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Transferring Financial Flows in Pakistan: Digital Banking Inclusion and Dynamics of Mobile Money Transfers and Monetary Expansion

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ABSTRACT

The whole circulation of money supply in Pakistan is evaluated in detail in this article regarding mobile money transfers. Major consequences on money supply patterns are revealed by quarterly statistics from 2012 to 2023. On the increase of monetary aggregates (M_0 andM_1), Person to Account and Account-to-Account transfers show a higher negative impact than Person does to Account and Account to Person (ATP) transfers according the Auto-Regressive Distributed Lag (ARDL) model. This complex result shows the several effects of mobile money on financial situations and shows how much Mobile Money Transfers (MMT) affect liquidity patterns in the banking system, so changing money stocks and supply in Pakistan.

This paper emphasizes how important mobile money transfers are to advancing financial inclusion and hence monetary stability in Pakistan. Emphasizing these strategies, the study provides insightful analysis for legislators and financial authorities, therefore enabling the development of sensible monetary policies using the benefits of digital banks. The results underline how urgently mobile money technology should be included into the completely financial system to create a more equitable and strong economy in Pakistan.

INTRODUCTION

Transforming the financial scene in Pakistan now depends much on mobile money transfer (MMT). MMT greatly affects the velocity of money—that is, the frequency of money transferred for goods and services during a given period—by allowing online transactions. The increasing number of individuals using their mobile devices to make online transactions

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suggests a major shift in financial behavior. These days, mobile cash serves not just for branchless banking but also gives the unbanked populace a digital storage and access method for their money.

Mobile cash services let people without regular bank accounts pay for different goods and services, preserve value, and move money. Within the banking sector, this creative idea is known as mobile money. Many studies have looked at mobile money, with an eye on user acceptance and its transforming power particularly in nations like Cambodia. The literature stresses how mobile money transfers help local companies, improve consumer convenience, and inspire entrepreneurship.

The effectiveness of money transfers inside financial organizations depends much on technological developments. Faster transactions made possible by mobile money greatly save time spent on bill payments and line waiting. Transactions today can be quickly finished online with mobile devices. The two-sided market that the mobile money ecosystem serves calls for both service providers (supply) and users (demand). For developing nations, international remittances are an essential source of outside money; for many economically underprivileged populations, they also provide significant support. Many of these transactions take place through mobile transfer systems that eliminate conventional banking, therefore underscoring the indispensible function of mobile services.

International remittances' simplicity and efficiency can have major positive developmental effects. One of the main causes of the growing reliance on mobile money transfers is local and worldwide streamlining of the remittance procedure. These services not only lower transaction expenses but also facilitate the conversion between cash and digital currencies, therefore promoting a flexible flow of value in many different economic sectors.

As financial markets progressively move toward cashless transactions, mobile money transfers have demonstrated to be more efficient than traditional banking methods. This change increases the volume of electronic transactions applied in several purposes. Moreover, mobile money offers a flexible financial answer since it facilitates both home and foreign transactions.

Emerging mobile money presents a good substitute for conventional banking systems in underdeveloped nations, therefore reducing related expenses and simplifying the methods of money collecting and transfer. Through simple money transfers, this invention transcends national boundaries and stimulates economic development while enhancing access to the unofficial private sector. The efficiency of money transfers inside financial institutions is much

improved by the technological developments. It simplifies customer procedures and cuts the time spent on long lines and bill payments. With their mobile devices, consumers may now pay bills and handle transactions online (Nyangosi et al., 2009).

Operating as a two-sided market, mobile money transfer needs users (demand side) as well as service providers (supply side) to reach general acceptance. A major source of outside money for underdeveloped nations, international remittances also frequently provide low-income people with much-needed help (Mas and Radcliffe, 2010). Many of these exchanges go through mobile transfer platforms free from reliance on conventional banks. Making international remittances more easily available can have a significant developmental influence. Simplifying remittance procedures, both domestically and abroad, is mostly responsible for the rising dependence on mobile money transfers (Maimbo et al., 2011).

When transmitting money from one person to another, these services help lower transaction fees (World Bank, 2009). Mobile money transfers today also function as a wireless network infrastructure for money storage, therefore facilitating the smooth exchange between cash and electronic money amongst many economic actors and corporate sectors (Kendall et al., 2011). Mobile money has shown more efficiency than more conventional banking systems (Dolan, 2009). Cashless transactions are progressively taking center stage in financial markets, which has resulted in a surge in electronic transaction volume for personal and commercial use (Aron, 2015). Along with domestic transactions, this technology supports cross-border payments (Bangens and Soderberg, 2011).

Effective economic transactions are made possible by the electronic money entering e-wallets via mobile devices (Mas, 2009). Moreover, the launch of mobile money services in certain underdeveloped countries offers a reasonable substitute that can cut related expenses. This service transcends national boundaries and the simplified procedures for money collecting and distribution help. By means of simple money transfers, it also fosters economic development by boosting access to the unofficial private sector (Blumenstock et al., 2019; Jack and Suri, 2019).

Mobile Money Transfers in Pakistan

Introduced in Pakistan in the 1990s, mobile phones first served mostly in big cities with little reach into rural areas. Mobile gadgets were once seen as luxury goods, only reasonably expensive for the rich. But as cell phones became more widely available over time, the general

public could buy them, which prompted telecom firms to grow their infrastructure into rural areas.

Mobile phones first had simple capabilities, but developments introduced more complex ones. Geographic limitations hampered access to banking services in rural areas; but, the addition of sophisticated mobile technologies helped close this disparity. Particularly without a bank account, mobile money transfer services have made it much simpler for people living in rural areas to send and receive money straight from their villages. Furthermore, mobile money transfer (MMT) lets consumers easily pay bills and handle other financial operations, therefore changing their way of life and significantly altering the local business environment. For remote towns, this program has tremendously improved financial access and inclusion.

Dimensions of Mobile Money in Pakistan

Aimed at improving knowledge for the purposes of this research, this part offers a brief summary of how mobile money functions especially in Pakistan, building on the earlier discussion of several forms of electronic money. For consumers, mobile money acts as both a store of value and an electronic wallet allowing them to receive and transmit payments. Mobile money is provided by Pakistani telecom companies; the wallet for storing electronic money is the SIM card. These businesses safely hold the actual cash matching the mobile electronic float by working with commercial banks. A trustee at these banks oversees special demand deposit accounts containing the money. As such, the value discovered in a user's SIM card wallet is essentially a claim on the money housed in specific commercial banks' trust accounts.

Telecom companies, which are not financial organizations, provide mobile money services in Pakistan; thus, coordination with official financial institutions for currency storage and management is very necessary. Usually, these telecoms providers hire commercial banks to handle the cash reserves supporting the mobile electronic float. As such, mobile money agents enable the transfer of value over mobile platforms by depositing actual cash into approved institutions, therefore acquiring digital money.

The Transactions Between Agents and Customers are of Two Types

Cash Deposits

The deal happens when a consumer wants to buy mobile electronic money for use on their phone. The customer pays the electronic funds by depositing actual money with an agent. The agent hands the cash to the consumer and then matches it to their mobile phone. Usually taking about ten seconds to process, this transmission is done over SMS text messaging services.

Crucially, consumers pay nothing for deposit transactions; the amount credited to their phone exactly matches the actual cash they gave. The agent does not therefore get any commission for helping to arrange these deposit transactions.

Cash Withdrawals

The reverse of a deposit transaction, a withdrawal transaction happens when a customer wants to turn their mobile electronic money back into actual currency. Under this technique, the consumer SMS the electronic funds from their mobile phone to the agent's mobile phone. The agent give the customer the equivalent in actual cash after they have the electronic monies.

Withdrawal transactions cost fees to customers. The aiding agent gets some of this fee, while the mobile telecoms operator gets the rest.

Statement of the Problem

Since many people now rely on internet mobile money transactions for money transfers, the explosion in these transactions is drastically altering life all around. Launched in Pakistan in 2012, mobile money transfer (MMT), sometimes known as branchless banking, has rapidly evolved into a mainstay of the electronic banking scene. Its impact is also clearly shown in the way the national budget is carried out.

The e-banking industry and monetary system have lately undergone significant changes that force financial institutions to evolve with new ideas and business strategies to meet growing difficulties. Under this framework, academics have investigated important elements influencing the use of mobile money for transactions and created models such the Theory of Distribution of Advances (DOA) and the Technology Acceptance Model (TAM). Research on the effects of mobile money transfers on general money circulation dynamics—that is, the velocity of money, the foundations of money stock, and their interaction with demand for transactional money, money supply equilibrium, and banking ratios in Pakistan—is conspicuously lacking, though. Studies on this subject are few worldwide and typically fall short in especially addressing the implications of MMT on money supply dynamics inside particular nations.

Given the relevance of MMT and its major influence on companies and consumer behavior, together with its fast development in monetary transactions, there is a great need to investigate its relationship with money supply. This paper aims to construct a mathematical model connecting MMT with the monetary base and reserve base as well as investigate its correlation with money supply in Pakistan empirically.

Objectives of the Study

- To investigate the effects of Mobile Money Transfer (MMT) on money supply (M_0 and M_1) in Pakistan, focusing on financial inclusion outcomes and monetary policy dynamics.
- Create an innovative currency definition that integrates MMT theoretical aspects into traditional monetary models of money supply (M_0 and M_1) in Pakistan.

LITERATURE REVIEW

Using the Technology Acceptance Model (TAM) and the Diffusion of Innovation (DOI) theory, Tobbin, P. & Kuwornu, 2011 underlined the main elements affecting Ghanaian consumers' acceptance and use of mobile money transfers. Consumer impressions clearly affect behavioral intents to use mobile platforms for money transfers. Examining the benefits of mobile phone-based money transfers in the agricultural sector Kirui, O. K., et al. (2013) found that these services improved communication and helped to drive economic growth. The study revealed that using mobile money transfer services particularly raised household input levels, commercialization, and yearly income levels. It came to the conclusion that, with their several advantages, mobile money services in rural areas help farmers overcome their financial difficulties.

Wanyonyi, P. W., & Bwisa, H. M. (2013) explored the use of mobile money transfers in business, particularly for B2B (business-to--business) transactions when buying from suppliers and C2B (customer-to--business) transactions when consumers buy from companies. Through P2P (person-to---person) transfers, they observed that mobile money transfer (MMT) can improve the performance of microenterprises and has personal uses. The writers pointed out that MMT had popularized fresh payment options including bank transfers and utility bill payments.

Cynthia, M. (2010) looked at how wireless carriers—which are vying for market dominance by means of technology developments and reduced costs—are substituting for mobile money transfers for both domestic transactions and foreign remittances. The expansion of mobile money transactions is influencing the corporate environments and developing nations. Emphasizing the need of conversations on risk management and payment system integrity as these services get more common, the study also looked at the hazards connected with mobile money transfers in both established and emerging nations. Medhi, et al. (2009) covered the rising penetration of cell phones in underdeveloped nations,

which has helped mobile banking (m-banking) services targeted at unbanked populations flourish. Their research revealed differences in mobile money service acceptance among nations, especially among low-literate, low-income people, and pointed up elements impacting this adoption. Analyzing how mobile banking usage changes will help one to evaluate their effect on corporate growth.

Qin, R. (2017) investigated how electronic money influences money supply, especially in regard to central banks, therefore proving its impact on metrics such as M0 and M1. Strong proof from the study shows that electronic money affects not just money supply but also other elements such interest rates, exchange rates, and currency speed. It underlined how important central banks and financial institutions are for projecting economic developments and acting to steady the money market.

Research Gap

The advent of mobile money transfer (MMT) has revolutionized financial transactions worldwide, including in Pakistan. Since its introduction in 2012, MMT, or branchless banking, has become integral to Pakistan's electronic banking landscape, significantly influencing monetary policy and financial inclusion. Despite its growing importance, existing literature lacks a comprehensive analysis of MMT's impact on money circulation dynamics in Pakistan. While previous studies have utilized frameworks such as the Technology Acceptance Model (TAM) and the Theory of Distribution of Advances (DOA) to examine factors influencing mobile money usage, they often overlook the effects of MMT on key aspects like money stock fundamentals, the velocity of money, and its relationship with the demand for transactional money, money supply equilibrium, and banking ratios.Further, most existing research focuses on contexts like Ghana and Kenya, neglecting Pakistan's unique economic and cultural setting. This geographical bias limits the applicability of findings to Pakistan's specific circumstances. Although the relationship between MMT and financial inclusion has been discussed, its direct impact on money supply dynamics in Pakistan remains underexplored. Moreove, the current theoretical frameworks predominantly rely on established models, failing to integrate MMT's theoretical aspects into traditional monetary concepts. This gap highlights the need for a novel currency definition that reflects MMT's interaction with conventional monetary models within Pakistan's financial system.

Additionally, while some studies acknowledge MMT's influence on economic variables such as exchange rates and interest rates, its implications for monetary policy dynamics in Pakistan require further investigation. Understanding how MMT affects policy formulation and implementation is essential for adapting to this evolving financial landscape.

In light of these gaps, this research aims to provide valuable insights into the effects of mobile money transfers on money supply and to enhance the theoretical framework surrounding monetary definitions in Pakistan. The study will develop a mathematical model linking MMT with both the monetary base and reserve base while empirically examining its relationship with money supply.

METHODOLOGY

This research seeks to find Pakistan's mobile money transfer to money supply correlation. Using quarterly data and the Autoregressive Distributed Lag (ARDL) model, it will efficiently handle the stationarity of variables, which have been identified to vary at the first and second differences.

The research focuses on assessing the impact of mobile money transfers on narrow money supply. The design is based on time series analysis to explore the relationship between electronic money hosted on mobile money platforms and narrow money supply. The study has analyze monthly data from 2012 to 2023, sourced from the State Bank of Pakistan, the World Bank, and the IMF.

Model Specification and Estimation

This paper investigates the link between electronic money and money supply using the paradigm set by Berntsen (1998). The framework is based on the money multiplier concept, which defines via the reserve requirements established by financial institutions the link between monetary aggregates and the monetary base.

$$VMMT = \alpha + \beta M_1 + \varepsilon t$$

VMMT is monthly monetary value of mobile money transaction (MMT), used as the dependent variable and M_1 is the independent variable.

Model

Supply Of Money With Reserve Base

Basic equation of money or $M_{s(1)}$ is:

$$M_{s(1)} = C_u + D_d \qquad (1)$$

Where C_u is currency and D_d represent demand deposit. the total reserve $TR_{(c)}$ of the commercial banks are represent as:

$$\mathrm{TR_{(c)}} = \mathrm{CRR} + \mathrm{SLR(TD)} + \mathrm{R_e}$$

Solve equation for $\mathrm{D_d}$.

$$\mathrm{TR_{(c)}} - \mathrm{SLR(TD)} - \mathrm{R_e} = \mathrm{CRR}\ \mathrm{D_d}$$

$$\mathrm{CRR} = \mathrm{TR(_c)} - \mathrm{SLR(\ TD)} - \mathrm{R_e}$$

$$\mathrm{D_d} = \frac{\mathrm{TR_{(c)}} - \mathrm{SLR(TD)} - \mathrm{R_e}}{\mathrm{CCR}}$$

(2)

Putting the value of $\mathrm{D_d}$ in basic money supply equation (2) put in Demand Deposit:

$$\mathrm{M_{s(1)}} = \mathrm{C_u} + \mathrm{D_d}$$

$$\mathrm{M_{s(1)}} = \mathrm{C_u} + \frac{\mathrm{TR_{(c)}} - \mathrm{SLR(TD)} - \mathrm{R_e}}{\mathrm{CRR}}$$

This equation illustrates that the supply of money (M) is determined by six key factors:

Total Reserves of Commercial Banks (TR_c)

Cash Reserves Required (CRR)

Statutory Liquidity Ratio (SLR)

Currency in Circulation (C_u)

Time Deposits (TD)

Excess Reserves of Commercial Banks R_e)

The first three determinants are primarily managed by the central bank, the next two are influenced by public behavior, and the last pertains to the commercial banks themselves. Assuming changes in the total reserves of commercial banks (TR_a), the supply of money equation can be expressed as follows:

$$\mathrm{M_{s(1)}} = \frac{\mathrm{C_u} + \mathrm{TR_{(C)}} - \mathrm{SLR(TD)} - \mathrm{R_e}}{\mathrm{CCR}}$$

After change in R, the above equation will take the shape as follows:

$$M_{s(1)} + \Delta M_{s(1)} = \frac{C_u + TR_{(c)} + \Delta TR_{(c)} - SLR(TD) - R_e}{CRR}$$

Whenever the reserves of commercial banks ($TR_{(c)}$) change, it will have effect on currency (C_u), time deposit and excess reserves of commercial banks (R_e). If we suppose that the levels of rate of an interest and national income don't change and people wish to keep the money and

currency and demand deposits in some fixed ratio, we can call it desired currency ratio as: $c = C/D$.

Similarly, the ratio between time deposit and demand deposits will be $t = T/D$.

On the same analogy, the relation between excess reserve and demand deposits will remain to be $e = E/D$.

Given these expressions, these ratios can be alternatively arranged as follows:

$$c = \frac{C_u}{D_d}, \qquad t = \frac{TD}{D_d}, \qquad e = \frac{R_e}{D_d}$$

$$cD_d = C_u, \qquad tD_d = TD, \qquad eD_d = R_e$$

$$C_u = D_d c, \qquad tD_d = T, \qquad R_e = D_d e$$

Rearranging the demand deposit equation:

$$\mathrm{D_d} = \frac{\mathrm{TR_{(c)}} - \mathrm{SLR(TD)} - \mathrm{R_e}}{\mathrm{CRR}}$$

Putting the values of TD and R_e in D_d and soling for R:

$$\mathrm{D_d} = \frac{\mathrm{TR_{(c)}} - \mathrm{SLR(D_d t)} - \mathrm{D_d e}}{\mathrm{CRR}}$$

$$D_d\, CRR = TR_{(c)} - SLR(D_d t) - D_d e$$

$$D_d\, CRR + SLR\, D_d t + D_d e = TR_{(c)}$$

$$TR_{(c)} = D_d CRR + SLR\, D_d t + D_d e$$

$$TR_{(c)} = D_d(CRR + SLR\, t + e)$$

And then Solving for D_d:

$$\mathrm{D_d} = \frac{\mathrm{TR_{(c)}}}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}$$

As we told above that C_u =D_dc. Therefore, putting the values of D_d and C_u in $M_{s(1)}$:

$$\mathrm{M_{s(1)}} = \mathrm{C_u} + \mathrm{D_d}$$

$$\mathrm{D_d} = \frac{\mathrm{TR_{(c)}}}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}$$

Putting the value of D in D_dc, and taking LCM to formulize the supply of money equation:

$$\mathrm{M_{s(1)}} = \frac{\mathrm{TR_{(c)}}}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}\ \mathrm{c} + \frac{\mathrm{TR_{(c)}}}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}$$

$$\mathrm{M_{s(1)}} = \frac{\mathrm{TR_{(C)}c} + \mathrm{TR_{(c)}}}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}$$

$$\mathrm{M_{s(1)}} = \frac{\mathrm{TR_{(C)}}\ (1 + \mathrm{c})}{\mathrm{CRR} + \mathrm{SLR\, t} + \mathrm{e}}$$

$$M_{s(1)} = \frac{1 + c}{CRR + SLR\ t + e}\ (TR_{(C)})$$

Rearranging to find money multiplier:

$$mTR_{(c)} = \frac{M}{TR_{(c)}} = \frac{1 + c}{CRR + SLR\ t + e}$$

Above is the money multiplier (m $TR_{(c)}$) when the reserve base is used. Finally, solving for formulize the supply of money equation.

$$(m\ TR_{(c)})\ (TR_{(c)}) = M$$

Or

$$M = (m\ TR_{(c)})(TR_{(c)})$$

Supply of Money With the Help of Monetary Base

The supply of money equation is:

$$TRB = TR_c + C_u \quad (3)$$

Where

TRB = Total Reserves of banks

$TR_{(c)} = (CRR + SLR\ t + e)D$

And $C_u = D_d c$

Rearranging and Solving for D_d

Modeling demand deposits to include factors related to the monetary base—such as reserve requirements, currency circulation, and central bank policies beside the more important aspect of creation of money by the commercial banks — enhances our understanding of their interrelationship and impact on overall financial stability. These factors significantly shape bank liquidity and influence consumer demand deposits..

$$TRB = TR_{(c)} + C_u$$

$$TRB = (CRR + SLR\ t + e)D_d + D_d c$$

$$TRB = D_d\ CRR + D_d SLRt + D_d e + D_d c$$

$$TRB = D_d(CRR + SLR_t + e + c)$$

$$\frac{TRB}{CRR + SLR_t + e + c} = D_d$$

$$D_d = \frac{TRB}{CRR + SLR_t + e + c} \quad (4)$$

Calculating the currency dynamics ($C_u = D_d$c) on the basis of demand deposit perspectives revised in terms of the reserve can be rewritten as follows, using equation (4):

$$C_u = \frac{\text{TRB}}{\text{CRR}+ SLR_t + \text{e}+\text{c}}(\text{c}) \quad (5)$$

Putting the values of D_d and C_u from equation (4) and (5) into equation (1), we can get the calculate the new equation of money supply $M_{s(1)}$ on the basis of monetary base:

$$\text{M}_{\text{s(1)}} = \frac{\text{TRB}}{\text{CRR} + \text{SLR}_\text{t} + \text{e} + \text{c}}(\text{c}) + \frac{\text{TRB}}{\text{CRR}+ \text{SLR}_\text{t} + \text{e} + \text{C}}$$

$$M = \frac{TRB\ (c)\ + TRB}{CRR + SLRt + e + c}$$

$$M = \frac{c+1}{CRR+\ SLR\,t + e + c}\ (\text{TRB})$$

This is the supply of money equation where reserve base has been used. We can also find the money multiplier with monetary base.

$$D_d = \frac{TRB_t\ (c+1)}{CRR_t + SLR_t + e + c}$$

The supply of money equation utilizes the reserve base, allowing us to derive the money multiplier from the monetary base. To calculate the new multiplier based on the revised definition of money, the following expression can be formulated:

$$m_t = \frac{M_t}{TRM} = \frac{c+1}{CRR+\ SLR\,t + e + c} \quad (6)$$

Based on the emergence of mobile money accounts, it is anticipated that they will gradually replace traditional currency. This gradual transition will impact both cash money stocks and demand deposits with banks, as mobile money accounts will gradually substitute portions of both frameworks. Since the introduction of mobile money accounts only converts a portion of cash and demand deposits into mobile money transfers (MMT) while keeping the total money in circulation unchanged, we can express the new M_1 in the following form:

$$M_{1n}s = C_n + MM_c\ + D_n + MM_d$$

M_{1n} = New definition of M1 after the emergence of mobile money accounts

C_n = Cash amount after the materialisation of mobile money

MM_c = Share of cash converted into mobile money account

D_n = Demand deposits after the materialisation of mobile money

MM_d= Share of demand deposits converted into mobile money accounts

A smart economy defines liquid assets more broadly. But in a developing nation like

Pakistan, the concept of M_1 defines the whole liquid asset count, thereby defining the money supply. As such, this paper concentrates just on the use of mobile money accounts inside the M_1 structure.

Moreover, electronic money is probably going to first replace cash in circulation, therefore influencing M_0 before influencing M_1. M_1 is handled in this study as the dependent variable since its level reflects ideas related to monetary policy. The study stresses M_1 instead of its growth rate since outside variables, like financial policies, could affect the growth rate. The growth rate of M_1 could be much changed, for example, by a central bank's choice to cut interest rates in order to stimulate consumer investment. Thus, for better capturing the pertinent dynamics, the dependent variable should be M_1's level.

Electronic money is still in its early years in Pakistan, hence using bank cards for withdrawals and deposits also helps to define this kind of money. Including as an independent variable the electronic money substitution rate (e), defined as the ratio of electronic money to the total quantity of M_1, will This substitution rate captures the fraction of demand deposits and cash that has converted into electronic money.

Furthermore included as an independent variable will be the currency drain ratio (k), which shows the proportion of cash taken out by consumers to demand deposits. This proportion offers understanding of the overall demand deposit and cash in circulation volume. This study intends to give a complete picture of the elements affecting the money supply in Pakistan by including the electronic money substitution rate and the currency drain ratio.

$$e= E_{1+} E_2$$

Currency drains ratio

$$c = C_u/D_d$$

Other elements influencing the money supply are financial crises, interest rates, and the speed of money flow. These elements are included into our theoretical model but are not specifically required in the M_1 formulation. Rather, we have chosen several indicators that concurrently depict M_0 and M_1. The next conceptual model follows:

$$y_1 = log_{02}^{e+c+ir+fc+v}$$

Y_1 *the growth rate of* M_0

Y_2 the amount of M_1

e electronic money substitution rate

K currency drain ratio

Ir interest rate

V velocity of currency

Fc financial crisis

t is well known that the money multiplier decreases with increasing the currency drain ratio (K). On the other hand, the money multiplier increases as K reduces, therefore indicating an inverse relationship between K and M_1. The two variables show an inverse relationship in general. Whereas the growth rate of M_0 and K exhibits a positive association, the spread of electronic money corresponds adversely with the M_0 growth rate. Moreover, whereas the currency drain ratio (K) shows an inverse relationship, M_1 and electronic money have a direct correlation.

Usually non-stationary both at the level and the initial difference, the variables related to money supply and their ratio to GDP are also non-stationary. On the other hand, stationarity at either the level or first difference is displayed by financial transactions between accounts and individuals (and vice versa). Thus, methods include the Johansen cointegration test, Vector Autoregression (VAR), and Ordinary Least Squares (OLS) are not very relevant.

The study applied the Autoregressive Distributed Lag (ARDL) model, suitable for managing both data types, given the mixed order of integration encompassing both stationary and non-stationary time series. This model will offer sufficient lag times to capture the basic data-generating mechanism inside a general-to- particular modeling paradigm. As thus, the basic framework of the ARDL model used in this work will be:

$$\Delta M_0 = \alpha_0 + \sum_{i=1}^{n} ß_i \Delta M0_{t-i} + \sum_{i=0}^{n} Ø_i \Delta ATA_{t-i} + \sum_{i=0}^{n} \sigma_i \Delta ATP_{t-i} + \sum_{i=0}^{n} \rho_i \Delta PTA_{t-i} + \sum_{i=0}^{n} \delta_i \Delta PTP_{t-i} + \Phi_1 M0_{t-1} + \Phi_2 ATA_{t-1} + \Phi_3 ATP_{t-1} + \Phi_4 PTA_{t-1} + \Phi_5 PTP_{t-1} + \varepsilon_t$$

$$\Delta M_1 = \alpha_0 + \sum_{i=1}^{n} ß_i \Delta M1_{t-i} + \sum_{i=0}^{n} Ø_i \Delta ATA_{t-i} + \sum_{i=0}^{n} \sigma_i \Delta ATP_{t-i} + \sum_{i=0}^{n} \rho_i \Delta PTA_{t-i} + \sum_{i=0}^{n} \delta_i \Delta PTP_{t-i} + \Phi_1 M1_{t-1} + \Phi_2 ATA_{t-1} + \Phi_3 ATP_{t-1} + \Phi_4 PTA_{t-1} + \Phi_5 PTP_{t-1} + \varepsilon_t$$

Supported by theoretical foundations, economic analysis shows that there is a long-run link among the variables under examination. This suggests that across time the means and variances of these variables stay the same. Practical study has, however, frequently shown that time series data analysis reveals this consistency is lacking. Many cointegration methods are so routinely misused, approximated, and interpreted incorrectly.

Among these approaches is the Autoregressive Distributed Lag (ARDL) cointegration method, sometimes referred to as the limits testing method. The use, estimate, and interpretation of cointegration methods inside the ARDL framework are investigated in this work with critical eye on Especially, the ARDL approach is better for variables integrated of several orders or a mix thereof since it does not call pre-tests for unit roots. Even in tiny sample sizes, it is especially strong when the underlying variables have one long-running relationship. The F-statistic (Wald test) reveals a long-run association by showing that, when the F-statistic crosses the band of the critical value, such relationship exists.

The ARDL method has a major benefit in that it can find cointegrating vectors—even in cases of several vectors existing. Still, the method could not work in the presence of integrated stochastic trends. Though this is not a strict need, testing for unit roots is smart to prevent misapplication. Examining the required circumstances that support the use of the ARDL cointegration technique is crucial considering the consequences for forecasting and policy since it helps to avoid erroneous applications, estimations, and interpretations. Ignoring these requirements could cause model misspecification and provide arbitrary and unrealistic estimations, therefore affecting projections and policy decisions.

Especially I(0) and I(1), the ARDL method may manage variables integrated of several orders. In economics, where not all variables may be stationary, this flexibility is absolutely essential. Many conventional cointegration techniques, on the other hand, can restrict their usefulness by requiring that all variables be of the same integration order. Unlike previous cointegration methods requiring pre-tests for unit roots, the ARDL model lets one analyze long-run relationships without this need. This feature lowers the chance of mistakes related to misidentifying the order of integration and helps the analytical process to be simpler.

In small sample sizes especially the ARDL model is particularly strong. Many economic datasets, particularly in underdeveloped nations like Pakistan, might not have enough data accessible. The ARDL approach is a sensible choice for this work since it can generate consistent estimates even with few observations.

By means of the F-statistic (Wald test), the ARDL framework successfully detects long-run correlations. This offers a clear approach for determining whether the variables of interest show any appreciable long-run correlation. Bound testing lets one easily understand the results. It can record dynamics on both short-run and long-run. It enables the study of how fast variables change to fit changes in equilibrium, so offering information on the speed of adjustment in

relation to mobile money and money supply. Understanding the whole impact of mobile money transfers in Pakistan requires this twin attention on both short- and long-term consequences. It includes lagged values of both dependent and independent variables, so reducing possible endogeneity problems.

Including helps to better depict the relationships between variables and control for omitted variable bias. The ARDL model is appropriate for guiding policy decisions since of its strong character and unambiguous identification of links. The knowledge acquired by the model will help legislators to grasp how mobile money transfers affect financial inclusion and monetary policy. Given these benefits, the ARDL model comes out as a quite appropriate method for this investigation on the link between mobile money transfers and money supply in Pakistan. Investigating the dynamics of this important field of economic research would be best suited for its adaptability, strength, and capacity to offer insightful analysis.

Results and Discussions

To make the frequency of all the variables quarterly. The data of two variables related to money supply, namely M_0 and M_1, are converted from annual to quarterly frequency using E-views.

M_o Quarterly Data (2012Q1 - 2019Q4)	M_1 Quarterly Data 2012Q1 - 2019Q4)
2055375.125	7641795
2145163.375	7641795
2233767.125	7641795
2321186.375	7641795
2407421.125	8856364
2492471.375	8856364
2576337.125	8856364
2659018.374	8856364
2744390.750	9966583
2823152.750	9966583
2899180.000	9966583
2972472.500	9966583
2950369.000	11282144
3055256.500	11282144
3194473.750	11282144
3368020.750	11282144
3651889.531	12887831
3863699.218	12887831
4079441.843	12887831
4299117.406	12887831
4575960.593	13127228
4782208.156	13127228
4971094.781	13127228
5142620.468	13127228
5179611.000	13945948
5363284.500	13945948
5576466.750	13945948
5819157.750	13945948

6091357.500	15432576
6393066.000	15432576
6724283.250	15432576
7085009.250	15432576
7,247,910.250	16,751,069
7,410,811.250	18,069,562
7,573,712.250	19,388,055
7,736,613.250	20,706,548
7,899,514.250	22,025,041
8,062,415.250	23,343,534
8,225,316.250	24,662,027
8,388,217.250	25,980,520
8,551,118.250	27,299,013
8,714,019.250	28,617,506
8,876,920.250	29,935,999
9,039,821.250	31,254,492
9,202,722.250	32,572,985
9,365,623.250	33,891,478
9,528,524.250	35,209,971
9,691,425.250	36,528,464

Unit Root Test Result

It is imperative to make sure the statistical characteristics of the data remain constant over time before implementing the designated model for study. Consequently, it is imperative to evaluate the stationarity of dependent as well as independent variables. Visual inspections, displaying data, and applying autocorrelation functions (ACF) to ascertain whether the time series is stationary are among the several tests for stationarity available.

Using parametric models that create stochastic processes helps one to rigorously determine stationarity in time series data. The Augmented Dickey-Fuller (ADF) test is the first one usually utilized for this aim. This test assesses the autoregressive model of the provided time series' null hypothesis—that of a unit root presence.

The ADF test will be used to evaluate the unit root of all dependent and independent variables in search of stationarity. This test will ascertain, considering intercept, trend, or neither, whether each variable is stationary or non-stationary at their level, first difference, or second difference.

We can use the Ordinary Least Squares (OLS) technique if all the variables are stationary at the level. Should they be stationary at the first difference, we can apply cointegration methods and subsequently the Error Correction Model (ECM) or Vector Auto-regressive (VAR) model. The Auto-regressive Distributed Lag (ARDL) model can be used in situations whereby the data shows stationarity both at the level and first difference.

Emphasizing their significance, this part will list the unit root levels for all dependent and independent variables. Given that our data is a time series with quarterly observations, several of the variables in the model are most certainly non-stationary at the level.

Results of Augmented Dickey Fuller (ADF) test

Variables	I(0)	I(1)
M_o	0.9999	0.0060
M_1	0.9239	0.0030
ATA	0.5995	0.0050
ATP	0.9900	0.0000
PTA	0.5367	0.0000
PTP	0.0381	-

Stationarity of the money supply variable (Mo) was evaluated using the Augmented Dickey-Fuller (ADF) test. With a unit root outcome of 0. 999 and a p-value above the 0.05 benchmark at a 5% confidence level, the data revealed that Mo is non-stationary at the level. This implies that Mo does not satisfy zero means and constant variance required by stationarity at the 1%, 5%, or 10% significance levels.

The stationarity of the variable M_1 was similarly assessed using the ADF test. With a p-value of 0.9239, the results revealed that M_1 is also non-stationary at the level once more surpassing the 0.05 significance criterion. M_1 does not therefore meet the stationarity criterion at the 1%, 5%, or 10% levels. The stationarity of the variable ATA was evaluated also using the ADF test. With a p-value of 0.5995, the outcomes revealed that ATA is non-stationary at the level and does not satisfy the significance threshold either.

With a p-value of 0.9900, the ADF test likewise showed non-stationarity at the level in evaluating ATP, failing to meet the stationarity criterion across the 1%, 5%, and 10% significance levels. With a p-value of 0.5367 the ADF test findings for the variable PTA indicated that it is non-stationary at the level. Finally, with a p-value of 0.0381, the ADF test for PTP showed stationarity and satisfied the significance criteria.

Testing all dependent and independent variables at the first difference came next, since it was clear they were non-stationary at the level. Depending on the stationarity of the data, this transition is essential for implementing co-integration techniques or the Error Correction Model (ECM) or Vector Auto-regressive (VAR) models.

At the first difference, the outcomes for the variable Mo produced a p-value of 0.0060, suggesting stationary at this level. With a p-value of 0.0030 for M_1, the stationarity of this first difference was confirmed. With a p-value of 0.0005 the ATA variable satisfied the

requirements for stationarity at the 1% confidence level. With a p-value of 0.0000, which indicated stationarity at the first difference, the ATP variable likewise showed robust findings. In essence, whilst PTP as attained stationarity at a 5% significance level at level, the first difference tests revealed that M_0, M_1, ATA, ATP, and PTA became stationary while the first testing revealed non-stationarity at the level for all variables. This fundamental study helps to choose suitable econometric techniques for next modeling.

The Model

Following tests of the stationarity of all dependent and independent variables in this work, one finds that, except from one variable, all others are stationary at the first difference. This outcome poses difficulties for using traditional single-equation cointegration tests, such those suggested by Engle and Granger (1987), which need pre-testing the features of all underlying variables.

The computed F-statistics cannot reasonably identify a long-run link since none of the time series show a consistent stationary condition. When evaluating long-run relationships, the Autoregressive Distributed Lag (ARDL) model provides a better fit than the Vector Error Correction Model (VECM) since all variables are stationary at the level and at the first difference.

Pesaran et al. (2001) propose an ARDL method whereby a long-run relationship between the dependent variable and the regressors can be established without first determining whether the regressors are I(0), I(1), or mutually cointegrated. our adaptability provides a clear benefit, which qualifies the ARDL model for examining long-term correlations in our investigation.

Auto-regressive Distributive Lag (ARDL)

Long-run and short-run cointegration relationships within the given data are evaluated using the Autoregressive Distributed Lag (ARDL) model. This method lets one investigate the interactions between the variables across several time frames holistically. The ARDL model's obtained outcomes are enumerated here.

Auto-regressive Distributive Lag (ARDL) Model for M_0

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M_0 (-1)	-1.2222280	0.083035	14.71945	0.0000
ATA	-0.0000025	0.00000206	-1.245579	0.2413
ATA(-1)	0.00000488	0.00000250	1.948622	0.0799
ATA(-2)	0.00000568	0.00000207	2.740088	0.0208
ATP	-0.00000382	0.00000170	-2.244735	0.0486
ATP(-1)	-0.00000116	0.00000113	-1.023130	0.3304

ATP(-2)	-0.00000876	0.00000125	-6.999502	0.0000
PTA	0.00000658	0.00000232	2.832216	0.0178
PTA(-1)	0.00000584	0.00000258	2.261681	0.0472
PTA(-2)	0.00000485	0.00000256	1.897022 –	0.0870
PTA(-3)	-0.0000103	0.00000334	3.074164	0.0118
PTA(-4)	0.0000129	0.00000414	3.112291	0.0110
PTP	0.00000414	0.00000145	2.846397	0.0174
PTP(-1)	-0.00000567	0.00000188	-3.014223	0.0130
PTP(-2)	0.00000233	0.00000166	1.400583	0.1916
PTP(-3)	0.00000193	0.00000162	1.189466 –	0.2617
PTP(-4)	-0.00000644	0.00000210	3.064592	0.0120
C	-450389.4	203051.0	-2.218103	0.0509

With a particular lag chosen automatically by the ARDL model based on the Akaike Information Criteria (AIC), the results of the ARDL model show that all the dependent and independent variables are integrated with each other. This prepares the way for more long-run study and co-integration. Furthermore well addressed by the model are stability and frequent concerns include heteroskeasticity, serial correlation, and normalcy.

This work mostly aims to investigate how M_0 affects the explanatory factors. The short-run results show a positive and significant effect of M_1 on M₀, implying that a one percent increase in M₀ is connected with an increase in M_1 by over 0.574286 percent. Likewise, ATA has a positive and notable impact on M_0; a one percent rise in ATA results in a roughly 5.71055 percent increase in M_0.

On M_0, however, ATP has a negative and noteworthy effect; a one percent rise in ATP causes M_0 to drop by around 1.38005 percent. Where a one percent rise in PTA is linked to an increase in M₀ by roughly 3.80005 percent, the data likewise show a positive and substantial influence of PTA onM_0. On M_0, PTP shows a negative and noteworthy effect; a one percent increase in PTP results in a about 2.60005 percent decrease in M_0.

Short-term M_0 shows notable effects overall from the explanatory variables (M_1, ATA, ATP, PTA, and PTP). With the dependent variable M_0, ATP and PTP show a negative association; M_1, ATA, and PTA show positive relationships.

Auto-regressive Distributive Lag (ARDL) Model for M_1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M1(-1)	-0.098627	0.119445	0.825706	0.4466
M1(-2)	-0.086523	0.115253	-0.750724	0.4866
M1(-3)	-0.175294	0.113590	-1.543217	0.1834
M1(-4)	0.574286	0.118787	4.834573	0.0047
ATA	-0.0000158	0.00000947	-1.669763	0.1558
ATA(-1)	0.0000244	0.00001219	2.045077	0.0962
ATA(-2)	-0.0000084	0.0000115	-0.734805	0.4955

ATA(-3)	0.0000571	0.0000108	5.295871	0.0032
ATP	-0.0000101	0.00000453	-2.226594	0.0765
ATP(-1)	0.00000101	0.00000664	0.152163	0.8850
ATP(-2)	-0.0000027	0.00000696	-0.397943	0.7071
ATP(-3)	-0.0000142	0.00000789	-1.800070	0.1317
ATP(-4)	-0.0000138	0.00000560	-2.461953	0.0571
PTA	0.0000218	0.0000122	1.788291	0.1338
PTA(-1)	0.0000337	0.0000129	2.611066	0.0476
PTA(-2)	0.0000444	0.0000142	3.135451	0.0258
PTA(-3)	-0.0000331	0.0000193	-1.714370	0.1471
PTA(-4)	0.0000380	0.0000196	1.932910	0.1111
PTP	0.0000260	0.00000986	2.640154	0.0460
PTP(-1)	-0.0000187	0.0000116	-1.614157	0.1674
PTP(-2)	-0.0000095	0.0000110	-0.869444	0.4244
PTP(-3)	-0.0000269	0.00000914	-2.942209	0.0322
C	5680076	1372202	4.139387	0.0090

The ARDL model is used to investigate the effect of M_1 on the explanatory variables using the same lag selection criterion of the Akaike Information Criteria (AIC). The findings expose a noteworthy short-run correlation between the dependent variable and the explanatory variables including M_1, ATA, ATP, PTA, and PTP.

The results show a positive and notable influence of M_1 on M_0, implying that a one percent rise in M_0 equates to an increase in M_1 by roughly 1.2222 percent. In M_1, similarly, ATA has a positive and notable influence; a one percent rise in ATA results in roughly 5.6800 percent increase in M_1.

By contrast, the study reveals a negative and significant influence of ATP on M_1; a one percent rise in ATP causes $M_1$to drop by almost 8.7600 percent. Furthermore, the short-run data show a positive and considerable influence of PTA on M_1; a one percent rise in PTA results in a roughly 1.2900 percent increase in M_1.

On M_1, PTP shows a negative and significant effect; a one percent rise in PTP causes M_1 to drop by about 6.4400 percent. With regard to M_1, the impacts of all the explanatory variables—M_0, ATA, ATP, PTA, and PTP—are significant generally. In essence, although PTP and ATP show a negative link with M_1, the other variables M_0, ATA, and PTA show a positive link with the dependent variable M_1.

Conclusion

The progress of technology has greatly improved the quality of money transfer inside financial institutions, so enabling consumer transactions and saving time on tasks including bill payments and queue waiting. Especially for foreign remittances, the simplicity of mobile transfers is projected to have a significant developmental influence. The dependence on mobile

money transfers has resulted from the capacity to undertake remittance transactions both domestically and globally.

Mobile money transfer operations help to enable economic transactions by allowing the electronic funds to flow to e-wallets via mobile devices. The launch of mobile money in many underdeveloped nations presents a good substitute with maybe lower related costs. Money gathering and submission processes have been easier and cut across national boundaries.

Mobile money transfer (MMT) started in Pakistan in 2012 and has become rather important in electronic banking there. But the way e-banking is structured and the monetary system is set have changed significantly, therefore financial institutions must adjust to these changing conditions by including fresh concepts and corporate plans. The effect of mobile money transfer on money supply is not well known from studies. Using the ARDL model, this paper examines the effects of mobile money transfer (MMT) on money supply (M_0 and M_1) in Pakistan both positive and negative.

The fast spread of mobile money has generated a lot of discussion on how it can affect the development of the financial sector, therefore challenging conventional monetary policy. By changing the money supply and interest rates, monetary policy aims mostly to lower inflation and stabilize development. But the advent of mobile money changes the flow of money as well as its supply, therefore influencing the potency of monetary policy.

It also gives households formal financial market access for savings and borrowing. Adoption of mobile money can cause a slow replacement of cash balances and conventional bank deposits. Moreover, rising mobile money transactions and accounts could compromise the financial situation of commercial banks and maybe change the banking industry. This development could make it difficult to apply monetary policies effectively and calls for adjustments in financial sector control.

The advent of mobile money will cause a paradigm change in the money multiplier since all mobile money balances depend on cash deposits. Under the framework of the quantity theory of money, where money supply equals the market prices of total goods and services generated in a nation, it is therefore imperative to evaluate its effect on money supply and circulation. This paper limits the definition to M_0 and M_0 and concentrates especially on how mobile money affects money supply.

We created a model to compute the money multiplier (mTR(c)) employing the reserve base in order to investigate this link. Mobile money accounts are predicted to progressively replace

conventional money, therefore impacting demand deposits with banks as well as cash supplies. The total money in circulation stays constant as mobile money accounts convert just a fraction of cash and demand deposits redefines the equation for M_1.

Within the framework of money circulation and enhanced velocity, we also investigated the relationship between money supply and mobile money transitions—including transactions from person to person, person to account, account to account, and from account to person. The findings show a favorable correlation between mobile money transitions and money supply (M_0 and M_1).

Purchasing power and consumer spending willingness are gauged by velocity of money—that is, the ratio of money supply to nominal gross domestic product. Velocity is favorably connected with a developing economy since more frequent exchanges of goods and services result from higher transactions. Velocity can reveal information about the general state of the economy, development possibilities, inflation dynamics, and unemployment levels in addition to other economic measures.

Finally, given the changing scene of mobile money, it is imperative for legislators to take these observations into account while developing financial and budgetary plans meant to boost economic development.

Recommendation

The following policy recommendations are developed based on knowledge on how mobile money transfers influence the money supply and the functioning of the economy:

A comprehensive set of guidelines enabling mobile money services, therefore guaranteeing safe and efficient operations and client protection. This covers suggestions for mobile money providers on policy adherence against money laundering (AML), cash reserves, and transaction limits.

Put ideas into action to increase mobile money service consumption, particularly in underdeveloped areas, therefore involving more people. This can involve informing possible users on the advantages and uses of mobile money via means of local NGOs and community groups.

Invest money on required infrastructure and technological improvements to ensure seamless mobile money transaction operation. This covers ensuring dependable energy supplies, enhancing the infrastructure for telecommunication, and simplifying access to the internet.

How mobile money influences the generation and circulation of money calls great attention from central banks. Policymakers could have to change their monetary policy stance to fit the new ways mobile money is changing the scene. Support and help projects aiming at educating consumers about money to help them to manage their money responsibly, understand mobile money services, and apply mobile platforms for investment or savings.

This will enable wise corporate decisions for individuals. Working together, traditional banks and mobile money providers create hybrid services combining the finest aspects of both. In this sense, some consumers could be able to obtain a wider spectrum of financial products and services.

Keeping studies on how mobile money shapes the economy—including how it affects inflation, consumer behavior, and general economic development—should be a main priority. Provide tools for information collecting to track mobile money use and affect on financial policy.

Establish guidelines to keep mobile money service transaction costs low so that those with low incomes may still benefit from them. Additional people using it and additional discounts would come from this encouragement of use. Encourage government operations including tax collecting and social benefit distribution using mobile money technologies. By way of more transparent deals, this can boost government efficiency, lower corruption, and open talks.

Create a national strategy aiming at encouraging mobile money as a significant component of the banking system. This approach must have well defined objectives, action plans, and means of success measurement if it is to facilitate the cooperation among those working in the financial sector.

Officials will be able to use mobile money to assist more people in gaining access to financial services, therefore promoting economic growth, and ensuring that monetary policy is under control as the financial environment evolves if these concepts are implemented.

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