countries that borrowed loans. However, they experienced reductions in cash holdings. The innovation of new financial instruments such as Credit Default Swaps, Collateralized Debt Obligation (CDOs) and Collateralized Mortgage Obligation (CMOs) help guarantee a lower risk of default by the debtor and thus insure greater size of loans.

E. Public debt in LBP

Kluza (2016) argues that after 2008 crisis the Polish government started to create new financial products by borrowing more to achieve a sustainable economic growth. He finds that the worse the financial standing of a government, the higher the

demand for innovative products which facilitates investment projects. However, he pointed out that in the long-run, this might increase the credit risk of the government debt. During periods of subdued inflation and low government borrowing rates, the government should issue more bonds and use these earnings in investments that yield innovation (Etzkowitz, 2017). Deregulated banks, also known as lazy banks would prefer lending governments as it is considered a good investment. They guarantee to receive payments back since there is a low probability for governments to default. Thus, public debt can be considered as a financial proxy.

Government spending is usually on capital expenditure, public sector wages or social welfare. Thus, if the state decreases its expenditure this would affect negatively the standard of living and increase unemployment which decreases economic growth later. Also, expenditure can be in the form of subsidies on research and development. Ilyina and Samaniego (2011) show that industries with more resources targeted toward research and development will benefit the financial development of the country.

F. Ratio of Public debt to net debt

It is similar to the proxy "Public debt in LBP"; however, we used it as a benchmark to check, as theories suggest, that when public debt exceeds private debt, the effect on money demand will be opposite to the public debt effect only. Many assume that financial systems that are less controlled by the governments are more efficient (Cull and Effron, 2008).

CHAPTER V

RESULTS

In Appendix B, the f-statistic results for all different models are above the I(1) bound and thus assure that there is co-integration relation.

In table 2, we represent results of the long-run models with monthly data using the ARDL method starting from 1997. We selected "restricted constant" in trend specification which tests whether B1= B2= 0 and chose lags up to 12 lags for both dependent and regressors as the data used is monthly. However, when we add the variable number of ATMs in the regression, as a proxy for financial innovation, the sample period changes to start from 2002 instead of 1997 due to lack of data.

For robustness check, we use quarterly data in our regression and estimates show very close values to the monthly data which indicates that our results are strong. Table 4 represents the results of the long run regression with quarterly data.

Ball (2012) suggests, following a long-run equation: $m-p = \alpha + \theta yY + \theta rR + \varepsilon$, that movements of the short-run might be predicted from the long run equation or deviations from it could reflect this short-run relation.

He modified the equation to represent deviations from the long run equation:

$(m-p)^* = \alpha' + \theta' yY + \theta' rR.$

Where α' is the mean of $(m-p) - \theta'_y Y + \theta'_r R$ and $(m-p)^*$ is an estimate of the long-run equilibrium. Thus, the behavior of the short-run equation is indicated by the difference between the actual path and estimated values of the predicted long-run model which is represented by the co-integration equation that reflects the time needed for

money demand to adjust. We used a similar process in our paper to reach the short-run function.

We can get the short-run results while applying the error correction form for the ARDL long-run function, where the independent variables are the difference of their lagged values as presented by the equation below:

$$\Delta\log(y)_t = \beta_0 + \Sigma\, \beta_i \Delta\log(y)_{t-i} + \Sigma\gamma_j \Delta\log(x_1)_{t-j} + \Sigma\delta_k \Delta(x_2)_{t-k}$$

The cointEq(-1) reflects the error term "z". The term error-correction relates to the fact that last-period's deviation from a long-run equilibrium, the error, influences its short-run dynamics. As Ball (2012) suggests, that movements of the short-run might be predicted from the long run equation or deviations from it could reflect this short-run relation.

The coefficient φ in equation 2, must be between -1 and 0 and significant. If a shock happens then the variable will deviate from the mean. The negative sign shows that in subsequent periods the variable will move in an opposite direction to the shock to return back to equilibrium and move along with the mean. For example, for model 1(table 4) money demand adjusts 4% each month equivalent to 60% per year.

A. Income Elasticity and Semi-interest Elasticity

High elasticities of interest rate and income in the traditional money demand equation could be driven by the omitted variable problem which is technological advancements (Arrau and Gregorio, 1993). Our results support theories that show high elasticities of income greater than one, which assure that there is an omitted variable problem. Income elasticity of 2.108* imply according to Makwin (1992) that the labor-supply curve is backward bending in the long run. This means that the income and

expenditure will move less proportional with the wage. However, the wages which reflect the dollar cost of going to the bank, as it requires to forgo some time to go, moves more than proportional to the income. Also, not all individuals incur the same before-tax interest rate; yet, these differences are not calculated. Another cause might be that the raise of income elasticity is due to incorporation of capital income taxation. The higher the income, greater taxation will be imposed leading to lower after-tax interest rate. As money demand is interest elastic, this will also imply income elasticity greater than one in the Baumol-Tobin model (Makwim, 1992). If you compare Model 1 to 3 were we added four different proxies for financial innovation, you will realize an increase in interest elasticities represented by B_r. This agrees with Gurley-Shaw hypothesis, indicating new interest-bearing substitutes will make investors more sensitive to changes in interest rates. Think of an ATM user who knows that interest rates increase, then he can easily deposit his money in the ATM machine to gain interest on them. However, results of interest rates are not significant in all my models. We suggest that this is due to the dependent variable M1 which doesn't include any interest bearing deposit in the case of Lebanon.

Now concerning the income elasticity of money demand, represented by $B_{cc,}$ which increased in Model 2 when we only added the variable ATM. We believe that this happened since the money in the deposit account is the money we receive from our income. Thus, if our income increased we will withdraw more money from the ATM and thus increase our money demand. While when we added other variables as proxies such as private and public loans, the elasticity of money demand decreased, meaning money demand is less sensitive to a change in income. This may imply that we have other sources of money other than the income we receive, which are the loans from

banks or interest payments of the bonds. Thus, any change in income will not largely affect money demand as there are more substitutes for money inflow.

B. Proxies of Financial innovation

1. ATMs

Model 2 results presented in table 2 show the new coefficients of the estimates upon adding the number of ATMs in Lebanon as a proxy for financial innovation. Results indicate that there is a positive relation with money demand, with coefficient of 0.0068 and significant at 10% level. Customers prefer using ATMS in order to reduce wasting time. Our findings contradict Attanasio et al. (2002) results where they had negative coefficient of ATMS; as ATM users more regularly withdraw money and carry less amount of money on average (Sowunmi, 2014*).* However, ATMS increase the chances of customers demanding for cash at any time, beyond banking hours and in weekends and holidays (Sowunmi, 2014*).* Recently, there are two types of ATMS, regular ones and smart ones which has an additional feature that enables customers to deposit their checks. In conclusion, ATM users affect positively the demand for money with respect to non-ATM users.

2. Internet Users

In the presence of new technologies in the banking sector, credit card holders make payments easily with holding less cash (Yang and King, 2011). Some argue that credit cards positively affect demand deposits, unlike the cash holdings which are negatively influence by this variable (Lee, 2004). When consumers increase the use of credit card, the components of M1 are affected oppositely, where the demand for money

significantly decreases and the demand for checking account deposits increases. There is no exact answer about the effect of credit cards on money demand; it depends on which component is affected more.

Lebanese banks try several ways to increase the circulation of Lebanese currency in the market in daily transactions. For example, Audi bank offers their clients a refund of 2000 L.L when they pay from their credit cards to movie tickets. Likewise, BLOM offers gaining more points to their card when doing so.

We must keep in mind that banks should repay these amounts for the merchants on behalf of the consumers. For this purpose a bank must hold enough level of money. Thus, credit cards do not necessarily decrease money demand. This is asserted by the results of Model 3, where the coefficient is equal to 0.0029 which indicates a positive relation between internet users and money demand. However, this variable is not significant. Thus, in the case of Lebanon, demand for LBP is not influenced by the number of internet users.

3. Legal system

Model 3 includes the dummy variable which represents the law of "Money Laundering" signed in 2001. The coefficient is negatively related to money demand and significant; the introduction of the law caused the money demand to decrease by 4 %. This is considered as an institutional law which prevents the transfer of illicit funds from illegal resources as previously mentioned. The government controls securities market through regulations that encourages corporations to give true information about them. A country should impose laws to insure better protection for investor rights. Improvements in the legal origins and accounting infrastructure lead to a better banking

performance (Rajan and Zingales, 2001). Although this helps reduce risk, but eventually this will decrease the deposits received by the banks as they must be more accurate about the sources of the money they receive. Thus, banks will decrease their supply of loans and this will lead to reducing money demand.

4. Loans to the private sector

The change of money demand goes along with the change in private debt, with the coefficient being equal to 0.2797 and significant. A developed system increases the chances for individuals to enter new investments and have more competition, mainly for smaller firms. As the size of loans given to households and firms increase, more funding for investments will be available for investors. Lebanese banks, as BLOM Bank and Audi have a special program for Small and Medium Enterprises, known as SMEs, which encourages them to open new businesses and expand their work contributing to the development of the economy. Eventually, this growth will increase consumption and thus increase the demand for Lebanese currency. This cycle will continue as long as the return from investment projects will be deposited in banks which will contribute to excess reserve and thus issuing more loans and increasing money demand.

5. Public debt in LBP

Deravi et al. (1990) find that there is a relation between government debt and interest rates through the money demand function. Results show that by OLS regression, there is a positive relation between government debt and money demand through extreme bound analysis. This implies that borrowing by the government is considered a net wealth for the country. This approves my results that show the

coefficient is positive and significant. When banks want to borrow money, this process is made by taking deposits from investors. This procedure actually creates money through using these deposits to lend others for different purposes as investing or in real estate, yet depositors can get back their money at any time they want. However, borrowing by government is made through issuing bonds to banks private or overseas investors that has fixed maturity and the money is repaid at the end of the period. These individuals actually lend the government as they consider it as a safe and relative low-risk investment with interest payments. Also, public bonds offer currency diversification. For example investors from abroad can buy Lebanese government bonds. Thus, this will increase the demand for LBP.

6. Ratio of Public debt to net debt

Borrowing is a healthy option as long as the government can repay its debts! They may offer better rates than short term or demand accounts (cash deposits) in the bank, and are liquid on a market. "Good debt" is when investors take money to invest in an asset that covers more than the cost of the debt. In contrast, "Bad debt" is when you put the money you borrowed on your vacation to gain leisure and not money return.

Results show that the ratio of public to net debt in Lebanese currency has a negative effect on money demand. The variable is significant at 10% level with probability equal to 0.0978. As the ratio for public to net debt in LBP increases by 1 unit, the money demand decreases by 71.3%. Monetary theory notes that the borrowing of the federal government has its impact on the amount of loans given to the private sector (Welch, 1992). When government demands more money, interest rates tend to increase as the market becomes uncertain about any default by the government. When

this happens people will decrease their demand for loans as they are sensitive to interest rates, unlike the government. This causes a crowding out effect where people are discouraged to borrow money to fund their investments. Some might argue that the government could monetize the debt through increasing money supply to raise excess reserves which reduces the effect on interest rates (Welch, 1992). However, this is not the case in Lebanon, since this process will yield to inflation and the devaluation of the Lebanese currency leading to the failure of the central bank to maintain fixed exchange rate. These results coincide with Emran et al. (2009) robust estimates of the causal effect of government borrowing on private sector in 60 developing countries. Estimates show that a $1 increase in government borrowing from private banks decreases private borrowing by $1.4 (Emran et al., 2009). These estimates are opposite to the results of loans given to private sector as expected, since households and firms mainly borrow in order to make investments and initiate growth in the economy unlike government borrowing.

C. Robustness check and Model diagnostic

This time we amended the dependent variable M1 to include also deposits in foreign currency. Results indicate that income elasticity and semi-interest elasticity of money demand decreased compared to Model 1. Interest rates became significant with probability 0.0006 and coefficient -0.07. The interest rates used are on Lebanese deposits only, thus if these rates increase people will increase their deposits in the saving accounts rather than sight deposit accounts to have return on them and thus M1 would decrease.

Now for Model 2, ATMs turned out to be not significant in determining M1 money supply in foreign currency. It might be the case that ATM users frequently withdraw or deposit cash in LBP and not in other currencies.

Shifting to Model 3, the independent variables of private loans and public debt were also not significant. Including USD in M1 variables will eliminate the significance of loans and bonds which are purely in LBP. When institutions increase the size of loans in LBP or when governments issue more Lebanese bonds, this will only increase the deposits in Lebanese currency and therefore will not affect the foreign currency part. On the contrary, the dummy variable representing "Money Laundery" law and the ratio of public to total debt remained significant with the same signs, meaning they had the same influence on M1 in LBP and M1 in foreign currency.

CUSUM of squares test show that there is stability in the long run demand function in both the traditional demand of money equation and the modified one. This shows that even when adding the variable of financial innovation, the stability is not disturbed. In figures below, we see that the movement is inside the critical lines. We can find minor movements outside these lines in few models which are not a problem. This suggests that the residual variance is stable and there is no structural change.

In Appendix D, we applied Breusch-Pagan-Godfrey heteroscedasticity test which show that we do not reject the null hypothesis and there is homoscedasticity. Furthermore, there is no serial correlation as indicated by the Ljung Box Q-stat test. Thus, this means there is no correlation between the errors of different periods. Finally, the normality test for residuals indicates they behave normally and are well distributed.

CHAPTER VI

CONCLUSION

Financial development is all around us and its effect on Lebanon requires further study. In this paper, we allocate different measures for financial innovation and tested their influence on money demand in Lebanon. We find that inventions and improvements in the market will eventually increase M1 in the long-run. At the same time, results show that stability exists in the long run money demand function with and without adding financial innovation as an independent variable. Also, findings support the Gurley-Shaw hypothesis which proposes that semi-interest elasticity rises with new developments as they provide more interest bearing substitutes. Digital economy in financial sector, which is mainly focused on use of technology, will eventually grow further in the future. It is no longer an option for us not to invest in financial innovation whether we like it or not. However, we must keep in mind that it has an ambiguous effect on money demand.

APPENDICES

APPENDIX I

TABLES

Table 1. Results of unit root test by ADF.

	Log(M1)	Log(Coincident indicator)	Average rate on deposits
I(0)	0.9978	0.9075	0.0189*
I(1)	0.000**	0.000**	-

*: Stationary variable of I(0) level.
**: Non-stationary of I(1) level.

Table 2. Long run Money demand for period 1997 to 2017.

	Model 1	Model 2	Model 3
B_{cc}	2.108*	2.419*	0.8683*
	(0.000)	(0.000)	(0.0002)
B_r	-0.0195	0.0622	0.0005
	(0.6286)	(0.3295)	(0.9857)
B_{atms}	-	0.01394*	-
		(0.0214)	
B_{prd}	-	-	0.3512*
			(•.•••)
B_{pbd}	-	-	0.2228*
			(0.0506)
B_{pn}	-	-	-0.7411*
			(0.0747)
B_{dummy}	-	-	-0.0273*
			(0.0129)

- * shows significance at 5% level.
- Models 2 starts from 2002 to 2017.

Table 3. Cointegration bounds test for monthly data

Model	F-statistic	Co-integration
Model 1	9.446	Yes
Model 2	12.163	Yes
Model 3	4.231	Yes

Critical values						
	1%		5%		10%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Model 1	4.13	5	3.1	3.87	2.63	3.35
Model 2	3.65	4.66	2.79	3.67	2.37	3.2
Model 3	3.06	4.15	2.39	3.38	2.08	3

Table 4. The co-integration equation of the lagged term with monthly data

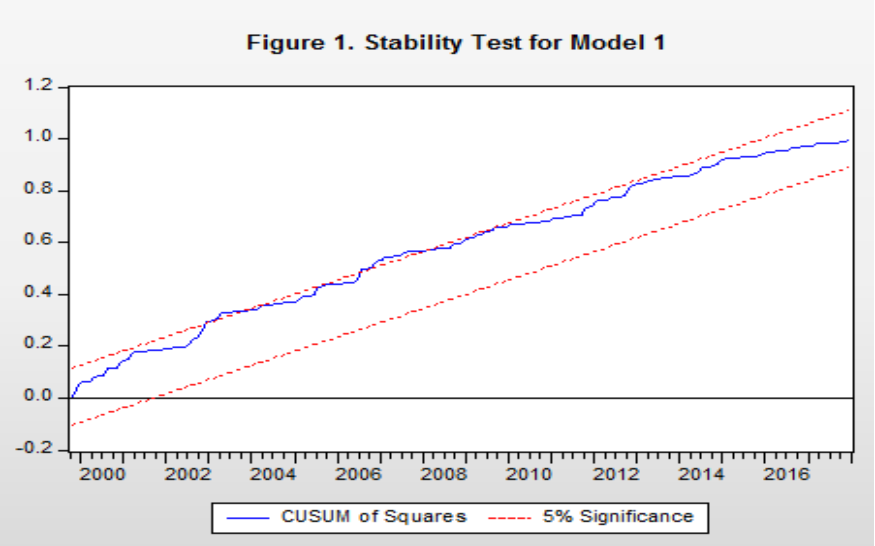
	Model 1	Model 2	Model 3
CointEq(-1)*	-0.0426* (0.000)	-0.0476* (0.000)	-0.1318* (0.000)

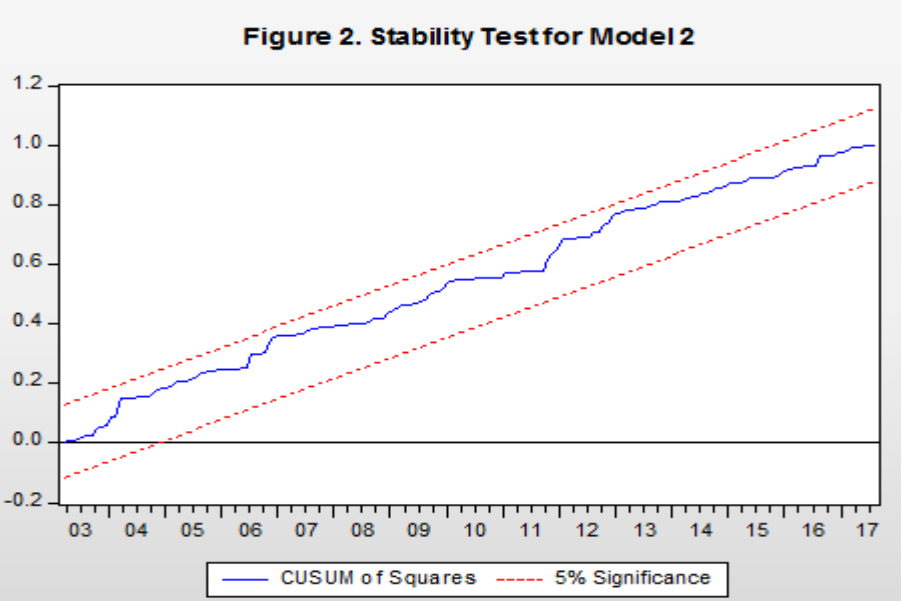
Results of the Bounds test in different models, using both monthly and quarterly data, show that F-statistics values are greater than I(1) at all levels(1%,5%,10%) which is an indication of a co-integration relation between all the variables.

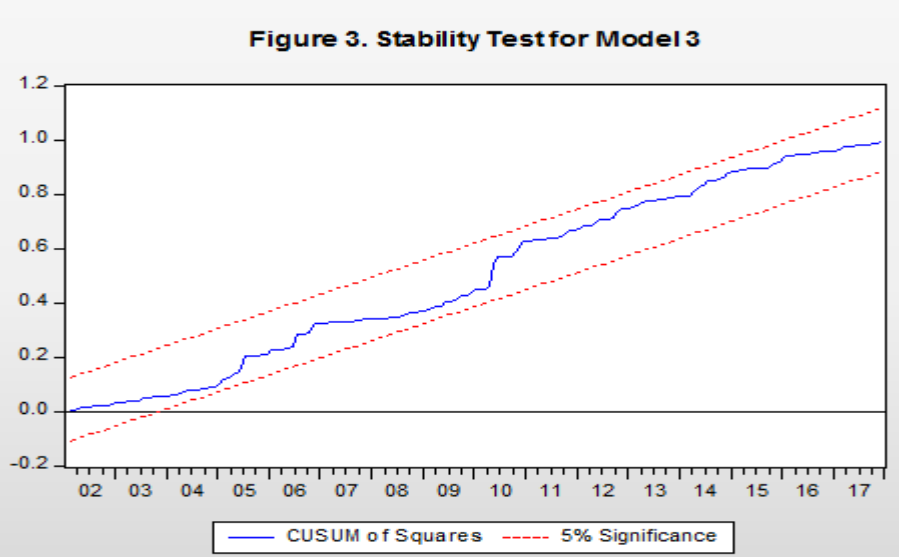
APPENDIX II

FIGURES

a- Monthly Data







b- Quarterly Data

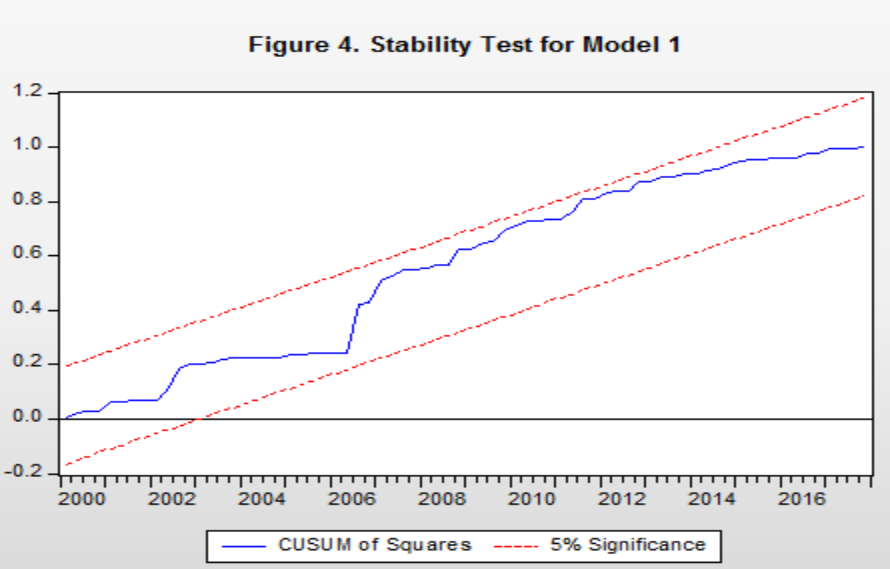


Figure 5. Stability Test for Model 2

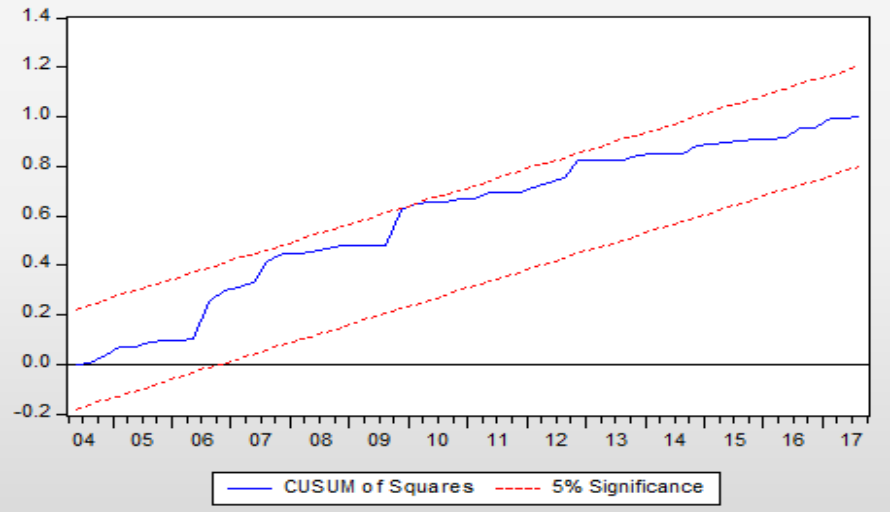
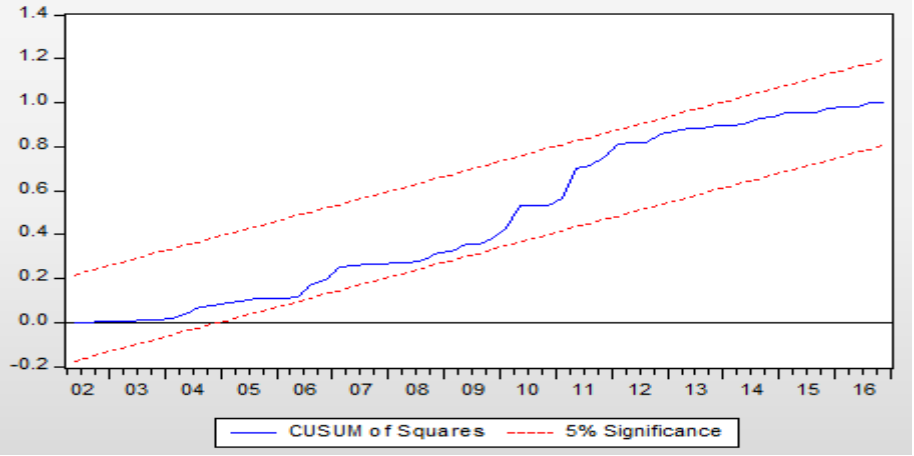


Figure 6. Stability Test for Model 3

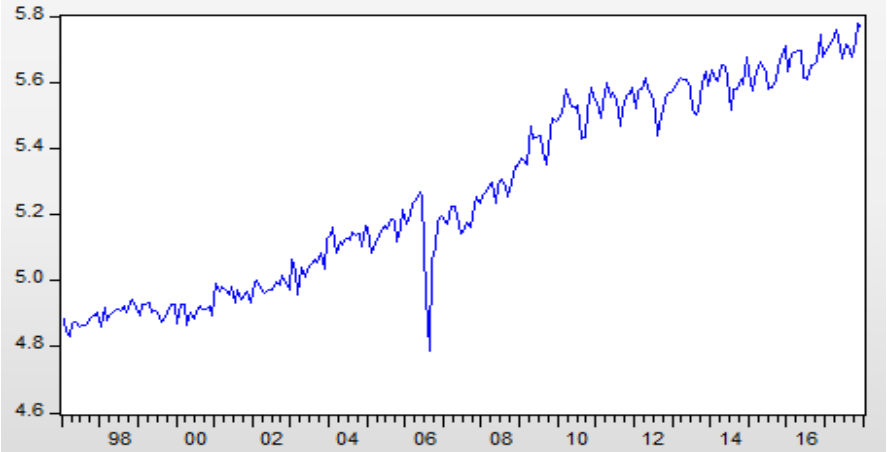


APPENDIX III

BASIC VARIABLES

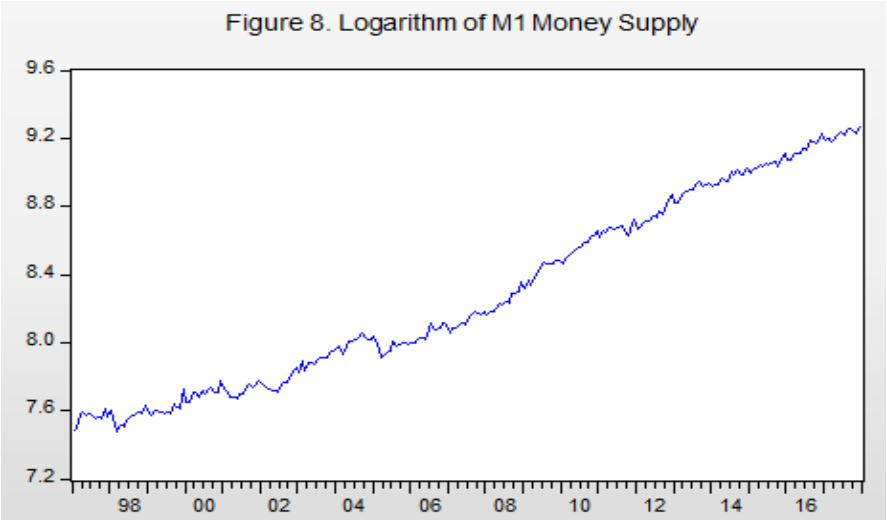
The graphs below show the monthly movement of the variables from 1997 to 2017.

Figure 7. Logarithm of Coincident Indicator

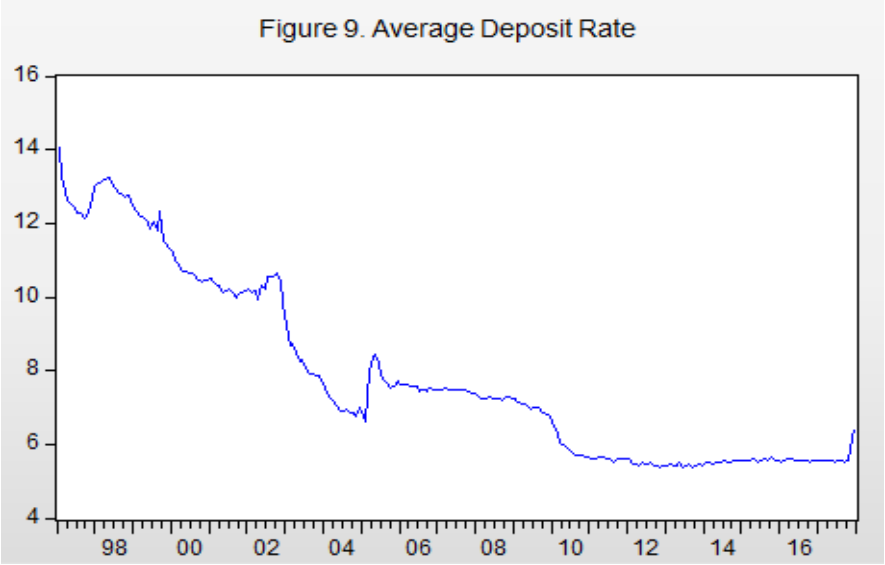


There is a sharp decrease in the coincedent indicator in 2006. This fall is due to the War with Israel were several industries stopped their production and hindered the economic activity in the country.

Figure 8. Logarithm of M1 Money Supply



Since 1997 and until now, the M1 money supply of the Lebanese currency is dramatically witnessing an upward trend.



The average rate on deposits declined from 14% to about 7% due to several reasons, one of which is the increase in inflation in the country.

APPENDIX IV

ROBUSTNESS CHECK

Table 5. Long –run money demand with quarterly data.

	Model 1	Model 2	Model 3
B_{cc}	2.2502*	2.7091*	0.7197*
	(0.000)	(0.000)	(0.022)
B_r	-0.0110	0.1390	0.0005
	(0.8028)	(0.1083)	(0.9848)
B_{atms}	-	0.0068*	-
		(0.0650)	
B_{prd}	-	-	0.2797*
			(0.0046)
B_{pbd}	-	-	0.2720*
			(0.0398)
B_{pn}	-	-	-0.7137*
			(0.0978)
B_{dummy}	-	-	-0.0414*
			(0.0152)
B_{users}			0.0029
			(0.4223)

Table 6. The co-integration equation of the lagged term with quarterly data

	Model 1	Model 2	Model 3
CointEq(-1)*	-0.0626*	-0.0801*	-0.2289*
	(0.000)	(0.000)	(0.000)

Table 7. Cointegration bounds test for quarterly data

Model	F-statistic	Co-integration
Model 1	12.128	Yes
Model 2	16.278	Yes
Model 3	4.081	Yes

Critical values						
	1%		5%		10%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Model 1	4.13	5	3.1	3.87	2.63	3.35
Model 2	3.65	4.66	2.79	3.67	2.37	3.2
Model 3	2.88	3.99	2.27	3.28	1.99	2.94

APPENDIX V

M1 IN FOREIGN CURRENCY

Table 8. Results of Long-run money demand for M1 in foreign currency in monthly data

	Model 1	Model 2	Model 3
B_{cc}	1.56*	1.780*	1.52*
	(0.000)	(0.000)	(0.022)
B_r	-0.071*	-0.008	-0.010
	(0.000)	(0.900)	(0.780)
B_{atms}	-	-0.001	-
		(0.859)	
B_{prd}	-	-	0.062
			(0.359)
B_{pbd}	-	-	0.205
			(0.197)
B_{pn}	-	-	-1.154 *
			(0.052)
B_{dummy}	-	-	-0.011*
			(0.030)

Note: F-statistic above the upper bound denotes rejection of the null of no cointegration at level of significance.

APPENDIX VI

TESTS FOR HETEROSCEDASTICITY, AUTOCORRELATION, AND NORMALITY

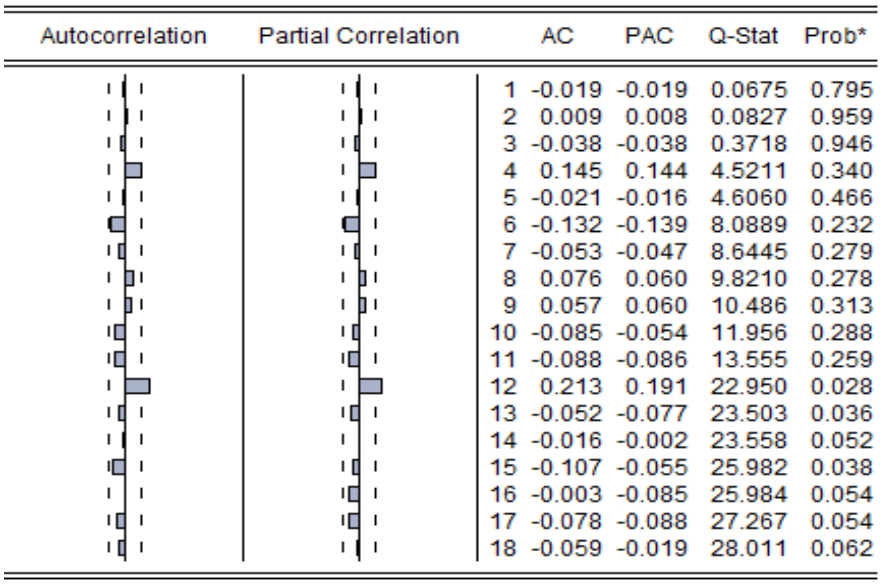
1- Table 9.Test for Heteroscedasticity: Breusch-Pagan-Godfrey

F-statistic	0.868
Prob.F(11,180)	0.572
Obs*R-squared	9.679
Prob. Chi-Square(11)	0.559

We should not reject the null hypothesis at 10%, 5%, 1% level with probability is equal to 0.572. Thus, heteroscedasticity does not exist and variances are equal.

2- Autocorrelation test

We use the "Ljung Box Q-stat" to test for serial correlation. If it exists then the assumption $Cov(u_t,u_s)= 0$ no longer holds.



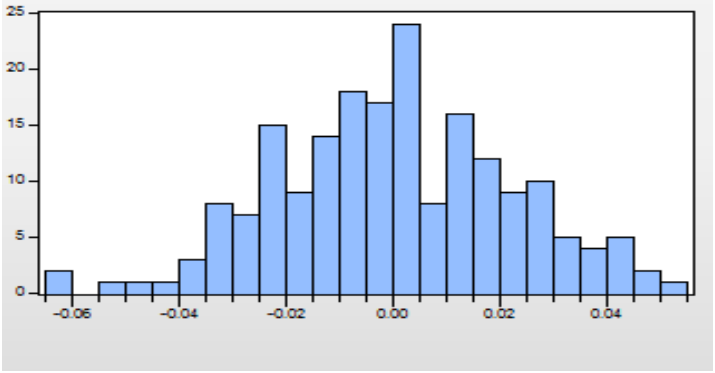
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.019	-0.019	0.0675	0.795
		2	0.009	0.008	0.0827	0.959
		3	-0.038	-0.038	0.3718	0.946
		4	0.145	0.144	4.5211	0.340
		5	-0.021	-0.016	4.6060	0.466
		6	-0.132	-0.139	8.0889	0.232
		7	-0.053	-0.047	8.6445	0.279
		8	0.076	0.060	9.8210	0.278
		9	0.057	0.060	10.486	0.313
		10	-0.085	-0.054	11.956	0.288
		11	-0.088	-0.086	13.555	0.259
		12	0.213	0.191	22.950	0.028
		13	-0.052	-0.077	23.503	0.036
		14	-0.016	-0.002	23.558	0.052
		15	-0.107	-0.055	25.982	0.038
		16	-0.003	-0.085	25.984	0.054
		17	-0.078	-0.088	27.267	0.054
		18	-0.059	-0.019	28.011	0.062

Results in the above table indicate that there is no serial correlation since the probability is greater than 5%. Thus error occurring at period "t" is not correlated with one at period "s".

3- Normality test for residuals

Jarque-Bera is a test for normality, applied on the residuals to show whether the data set is normally distributed or not.

Figure 10. Normality test



Results show that probability is equal to 0.89 which is greater than 5%, meaning that we do not reject the null hypothesis which assumes there is normality. Thus, the distribution of the residuals is normal.

REFERENCES

Al-Laham, Mohamad, Haroon Al-Tarawneh, and Najwan Abdallat. "*Development of electronic money and its impact on the central bank role and monetary policy*." Issues in Informing Science and Information Technology 6.unknown (2009): 339-349.

Arize, Augustine C. "*Effects of financial innovations on the money demand function: Evidence from Japan*." International Economic Journal 4.1 (1990): 59-70.

Arrau, Patricio, and José De Gregorio. "*Financial innovation and money demand: application to Chile and Mexico.*" The Review of Economics and Statistics (1993): 524-530.

Attanasio, Orazio P., Luigi Guiso, and Tullio Jappelli. "*The demand for money, financial innovation, and the welfare cost of inflation: An analysis with household data.*" Journal of Political Economy 110.2 (2002): 317-351.

Ball, Laurence. "*Short-run money demand*." Journal of Monetary Economics 59.7 (2012): 622-633.

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine. "*Law and finance: why does legal origin matter?*." Journal of comparative economics 31.4 (2003): 653-675.

Casto Martin Montero Kuscevic, "*Money demand, income elasticity and financial innovation: A regional case study of Bolivia*". (Working paper)

Choi, Woon Gyu, and Seonghwan Oh. "*A money demand function with output uncertainty, monetary uncertainty, and financial innovations*." Journal of Money, credit, and Banking 35.5 (2003): 685-709.

Cull, Robert, and Laurie Effron. "*World Bank Lending and Financial Sector Development.*" The World Bank Economic Review, vol. 22, no. 2, 2008, pp. 315–343. JSTOR, JSTOR, www.jstor.org/stable/40282276.

Deng, Ziliang, and Lei Hou. "*Financial underdevelopment, distorted lending and export market survival*." The Journal of International Trade & Economic Development 23.5 (2014): 600-625.

Deravi, M. Keivan, Charles E. Hegji, and H. Dean Moberly. "*Government debt and the demand for money: An extreme bound analysis.*" Economic Inquiry 28.2 (1990): 390-401.

Donghyun Park & Kwanho Shin (2017) "*Economic Growth, Financial Development, and Income Inequality, Emerging Markets Finance and Trade*" 53:12, 2794-2825.

Emran, M. Shahe, and Subika Farazi. "*Lazy banks? government borrowing and private credit in developing countries*." Institute for International Economic Policy Working Paper 9 (2009).

Etzkowitz, Alex, and Henry Etzkowitz. "*Counter-cyclical public venture capital: Debt-funding as an anti-austerity innovation strategy*." Social Science Information 56.3 (2017): 477-495.

Fischer, Andreas M. "*Measuring income elasticity for Swiss money demand: What do the cantons say about financial innovation*?" European Economic Review 51.7 (2007): 1641-1660.

Frame, W., Scott, and Lawrence J. White. 2004. "*Empirical Studies of Financial Innovation: Lots of Talk, Little Action?*" Journal of Economic Literature, 42(1): 116-144.

Guiso, Luigi, et al. "*Does Local Financial Development Matter?*" The Quarterly Journal of Economics, vol. 119, no. 3, 2004, pp. 929–969. JSTOR, JSTOR, www.jstor.org/stable/25098706.

Hasan, Mohammad S. "*Financial Innovations and the Interest Elasticity of Money Demand in the United Kingdom, 1963-2009.*" International Journal of Business and Economics 8.3 (2009): 225.

Ilyina, Anna, and Roberto Samaniego. "*Technology and Financial Development.*" Journal of Money, Credit and Banking, vol. 43, no. 5, 2011, pp. 899–921. JSTOR, JSTOR, www.jstor.org/stable/20870084.

Ireland, Peter N. "*Endogenous financial innovation and the demand for money*." Journal of Money, Credit and Banking 27.1 (1995): 107-123.

Kabir, M., and I. Mangla. "*Effects of financial innovations on the money demand function: a Canadian evidence*." Applied Economics 20.9 (1988): 1263-1273.

Kluza, Krzysztof. "*Financial innovation in local governments as a response to the deterioration of their risk profile and legislative changes: The case of Poland*." The Innovation Journal 21.1 (2016): 1.

Lee, Sunhee. "*Money Demand and Financial Innovation*". Diss. Vanderbilt University, 2004.

Mendoza, Enrique G., et al. "*Financial Integration, Financial Development, and Global Imbalances.*" Journal of Political Economy, vol. 117, no. 3, 2009, pp. 371–416. JS TOR, JSTOR, www.jstor.org/stable/10.1086/599706.

Mulligan, Casey B., et al. "*US money demand: surprising cross-sectional estimates.*" Brookings Papers on Economic Activity (1992): 285-343.

Padrini, Flavio. "*Velocity innovations, financial markets, and the real economy*." Journal of Monetary Economics 49.3 (2002): 521-532.

Rajan, Raghuram G., and Luigi Zingales. "*Financial systems, industrial structure, and growth.*" Oxford review of economic Policy 17.4 (2001): 467-482.

Singh, Sunny Kumar. "*Currency demand stability in the presence of seasonality and endogenous financial innovation: Evidence from India*." Journal of Financial Economic Policy9.02 (2017): 122-139.

Sowunmi, Fatai Abiola, et al. "*Effect of Automated Teller Machine (ATM) on demand for money in Isolo local government area of Lagos State, Nigeria*." The Journal of Applied Business and Economics 16.3 (2014): 171.

Tian, Xiaowen, Wenjuan Ruan, and Erwei Xiang. "*Open for innovation or bribery to secure bank finance in an emerging economy: A model and some evidence*." Journal of Economic Behavior & Organization 142 (2017): 226-240.

Welch, Patrick J., and Gerry F. Welch. "*Economics, Theory & Practice*". Dryden Press, 1992.

Yang, Bill Z., and Amanda S. King. "*Do credit cards really reduce aggregate money holdings?*." Atlantic Economic Journal 39.1 (2011): 85-95.