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FINANCIAL INNOVATION, TECHNOLOGICAL IMPROVEMENT AND BANKS' PROFITABILITY: AN EMPIRICAL INSIGHT

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ABSTRACT

An increasing trend of development in the financial system, with the use of information technology and the modernization of products and services, has led to financial innovation being considered one of the most important topics in the research community. The paper discusses the role of financial innovation and its importance in the modern financial system. We have proxied financial innovation in three dimensions, namely Fintech infrastructure, Fintech number of transactions, and Fintech amount of transactions; and we have tested the impact of these financial innovation variables, along with some control variables, on the profitability of the banking system. The study uses time series data from 2008 Q1 to 2021 Q4 and the ARDL Bounds test for analysis purposes. Using the ARDL model, a few proxies (latm, advtodep, cosstoinc, netpltonetloan, postram) of financial innovation demonstrate a positive and significant relationship in long run implying that financial innovation has an effect on the profitability of the financial sector in long run.

INTRODUCTION

Throughout history, humans have been encountering a phenomenon that is both, threat and opportunity, it depends upon the attitude of people what to make out of it. That phenomenon is called change. The famous maxim of Heraclitus, "Only constant in life is change", alerts that nothing is stagnant, the problems would change and therefore the solutions must also change (Osborne, 2003). Chinese politician, Li Keqiang once said, "Changes call for innovation, innovation leads to progress". This is the reason why we have observed that the innovation has remained the most famous mantra in scientific and business communities (Rao et al., 2001) in past more than hundred years and financial system is no exemption in this regard. The financial system facilitates the easy exchange between the participants regarding

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their funds and other transactions (Fohlin, 2016), from a simple exchange between lenders and borrowers to the complex models and software-based transactions, it has traveled a great deal of innovation. Since the medium of communication keeps on changing, or to say, it keeps on advancing, therefore the problems related to the exchange of funds, transactions, market dynamism vary over time, the financial system has kept on evolving itself to meet the needs. A typical financial system involves Banks, financial institutions other than banks, financial markets, financial transactions, financial instruments, and financial services. The financial system, as a whole, and its components have a long history of innovation and evolution. When it comes to instruments and institutions, both can be understood from global, regional and local perspective. Today, the world has a global financial system, that includes, global financial institutions and instruments (Verdun, 2018), whereas every region has its own such systems as well (García-Herrero & Wooldridge, 2007). Similarly, every country has its local financial system including its all relevant components (Kendall, 2012). These three levels of financial systems have their innovation-based evolution. Pakistan has a local financial system. Not only globally, but in developing countries like Pakistan, financial innovation enlarges the financial sector and ultimately contributes to the growth and economic development. This makes financial innovation a high priority in countries like Pakistan which direly needs growth and development.

Historical Background: Evolution of Financial System

The main role of the financial system is to channel savings from ultimate lender to ultimate borrowers. Households and institutions i.e insurance companies, pension funds, and mutual funds. Some credit is provided directly from the lender to borrowers like corporate bonds, treasury securities, and municipal bonds, and other investments on behalf of households. The financial system has evolved through various stages from its beginning and therefore it is important to understand how it has been developed and changed up till now. Before industrialization, the medium of exchange and its development was the point of concern for finance. Methods of payments were the main factors in the development of the financial system and barter was inefficient. To discourse this need, two financial innovations evolved-deposit bank and bill of exchange. After the mid of nineteen century, when large scale industrialization was originated and urban society expanded, the role of finance was modified. Now, mobilizing resources for heavy capital investments and large scale infrastructure was the main role of finance. But due to fraud and mismanagement, this system suffered and experienced crises. Soon in the 1930s, after great depression governments

started to monitor the financial system more closely and these monitoring turned the financial system to be less flexible and reduced frauds.

Subsequently, agents of the economy have proven to adapt the regulations of that time. However, recently the focus has been split into regularizing the competition and financial innovation. There are two aspects in which the policymakers of the developed countries are more interested. One is that of the role of the financial system in promoting industrialization and development and another is regarding the role of the government in their respective countries.

Besides this development of the payment system and monetization of mental resulted in a safer and convenient payment mechanism. Slowly and gradually these metallic coins and bullions were replaced by paper-based instruments. In Europe with the expansion of non-local trade negotiable bill of exchange, payment orders and letters of credit were evolved. The government's role in the development of money was greater directly and indirectly. In the ninth century, paper money was invented in China and after that, it was introduced in Japan. Although in Europe, banknotes were issued by goldsmiths, merchants, and notaries in the seventh century, and these were gradually developed into bankers. Attempts were made to regulate the supply of "gold-backed notes" to encourage the use of payment instruments i.e to use check drawn on bank deposits which promoted payment instruments efficiently. A while later, in late nineteen fiat money was adopted. Fiat money is money that is not backed by bullions. Its introduction resolves the issue of loss of confidence in banknotes. Many countries like Latin America, Asia, and Europe faced hyperinflation as the government used the printing press of central banks to finance the country's deficits. Nonetheless, innovations and development in payment instruments were made in the twentieth century such as electronic transfers and paper money. Initially, small scale lending and borrowing were done i.e small loans, short term loans, and few private banks, money lenders & money changers were the main part of the financial system. Over time this development accelerated with the advancement of in scale of production of electrical and mechanical industries which needed more capital.

New institutions like investment firms, mortgage banks, and building societies, saving banks, pension funds, and loan associations were formed. These were small, to begin with, but started meeting the financial needs of homeowners, traders, farmers, and savers. These emerging financial practices and institutional structures had an obvious impact on financial systems functions in industrialized countries. In the middle of the nineteenth century, foreign

and domestic government bonds dominated stock exchange, whereas shares of industrial firms were given less importance except for NYSE, leading to unceremonious sources of long term equity and debt financing for industries of major countries. Moreover, with the growth in industrial capital requirements, stock exchange in the second half of the nineteenth-century become the most important source of industrial finance and till the end of the century, the United States and Britain had a well-developed bond and equity market. But just like the financial system of developing economies, the financial system was dominated by commercial banks in large industrial economies resulting in small ownership of shares of insurance companies and other institutions.

However, with the development of banking institutions and security markets, financial stability started to get its way by depending upon the institution's soundness. By that time, the need for laws, easily enforceable contracts, and prudential regulations have arisen when the risk associated with complicated and bigger loans with longer maturity increased. In the 1720s Bank of England during the South Sea bubble crisis acted as lenders of last resort to take up and manage these kinds of other crises, after that in the 1792 crisis, New York Stock exchange was established, then in 1907 (FED) federal reserves against wall street crises. Due to rapid change in foreign exchange markets, the banking system, and global capital markets, institutional environments were improved drastically in the 1930s and 1980s. But these changes and implications have not always been the same. Previously, they work to intensify the systems exposed to the shocks, but now some works in other directions. There is a series of features of financial crises that may occur in financial system /financial institutions such as solvency and liquidity problems in large financial institutions, credit crunch, rare asset price variation, debt crises, credit market disturbance, etc (Claessens and Kose, 2014). Most of the financial crises were known to happen due to natural disasters, currency debasement, and war in the preindustrial era. The underperformance of state charter and private banks caused financial stability before the industrial revolution.

During the second half of the 1990s (period of Great Depression), in emerging markets, financial system reforms were initiated to manage effects caused by financial crises and make banking system strong enough to face shocks that occurred during the crisis. Consequently, in 2008 government of Europe along with US congress initiated “domestic and international financial markets” sweeping reforms in response to crises that occurred during that time.

In late summer 2008, the financial crisis related to mortgage securities developed, that spread through the international financial system and U.S market and collapsed in value. This

damaged a large part of the world's financial system and affected large financial institutes (Adam & Guettler, 2015). To handle these kinds of financial crises, Dodd-Franck, in 2010 put guard rail to protect the banking sector. It was a periodic stress test through which the biggest bank of the country was supposed to through this to prove that it can survive and face other crises. Moreover, many wealthy economies came up with extensive fiscal interventions in repose to these crises. Other economies launched programs regarding these kinds of interventions, and countries like China that had a low budget deficit and substantial currency reserves were able to do so. In 2009 and 2010, china announced CNY 4 billion programs, to invest in technology, domestic infrastructure, education, and social security.

The evolution of financial and retirement systems can be viewed as an innovation spiral, where financial intermediaries and organized markets complement each other in a dynamic sense and compete statically. Innovative product's histories explain that financial products when offered follow a pattern from intermediaries to market (Finnerty, 1988).

Innovation happens in either of two way or maybe in both the ways, those ways are the innovation in process and innovation in product. When marketing witnesses the novel product or service it's the part of product innovation and when the same product or service starts to be delivered in a novel way, it becomes process led innovation (Perez-Luno et al., 2014). But financial innovation is more dynamic, it happens in financial organizations, financial markets, regulations (Nejad and Estelami, 2012) and the instruments for usage and trading, these all participants of the financial system are interconnected and affiliated with each other and the product or process innovation in any of the part affects the entire system (Gubler, 2010). The existing literature suggests that there is strong relationship between economic growth, financial development and financial innovation (Shahbaz et al., 2016).

Research Gap

The economic and financial environment is enormously motivated by financial innovations, as these innovations have a significant role in the growth of the economy through easing financial facilities, easing financial operations, access to finance, and international trade (Błach, 2011; Abbasov, et al., 2020; Safari et al., 2021). Pakistan is on its way to meet the globe in adoption of financial innovation, however, as mentioned earlier, the financial system works globally, regionally and at the local level as well. It is a fact that global financial system sets the agenda for the world, and regions and countries try to follow, however, there are local dynamics for every region and country that makes them different in their adoption of the global innovation, and sometimes, local systems have their share of innovation that

might be different from the globe. This happens because every country, despite being connected with international financial mechanisms, varies in their cultural settings, perceptions, resources, education, and different other factors, that help them or hamper them from adopting the global innovation or going for their ways.

Recent studies have revealed that there is a need of understanding the role of financial innovation as still there is a lot of research gap on various aspects of financial innovation in developing countries (Beck et al., 2016; Muhammad and Abdullahi, 2020) as this area is broader and complex (Sandor, 2012). According to prior literature, the focus has been mostly given on payment systems, new products, and developments on banks, internet, mobile banking etc. (Moser, 2015). Much has been studied when it comes to financial innovation. There has been on and off discussions about the role of financial innovation in research, its consequences, and its impact on performance, industrial growth, and economic growth of developed economies. (Misati et al., 2022) identified and suggested the need for more empirical work and capturing data from other stakeholders to create further knowledge in this area.

However, when we talk about the role of financial innovation in the financial system of developing economies specifically Pakistan, very little work has been done in this regard. In studying financial innovation in the context of Pakistan. Since the last decade Pakistan has been adopting the financial innovations rapidly, however, it is very pertinent to study the innovation in the financial system of Pakistan and to develop a clear understanding of the impact of financial innovation and exploring opportunities available for innovations in the financial system for sustainable economic growth.

LITERATURE REVIEW

Financial innovation has been explained differently in the literature i.e (Tufano, 2003) explains financial innovation as completion or development of markets, regulation changes, reduction of transactions. As per European Central Bank, financial innovation is change or development in organization and product that helps in risk reduction, cost reduction, and improvement in services in banks or financial industry. (Gardner, 2009) explicates innovation in three terms i.e Incremental, radical, and revolutionary. Incremental innovation is known for minor and small improvements/upgrades in any product or service which already exists have positive payback and considered to have low risk. Radical innovation has occurred from time to time in the banking industry as it is usually known for change in whole processes/industry. Radical innovation is best known for replacing the existing model with an

entirely new one. Whereas revolutionary innovation relates to or more connected with bringing new ideas to the world (Llewellyn, 2009).

Modigliani and Miller (1958) theorem on financial innovation explains that tax and regulations are the reason, an investor should take into consideration the type of securities that firm needs to issue. It further says that the financial structure of the firm does not affect its value. Additionally, the Black-Scholes model and Gaussian copula model have played significant role development of capital and investment markets and the advancement of financial innovation in the diversification process, corporate banking, risk management, derivative industry, and others (Merton, 1995). Moreover, Arthur lewis models of structural transformation development. This model suggests "*that economic development postulates two sectors such as the capitalist sector and subsistence"* he further explained the relation between technical progress growth and growth of capital. Lewis explained that capital and technical knowledge work in the same direction inside the capitalist sector but outside the capital sector, growth in technical knowledge decrease capitalist surplus and increases wage level. Lewis model also provides an understanding of the role of bank credit. His model further suggests that capital creation opportunities can not only be created through profit but also the credit of banks. Nevertheless, the less developed economies suffer from a lack of resources and the availability of credit. Another factor explained by Lewis in his two-factor model is the role of savings and he argues that it is very difficult to explain the industrial revolution of any country until and unless we explain why the rate of savings rate is increased relative to the national income. Since the decade industrial revolution has crossed various stages and its fourth stage is on its way to reshape businesses (Schwab, 2016). Many firms are showing their interest in new emerging technologies and replacing them with the old ones to remove inefficiency (Hoekman & Shepherd, 2017). On the other hand (Lee et al., 2020) argues that financial innovation has unfavorable impact on stability and growth in emerging markets. The financial industry has been on the frontline of these changes as the new entrance of technologies could have prominent effects on the financial sector. (Levin et al., 2017) financial development may help in easing credit constraints on flow of capital and may facilitate innovation activities to its most productive projects and hence promote R&D financial and growth. Also the idea of expansion of financial sector has increase the concern for "brain drain" between the industries (Boustanifar et al., 2018). In modern industrialization, the financial service sector plays a critical role to support services required by industrial development and tradable services itself (Arnold et al., 2016). Therefore,

identifying the importance of financial services and facilities for sector development is essential to develop policies of the industrial sector. In other sectors like manufacturing, investment, and mining business and infrastructure play a vital role in the development of industry (Arora et al., 2010). Financial service sector channel funds internationally as well as domestically through different means of lending i.e through equity financing, market-based lending, and bank lending, thus this fundraising helps to support the development of the industry (Qamruzzaman, & Jianguo, 2018). Particularly, this includes investment in research and development, new and advanced technologies, supportive infrastructure for the development of industry (Verghese, 1990). Nevertheless, financial markets and banks are supportive sectors that allocate funds to the more productive area of the economy efficiently and effectively (Misati, et al., 2022). Therefore it is important to have well regulated and well developed, functional financial markets and institutions, which tend to generate money flow in the economy. Supporting and encouraging new financial products, businesses, and innovations in financial services will lead to a more diversified financial sector which will in one way or another provide more diverse industrial development (Cohen and Klepper, 1996). A stable financial system of the country, therefore, is important as it helps to fabricate a favorable environment for investments and also attracts foreign direct investments in relevant sectors i.e manufacturing (Stefanadis, 2003).

From the past few years, financial innovation has been considered a core topic in research, as it contributes to the financial system's stability (Levine, 1997) and economic growth in one way or another (Lerner and Tufano, 2011). Newly developed financial products (securitization of assets) were supposed to have great potential for managing risk efficiently (Mendoza et al., 2009) and diversification (Merton, 1992; Trichet, 2009). But this belief changed after the financial crises of 2007 and period of the great depression, as the financial system faced many losses and was brought down due to some excessive risk takings in specialized innovative products which ultimately produced prolonged and severe crises to the economy. There has been an argumentative debate on the advantages and disadvantages of financial innovation in prior literature. (Rajan, 2005) The financial economy's excessive growth might be unfavorable to the real economy's growth (Piazza, 2010; Johnson and Kwak, 2012). Additionally, (Stiglitz, 2010) says innovation is two-folded, innovations that are not properly used can affect the overall economy negatively and can have serious consequences; on a contrary right kind of innovation can work favorably for the financial system, deliver growth and can spur banks to invest in latest and new technologies (Beck et

al., 2012). The usage of digital financial services has enhanced transparency, security, speed and efficiency in financial services in order to serve all categories of consumers (Pazarbasioglu et al., 2020). Financial innovation is more suitable and works effectively for the economic environment when there is some kind of imperfections to the financial system. Where the economy is functioning well and markets are efficient with no risk, no asymmetric information, financial innovation would work as just a simple change and might not be useful (Campbell, 1988). Thus financial innovation corresponds to market effectiveness and answers to different problems that exist in the financial system (Merton, 1992). To understand the role of financial innovation it is necessary to study functions, theoretical models, and empirical studies to support the functionality of financial innovation and its need. The following are the main changes that encouraged the development and functions of financial innovation (Tufano, 2003).

Regulatory and taxation constraints could be answered by financial innovation. Tax policy in every country varies for different income groups i.e. businesses, households, etc. (Santangelo & Tufano, 1997) and with a passage of time, if the country doesn't work on changing this fiscal framework, it won't motivate innovation (Warren, 1993). When the government decides to amend and revise the existing structure, financial innovation is introduced to help overcome difficulties that may be present in the new structure (Knoll, 1997 & 2001). The second factor that encourages innovations in market regulatory framework change. Another important function of financial innovation is to satisfy and fulfill investor's demands (Allen & Gale, 1994) for capital concentration, risk counterbalance market completion, and proper market structures (Grinblatt & Longstaff, 2000). Successful innovation should help reduce transaction and marketing cost included in payment system i.e many of the introduced innovations tend to reduce costs such as e-banking/internet banking, ATMs, and cards. Similarly microfinance/microcredit institutes for developing economies, e-commerce are also an example of some newly introduced financial products for issuers and consumers (Ang & Cheng, 2005). The other two phenomena's that explain the need for financial innovations are globalization and instability (Finnerty, 1992). Globalization creates the potential for new investors and causes investors, government, and companies to expose to new risks like exchange rates and thus the introduction of some innovations helps to manage and assist these risks. However, new policy, structure, and products help to economic activity (Citaana & Schmedders, 2005).

Financial Innovation and the Banking Industry

Financial innovation has helped the financial sector to expand in one way or the other, and this expansion has led to an increase in the ability to spread risk in the financial sector (Rajan, 2006). This risk-bearing and risk-taking capacity of economies have increased financial transaction's range and also resulted in creating greater opportunity for households and firms to easily access to finance. However most recent studies (Gennaioli et al., 2012), mostly focus on the benefits of financial innovations and its positive effects on the banking sector. The financial industry is categorized into a broad range of businesses and its four main groups include financial intermediaries, financial institutions, insurance companies, and monetary institutions. investment, central and commercial banks are part of financial monetary institutions and payment service institutions, non-bank credit grantors, electric money institutions, consumer credit institution, home financing institutions, mortgage, and hedge funds, financing leasing firms comes under other financial institutions category (Burgess, 2011). Innovation in products and services of these sub-sector financial industries (Batiz-Lazo and Woldesenbet, 2006) could be through a normal product life cycle or reverse product life cycle. With these financial and monetary intermediaries, some include large scale distribution and production processes i.e investment banks, where the amount of risk associated with the scale and scope of financial trade increases and is positively correlated (Nightingale et al., 2003). Therefore innovation tends to help in minimizing this risk (Nightingale and Poll, 2000) and create a control system. Financial intermediaries create/introduce products and services in response to demand and these goods are in comparison with traditional ones are considered good substitutes (Safari et al., 2021). And sometimes these newly introduced securities are exposed to risk neglected by investors previously. This neglected risk however may have some negative effects. For instance, a few examples include in the early 1990s, the collapse of the collateralized mortgage market, in 2000s securitization of mortgages, and the 2008 money market fund sector (Gennaioli et al., 2012). Nevertheless, managerial incentives are also been transformed by financial innovation, due to which risk undertaken by the bank has changed. These risks potentially can have adverse consequences on the profitability of banks, its safety, and its soundness, which directly or indirectly affects the industry as a whole (Moyo and Le Roux, 2020). Financial sector development not only leads to an increase in financial institutions but also leads to development in the new payment system and asset alternatives to holding money. Financial innovation also tends to increase capital accumulation and savings which directly or

indirectly leads to higher economic growth (Nazir et al., 2021). Researchers have explained that the undeveloped financial system in developing countries could be one of the major reasons for the country's lower growth rate and economic development. Developing countries' financial system faces several difficulties due to which it hinders the financial system to operate efficiently, few of them are bankruptcy, inadequate property rights, absence of a system to tackle corruption. These lead to financial crises.

Previous Literature on Financial Innovation

Previous literature on financial innovation is relatively less and limited from the very beginning but since the last few years' scholars have shown interest in this topic. (Friedman et al., 1981) highlights that innovations and financial development are created to enhance the company's ability to handle risk, manage administrative issues, and to reduce transaction costs. In 1975, the microeconomic model of financial innovation was developed by Silber and explained that new developments and innovations are introduced to reduce internal and external constraints of the company. The creation of new diversified securities can control market frictions and restrictions of short sales (Chen, 1995). (DeMarzo & Duffie, 1999) studied the role of financial innovation with regards to investors need (Allen & Gale, 1994) and on asymmetric information (Demange & Laroque, 1995) and some (Cuny, 1993; Ohashi, 1995) also argue that financial institution plays a role of intermediary in the creation of a need for financial innovation for-profit based strategies (Hara, 2011). Since the financial crises of 2007-2009, researchers argued that financial innovation has both positive and negative effects. (Brunnermeier, 2009) has argued that due to extraordinary expansion of credit, financial innovation (new and advanced computer technology and statistical tools) is considered as the root cause of these financial crises. On another hand, many scholars in previous literature explain the importance of financial innovation (Miller, 1986) in the form of new products and services in the financial sector (Merton, 1992). Additionally, (Beck et al., 2016; Safari et al., 2021; Derbali, 2021) states that financial development contributes positively to the country's economic growth as recent few developments in microfinance has contributed to poverty and living standards of low-income group people (Levin et al., 2017). Development in digitalization, financial products, digital Apps, Fintech, and microfinance banks are few types of financial developments done in financial institutions.

Moreover, (Tadesse, 2005) says industrial activities have a significant impact on financial architect and innovation. He further underlined that it is more focused on financial purchases. (Plosser, 2009) financial innovation followed by development plays an important role in

economic thriving. Although crises, that occurred in the financial market have raised questions on the role, impact, and nature of financial innovation and its effects on economic stability (Mugo, 2012). One answer to the question of how financial innovation is applied in financial markets is through products and services offered, and various similar products and services are provided by microfinance institutions to the customers (Armendariz & Morduch, 2000). Additionally (Yeboah, 2010) comments that nowadays many products have been offered by microfinance institutes which includes business education, emergency loans, insurance, etc. Microfinance is typically known for financial services provider to a lower-income group of people and it is identified by previous research scholars that microfinance has a positive effect on the living standard of poor people. (Gibbons and Meehan 1999), microfinance is known to be one of the tools for reducing poverty in developing economies as it promotes accessibility of finance to poor populations easily. Microfinance institutes are considered important because these institutes provide funds to small and medium scale enterprises, and these SMEs are perceived as a fundamental part of the private sector, which in return drives the growth of the economy (Ellis, 2008).

Financial Innovation in Developing Economies

Development and innovation in the financial structure of developing economies anticipate the financial sector's expansion (Vuong, & Napier, 2014). Financial innovations are revealed to have major effects on financial progress and exploring instruments that foster the financial sector's progress (Silve and Plekhannov, 2014), enhanced economic growth, technological development, and competent financial intermediations (Valverde et al., 2007; Johnson and Kwak, 2012). Different financial innovations in the financial system have been experienced by Asian countries over the past two decades, to support and encourage financial development with a vision of improving capital sufficiency. Developing economies financial system includes leasing institutions, house building Financing Corporation, commercial banks, and financial markets. (Chou et al., 2011) innovation in the financial sector not only helps to intensify financial advancement but also helps to grab capital growth along with technical and industrial growth which directly or indirectly results in economic growth. (Moguillansky, 2006) suggests economies that are highly developed achieve desired capital accumulation and growth through networks that are spread globally. These global networks include global markets, trade markets, production sectors, public policy matters, and other financial channels. As far as developing markets are concerned these markets have limited access to global networks along with limited resources of research institutions that provide

proper directions for research and development, have limited resources for investment in private companies and small financial sectors. These factors explain the reason why the magnitude of financial innovation on financial development is not the same for developing and developed countries. In an economy where the financial sector is well developed, innovation projects are given a good chance and are more likely to be funded as compared to developing countries (Dabla-Norris et al., 2012). (Tadesse, 2005) discovers that industries in a financially developed economy tend to have more productively and reduced real cost through innovation because new technologies need physical capital, which is possible only if countries' capital market is properly developed that its financial market encourages long term investments.

Hypothesis:

H1: There is impact of financial innovation and financial system's Profitability.

H1a: Financial innovation has significant impact on ROA of financial system.

H1 (a): Number of ATMs, Number of Real time online branches, number of Point on sale, has positive long run relationship with Return on Assets of banking sector.

H2 (b): ATM number of transaction, POS number of transaction, RTOB number of transactions, mobile banking number of transactions, internet banking number of transactions has positive long run relationship with Return on Assets of banking sector.

H3 (c): ATM transaction amount, POS transaction amount, RTOB transaction amount, internet banking transaction amount, mobile banking transaction amount has significant negative relationship with return on assets of banking sector.

METHODOLOGY

The research approach of this research study is quantitative. The main research objectives of this research study focuses on finding out the relationship between financial innovation and financial sector's performance and impact of financial innovation on financial performance of financial sector of Pakistan, and to achieve these objectives quantitative data has been used.

Financial sector's performance has been measured by banking sector's performance and banking sector's performance is measured by Return on Assets (Sindani et al., 2019; Olalere et al., 2021) used similar proxies in their research to identify relationship between financial innovation and performance. Sample of this research study includes all banks of Pakistan listed in Pakistan stock exchange and all bank related data has been collected from Payment review system[3], published by State bank of Pakistan every quarter. The most suitable model

[3] https://www.sbp.org.pk/psd/reports/index.htm

to estimate results is ARDL model (Nazir et al., 2020) for this research study as series were non-stationary and ARDL model is best suitable for small sample data (Muhammad and Abdullahi, 2020). ARDL model stands for "Autoregressive-Distributed Lag". This model is widely used since decades and proven very helpful in identifying long run and short run relationship and co-integration and the bound test included in this model will help to deal with or eliminate the issue of serial correlation (Rahman and Kashem, 2017).

An ARDL is a least squares regression containing lags of the dependent and explanatory variables. ARDLs are usually denoted with the notation ARDL (, q1, … , qk), where p is the number of lags of the dependent variable, q1 is the number of lags of the first explanatory variable, and qk is the number of lags of the kth explanatory variable. Based on Generalized form of study model can be represented as:

Y (Banking sectors Performance) = FI (Financial Innovation), ADVTODEP, COSTTOINC, NETNPLTONETLOAN, WCAR (1)

After Transforming Eq 1 into ARDL linear form, it can be represented as:

$$\gamma t = \alpha + \sum_{t=1}^{p} \gamma i \gamma t + \sum_{j=1}^{k} + \sum_{i=0}^{qj} X'_{j,t-i}\, \beta j, i + \epsilon i$$

$$\ln Y_t = \alpha_0 + \beta_1 \ln FI_t + \beta_2 \ln \text{ ADVTODEP} + \beta_3 \ln \text{ COSTTOINC} + \beta_4 \ln \text{ NETNPLTONETLOAN} + \beta_5 \ln \text{ WCAR} + \epsilon I \quad (2)$$

Where Y is banking sector performance measured by ROA, FI is financial innovation, *ADVTODEP is advance to deposit ratio, COSTTOINC is cost to income, NETNPLTONETLOAN is net non-performing loans and WCAR is weighted average car and these are taken as control variables in the model.*

ANALYSIS

This section discusses preliminary analysis and hypothesis are tested through ARDL model. Data of ATMs, internet banking, mobile banking, LRTOBs, POS was collected from Pakistan Payment review system, financial statements of bank and State Bank of Pakistan. Moreover, according to theory of econometrics if variables/series are not stationary at level than we choose ARDL model for co-integration analyses to identify long run and short run relation in the series. The section consists of three models first model shows results of E-banking infrastructure, second model shows results of transaction numbers and third model shows results of transaction amounts. Data is collected from 2008 Q to 2021 Q.

Model 1: E-banking Infrastructure

Selected Model: ARDL (4, 4, 1, 0, 2, 4, 4, 4, 2, 4)

Table 1: Short run estimation under error correction

Variables	Coefficients	Std Err	T- value	p-value
C	-1.347448	13.17014	-0.102311	0.9197
D(LATM)	-4.599832	2.151989	-2.137479	0.0474
D(LCC)	0.524538	0.630463	0.831988	0.4170
D(LPOS)	-0.075715	0.147969	-0.511695	0.6154
D(ADVTODEP)	0.020162	0.035532	0.567432	0.5778
D(LRTOB)	8.388004	2.335392	3.591690	0.0022
D(NETNPLTONETLOAN)	0.059561	0.058494	1.018248	0.3228
D(COSTTOINC)	-0.074166	0.018863	-3.931785	0.0011
D(WCAR)	-0.017830	0.086495	-0.206141	0.8391

Model one tests the relationship of e-banking infrastructure on the performance of the banking sector of Pakistan, showing short run and long run relation of ATM (Automated teller machine), Credit cards, and debit cards POS (Point on Sale), RTOB (real time online branch), and Advance to deposits, cost to income, net non-performing loans to net loans, WCAR and ROA. To remove heteroscedasticity from the data HAC (Newey-west) has been used. Above results in table 1 shows significant short run relationship between ROA and ATM, LRTOB, COSTTOINC having p-values of 0.0474, 0.0022 & 0.0011 respectively. LRTOB having positive coefficient and significant relation explains that 1% increase in real time online branches can lead to 8.3 % increase in ROA in short run and number of ATMs has significant negative relation.

Table 2: Estimated long run Coefficients

Variables	Coefficients	Std Err	T- value	p-value
LATM	-2.632736	0.413465	-6.367489	0.0000
LCC	0.454080	0.304706	1.490226	0.1545
LDC	-0.039464	0.039128	-1.008589	0.3273
LPOS	-0.003554	0.046815	-0.075918	0.9404
LRTOB	3.446183	0.642639	5.362552	0.0001
ADVTODEP	-0.067998	0.012790	-5.316382	0.0001
COSTTOINC	-0.112693	0.009089	-12.39916	0.0000
NETNPLTONETLOAN	0.042999	0.018265	2.354218	0.0308
WCAR	-0.179275	0.066225	-2.707076	0.0150
C	-0.501253	4.887220	-0.102564	0.9195

	F-statistics	1%		5%		10%	
Critical Value: Pesaran et al. (2001)	5.199	I(0)	I(1)	I(0)	I(I)	I(0)	I(I)
		2.5	3.68	2.04	2.08	1.8	2.8

Table 2 shows estimated long run coefficients of ARDL model and from the long run and bounds test we can see that series have long run relationship as p-value of LRTOB (Real time online branches), LATM (Automated teller machine), ADVTODEP (Advance to deposit), COSTTOINC (Cost to income), NETNPLTONETLOAN (Net non-performing loan to net loan), WCAR (Weighted average cost of capital) are significant, stating to 0.0000, 0.0001, 0.0001 0.0000, 0.0308 and 0.0150 respectively, which means various financial innovation

proxies promote performance of financial sector in long run. Number of RTOBs has significant positive relationship with ROA stating that with 1% increase in real time online branches ROA will increase by 3.44% in long run respectively, reflecting that RTOB are most convinent method of effecting transactions anytime and anywhere in the country. These findings are consistent with findings of (Motsatsi, 2016; Okafor, et al., 2017). LATM shows significant but negative relationship and the major reason for this could be increase in number of frauds now a days, ATM maintenance, ATM breakdown, ATM theft or cash shortages which could directly or indirectly affect the profitability of banking sector. These results are consistent with the previous study conducted by (Alber, 2010; Giordani & Floros, 2015; Javaid, 2016).

The f-statistic value 5.199157 of above model is evidently greater than the absolute value of I(I)upper bound at 5% level of significance. Thereby analysis of this series indicates that we reject the null hypothesis stating that there is no equilibrating relationship, and hence conclude that there exists long run relationship.

Model 2: Error correction Representation for the selected ARDL-MODEL-Transaction Numbers

Selected Model: ARDL (4, 4, 2, 4, 4, 4, 4, 4, 4, 4)

Table 3: Short run estimation under error correction

Variables	Coefficients	Std Err	T- value	p-value
C	36.17061	16.37898	2.208356	0.0582
D(LATMTRNO)	-0.511120	1.516178	-0.337111	0.7447
D(LIBNOTR)	0.248085	0.119095	2.083076	0.0708
D(LMOBTRNO)	0.014272	0.168142	0.084883	0.9344
D(LPOSTRNO)	0.607723	0.801830	0.757920	0.4702
D(LRTOBTRNO)	-3.353751	1.511261	-2.219174	0.0573
D(ADVTODEP)	-0.011443	0.038016	-0.301015	0.7711
D(COSTTOINC)	-0.072935	0.017091	-4.267543	0.0027
D(NETNPLTONETLOAN)	0.103818	0.061981	1.674985	0.1325
D(WCAR)	0.078624	0.092556	0.849471	0.4203

Model 2 represents the short run and long run results of ATM transaction number, internet banking transaction number, mobile banking transaction number, Point on sale transaction number, real time online branches, and advance to deposit, cost to income, net non-performing loans and WCAR with dependent variable ROA. The optimal number of lags selected are 4. Table 3 represents results of short run estimation and result suggests Real time online banking and cost to income has significant short run relationship with ROA having significance value of 0.05 & 0.002.

Table 4: Estimated long run Coefficients

Variables	Coefficients	Std Err	T- value	p-value
LATMTRNO	-0.060468	1.549101	-0.039034	0.9698
LIBNOTR	0.688843	0.434665	1.584767	0.1517

LMOBTRNO	-0.111608	0.180562		-0.618117		0.5537	
LPOSTRNO	-0.306331	1.225278		-0.250009		0.8089	
LRTOBTRNO	-1.118515	2.062931		-0.542197		0.6025	
ADVTODEP	-0.083062	0.083896		-0.990059		0.3511	
COSTTOINC	-0.254750	0.104936		-2.427662		0.0414	
NETNPLTONETLOAN	0.085003	0.115394		0.736629		0.4824	
WCAR	-0.649434	0.423694		-1.532789		0.1639	
C	45.27940	22.72994		1.992060		0.0815	
F-statistics		1%		5%		10%	
Critical Value: Pesaran et al. (2001)	4.5425	I(0)	I(1)	I(0)	I(I)	I(0)	I(I)
		2.5	3.68	2.04	2.08	1.8	2.8

Above table 4 indicates results of long run coefficients and model suggests that COSTOINC has statistical significant long run relationship with ROA having P-value of 0.0414 explaining that few products of financial innovation can promote financial performance of financial system in long run. Additionally results of bound test suggests that there is long run relationship between the variables as F- statistics 4.5425 value is greater than absolute value of upper bound. Moreover, the issue of hetroscadacity was removed by HAC (Newey-west) and optimal lag selection has been done Akaike Info Criterion.

Model 3: Error correction Representation for the selected ARDL-MODEL-Transaction amount

Selected Model: ARDL (3, 4, 4, 4, 4, 4, 4, 4, 4, 4)

Table 5: Short run estimation under error correction

Variables	Coefficients	Std Err	T- value	p-value
C	89.20057	32.03139	2.784786	0.0271
D(LATMAM)	1.357286	1.221801	1.110889	0.3033
D(LIBTRAM)	-0.064523	0.173062	-0.372833	0.7203
D(LMOBTRAM)	0.380952	0.110919	3.434517	0.0109
D(LPOSTRAM)	-0.341046	0.258036	-1.321701	0.2278
D(LRTOBTRAM)	-1.148492	0.942600	-1.218431	0.2625
D(ADVTODEP)	0.009200	0.061121	0.150526	0.8846
D(COSTTOINC)	-0.097008	0.023080	-4.203084	0.0040
D(NETNPLTONETLOAN)	0.048345	0.080744	0.598746	0.5682
D(WCAR)	0.013867	0.238113	0.058238	0.9552

Model 3 shows relationship of ATM transaction amount, Internet banking transactions amount, Mobile banking transaction amount, Point on sale transaction amount, Real time online branches transaction amount, Advance to deposit, Cost to income, Net non-performing loans to net loans, WCAR with ROA. From above given Table 5 we conclude that mobile banking transaction amount has positive and significant short run relation with banking system performance having significant P- value of 0.0109. Only one proxy of financial innovation has significant relationship with dependent variable ROA and one control variable which is COSTTOINC has significant short run relationship.

Table 6: Estimated long run Coefficients

Variables	Coefficients	Std Err	T- value	p-value
LATMAM	1.085815	0.653137	1.662460	0.1404
LIBTRAM	-0.301633	0.415302	-0.726299	0.4912
LMOBTRAM	0.498397	0.459579	1.084465	0.3141
LPOSTRAM	-2.255268	0.897556	-2.512675	0.0402
LRTOBTRAM	-1.031259	1.424498	-0.723945	0.4926
ADVTODEP	-0.138696	0.148072	-0.936677	0.3801
COSTTOINC	-0.265479	0.111548	-2.379952	0.0489
NETNPLTONETLOAN	-0.010059	0.081584	-0.123294	0.9053
WCAR	-0.728186	0.675792	-1.077531	0.3170
C	85.34402	47.60186	1.792872	0.1161

	F-statistics	1%		5%		10%	
Critical Value: Pesaran et al. (2001)	5.719408	I(0)	I(1)	I(0)	I(I)	I(0)	I(I)
		2.5	3.68	2.04	2.08	1.8	2.8

Table 6 represents result of long run coefficients and bond test of co-integration. As per Bounds test there is long run relationship among the variables as f-statistics 5.719408 has greater value that absolute value of I (I) upper bound and point on sale transaction amount and cost to income shows long run with ROA. Additionally, in short run mobile banking transaction amount and cost to income show significant relationship with ROA. Moreover, the issue of hetroscadacity was removed by HAC (Newey-west). The optimal lag selected are 4. In the long run, POSTRAM and COSTTOINC has shown significant relationship having significance value of 0.0402 and 0.0489 respectively with a negative coefficient.

CONCLUSION

This research aimed to investigate the relation between financial innovation and performance of banking sector. Financial innovation proxies used were in three categories. The first category included financial innovation infrastructure i.e number of ATMs, number of POS and number of RTOBs. Second category included number of transactions i.e ATM number of transactions, POS number of transactions, RTOBs number of transaction, internet banking number of transactions and mobile banking number of transactions. Third category included transaction amounts i.e ATM transaction amounts, POS transaction amounts, RTOBs transaction amounts, internet banking transaction amounts and mobile banking transaction amounts. Return on Assets was selected as a proxy to measure banking sector performance. Quarterly data from 2007 to 2020 was used. The idea behind this research was to identify the effect of financial innovation on performance of financial system, as strong financial system leads to sustainable economic growth and financial development along with efficient financial institutions. An Autoregressive Distributed Lag (ARDL) model was used to study the relationship, proposed by (Pesaran et al. 2001). The result of the long run co-integration

suggested that there exists a long run relationship between some financial innovation proxies and banking sectors performances and few proxies also have short run relationship. Most of the series have long run relationship as p-value of LRTOB (Real time online branches), LATM (Automated teller machine), ADVTODEP (Advance to deposit), COSTTOINC (Cost to income), NETNPLTONETLOAN (Net non-performing loan to net loan), WCAR (Weighted average cost of capital) are significant, stating to 0.0000, 0.0001, 0.0001 0.0000, 0.0308 and 0.0150 respectively, these results are in consistent with first hypothesis which says there is positive significant long run relationship with Return on assets, that is we fail to reject H1(a) and tends to accept it. These results are similar with study of (Motsatsi, 2016; Okafor, et al., 2017). However, ATM number of transaction & ATM transaction amount, POS number of transactions & POS transaction amount, RTOB number of transactions & RTOB transaction amount, mobile banking number of transaction and internet banking number of transaction doesn't show any significant long run relationship with return on assets, thus we fail to accept H1(b) and H1 (c). These insignificant results could be due to number of reasons. The major reason could be limited data. Another possible reason could be increase in number of non-bank financial service providers, consumers have various diversified choices through which they can manage their financial portfolio. (Lee, et al., 2020 & Misati, et al., 2022).

DISCUSSION AND IMPLICATIONS

Therefore, we can say the higher the number of ATMs the better the chance that there would be reduced labour costs, thereby improving productivity and performance of financial institutions. Additionally more availability of electronic funds transfer facilities would provide efficient and cost effective payment systems when compared to cash payments. There should be more policies aimed at promoting and encouraging bank based financial development process with respect to infrastructure enhancement, business and technological innovation particularly in rural areas and financial integration in financial institutions. Additionally there should be policies concerning financial risk management, financial instrument development and institutional cooperation development. The government should ensure these policies in order to have positive development of banking sector and banking sector could optimize its full potential with efficient payment mechanisms and improved financial services. This improvement could lead to have positive effect on country's economic growth.

Moreover, this research study has a few limitations. Firstly, it is limited to Pakistan only as there is a geographical limitation. Second, major limitation is of availability of data. Thirdly, this research study does not intend to study financial innovation in each financial market individually. Furthermore, qualitative research could be done in order to study financial innovation phenomenon in detail, as secondary data is limited. There is also a possibility that bank wise data may bring different empirical evidences. Therefore, it is suggested for future researchers that collecting bank wise data could bring some generalized results through which it one can draw relevant conclusions with respect to relationship between financial innovation and financial performance of financial system in context of Pakistan.

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