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Financial Derivatives, Macroeconomic Variables and Banks' Systemic Risk: Empirical Evidence from the Banking Sector of Pakistan

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Abstract

This study investigated the impact of financial derivatives' usage and macroeconomic forces on systemic risk of the banking firms in Pakistan for the year 2017 to 2021. Study utilized panel data approaches for investigating the impact of variables on systemic risk of the banks. This is robust to a number of controls. Results revealed that increasing use of derivatives increase systemic risk of the banks and there exist a strong relationship between macroeconomic forces and systemic risk of banks. Findings have policy implications for regulators and risk managers because unprecedented situation may strike us without warning.

Keywords: Systemic Risk, Financial Derivatives, Banking Sector

1. Introduction

In financial systems, financial derivatives have empowered market contributors to pick what sort of risk-bearing they will concentrate in, and which types of risk they can lay off to other risk-bearing specialists. Equally relevant to the issue are questions of managing risks from the financial markets in which different financial institutions are interlinked. Banks' failures and collapses can have far-reaching consequences or send shockwaves throughout the economy. In modern banking systems, banks hold different kinds of securities, collaterals and loan portfolio each with different risk and return characteristics to hedge against the risk (Halili *et al*., 2021) [13]. Use of financial derivatives has been an embryonic approach in the financial markets of Pakistan to hedge against risk and is mostly used for speculative purposes. According to Acharya and Richardson, (2012) [1] derivatives do not mitigate the risk from financial system but transfer risk from one party to other. This spillover nature cause systemic risk of the firms to increase; especially the firms having larger market share become the source of greater systemic risk in the system.

Risk management approaches such as securitization and derivatives, however, continue to face opposition as several sorts of risks and uncertainties connected with banks cause systemic risk agitation in financial institutions because banks' operations are highly interconnected. This intricate web of financial exposures that is a single institution's collapse and subsequent default might cause other institutions to go bankrupt, resulting in an insolvency cascade. Ripple effect stemming from systemic risk affects other parts of a financial system whose components are interconnected so it is very possible that a bank's misfortune can spread and cause distress in other institutions as well (Lizieri, 2012) [18]. However, it is important to add that how holding of derivatives affects systemic risk of the banks in an emerging economy.

In terms of volume traded, derivative markets of Pakistan are the smallest in the area. The growth of derivatives markets in Pakistan is hampered by a number of supply and demand side issues. On the supply side, the expansion of derivatives has been stifled by a nonexistence of publicizing and consciousness about derivatives, a lack of product modernization, insufficient training and schooling of supply-side market contributors, and prohibitive code of practice. Pakistan's savings rate, as dignified by the savings to GDP ratio, has historically been near to the ground. In fact, when compared to China, India, Sri Lanka, and Bangladesh, it is the lowest in the area. The accounting treatment of derivatives on financial statements may be a restricting factor for institutional investors' involvement in organized derivatives markets. The underlying's qualities, such as price pellucidity and volatility, cross-hedging compatibility, a homogeneous product with set marks and principles for quality and amount, and hedging efficacy, all play a role in the success of derivatives instruments. So, in respect of emerging economy like Pakistan this study tried to explain the functionality of derivative instruments and their success height.

Systemic risk is influenced by market structure and dynamics which are the result of market uncertainty. These shocks can come from a variety of places, including the global economy, government policy mandates, natural disasters, and more. From the standpoint of the securities market, it is not irrational to construct systemic risk information-contained variables as predictors of firm bankruptcy because the prices of stock are a strong predictor of firm insolvency (Giglio *et al*., 2016 and Acharya *et al*., 2017) [12, 2]. From internal operations of the banks, according to Halili *et al*., (2021) [13], aside from derivatives different nature of loans, deposits, size of institution, non-performing loans and leverage are contributing factors to systemic risk. Systemic risk is comparatively greater when the financial zone is enjoying a reduced amount of risk-aversion. On the one hand, increasing thrill-seeking in the financial industry means that the sourcing of money to those risk-averse enterprises will decline, which would subsequently bound their progress potential as finance bases and costs become more indefinite. As a result, information regarding a firm's insolvency may be found in the systemic risk.

Susceptibility of the financial system to macroeconomic shocks has been keen area of interest for the researchers. Macroeconomic forces like Inflation, exchange rate, interest rate, debt-to-GDP ratio, current account balances, un-employment and money supply all have significant impact on the risk and return of any financial system (Hu *et al*., 2012) [15]. It is because systemic risk is primarily influenced by macroeconomic factors; a strong link between systematic risk and macroeconomic factors is found in this study. Macroeconomic factors' capacity to explain risk differs by industry and sector. Although the ability to explain systemic risk varies by country and sector, macroeconomic factors such as debt-to-GDP ratio, lending and deposit rates, trade balance, foreign exchange rates and monetary magnitudes are among the most important factors that can explain systemic risk (Thiagarajan *et al*., 2011; Castro, 2013 [8]).

In conclusion, to provide a flexible, effective, and robust instrument for the financial system was the initial driving force behind the development of the derivative market. This strategy had to be re-evaluated in the wake of the global financial crisis, which led to more active financial market ruling. Even while empirical data suggests that financial reforms have reduced systemic risk, our findings demonstrate that more derivative holdings are linked to increased banks' risk. Under the umbrella of macroeconomic forces this risk has also found strong association with various factors.

2. Literature review

Michael Rothschild and Joseph Stiglitz (1970) gave perhaps the most influential of risk theories: If we transport probability figure from the center to the tails of a probability distribution while keeping the mean constant, we make intensification in the risk associated with the distribution. It is possible to design a measure based on this idea (mean preserving spread) that has more appealing mathematical properties than the older standard deviation measure. According to Merton Miller and Kevin Rock, (1985) derivatives' trading provides information to individual and institutional investors about the firm's future prospects and hence help in risk management.

Spillovers through organizations can happen either openly over and done with promised links or indirectly, as a result of price effects and liquidity spirals. The measured co-movement of institutions' assets and liabilities is likely to augment above and above levels merely explained by fundamentals as a consequence of these spillovers. The increase in tail co-movement that can occur as a result of the spread of financial crisis across institutions is measured by systemic risk metrics (Adrian, 2016). It is well documented that in times of financial difficulty, conditional correlations among asset returns are substantially robust (Longin and Solnik, 2001; Ang and Chen, 2002; Jondeau and Rockinger, 2006; Chollete *et al*., 2009) [20, 5, 16, 9] and that these correlations usually get out of bed heading to common shocks, though exaggerations of financial shockwaves are also linked to balance sheet networks and liquidity helixes (Brunnermeier, 2009; Adrian and Shin, 2010) [7, 4].

Yesin (2013) [26] analyzed that systemic risk may result from banks' long-term foreign currency lending activity and their ownership of a sizable number of derivatives involving foreign exchange. Li and Yu (2010) [19] studied the effect of derivatives activity on commercial banks using panel data from 18 major U.S. bank holding companies (BHC) for the years 2005-2008. According to this study, the higher the notional value of non-traded derivatives, the more derivative positions banks have, implying potentially better performance increasing total risk level. Brownlees and Engle (2017) [6] developed ration to assess a financial firm's impact on systemic risk. Systemic risk is determined by a firm's size, leverage, and risk, and assesses a firm's capital deficiency in the wake of a significant market drop.

Studies of Mayordomo *et al*., (2014) [21] and Reboredo *et al*., (2016) [23] indicated that rising changes in foreign exchange will raise systemic risk. Ho (2016) [14] employed current account, external debt, and internal reserves as variables affecting CDS spreads in his analysis of 8 developing nations' credit default swaps covering the period from 2008-2013. Pooled mean group co-integration analysis was utilized to get the result those current account coefficients, foreign debt, and international reserves all have a significant impact on CDS spread, although current account has a minor impact. Laséen *et al*. (2017) [17] found that systemic risk did not decrease with tightening monetary policy, particularly when the monetary structure was susceptible; and Sabri *et al*., (2019) [24] found that elevation of short-term interest rates could upturn the risk of a crisis. As a result, we anticipate a positive correlation between monetary policy and systemic risk.

Fang *et al*. (2018) [11] designed a network of tail risk to depict general systemic risk of financial institutions of China, given macroeconomic and market externalities. The results revealed that a firm's idiosyncratic risk is influenced by its connection with other institutions. As Between June 2014 and June 2016, the number of linkages between institutions expanded dramatically. When compared to the macroeconomic situation, business features, and chronological price movement, the spillover impact from other companies is the key energetic force of firm-specific risk.

Tram and Hoai (2021) [25] conducted a research to find a link between Vietnam's systemic risk and macroeconomic indicators such the interest rate, rate of currency exchange, and economic development. Four different estimators are used by us (POLS, REM, FEM, GMM). Economic growth is found to have a positive influence on systemic risk, whereas the exchange rate has an opposite association with systemic

risk in Vietnam. The development of indicators for systemic risk forecasting and the measurement of the elements contributing to systemic hazards and the role of financial institutions in various marketplaces, are the two main topics of these works. The central bank can quickly track financial market swings and accurately predict financial instability by using macro security monitoring.

3. Data and Methodology

The integration of off-balance sheet pieces in the firm balance sheet configuration is the one key and prominent trend observable in the banking industry. Commercial banks' OBSAs include various types of contingent guarantees which are e.g. a letter of credit and other financial derivatives (futures, forwards, options, and swaps) instruments (Basheera *et al*., 2019). Off-balance commitment and contingency, on the other hand, is a good option when done on a notional size and with a more attention on derivatives (Qin and Zhou, 2019) [22]. This choice is consistent with the findings of some other studies on off balance-sheet activities, such as Cornett *et al*. (2011) [10].

Analytic subset of this study is made of Pakistani commercial banks. Secondary data has been taken for the period of five years between 2017 and 2021. Balanced Panel data approach has been used for 10 listed Pakistani banks working under the regulation of State Bank of Pakistan (SBP) selected on the basis of market capitalization. Data for derivatives and other bank specific variables is taken from audited financial annual reports (consolidated) of the banks published on official website of SBP. World Bank's economic data website is retrieved for macroeconomic variables. To measure systemic risk official website of Pakistan Stock Exchange (PSX) is also accessed to get stock prices' data. Most recent period of time is selected for study because the concept of derivatives is embryonic in Pakistan and not highly structured derivative instruments are traded in this market.

The main estimation model is a pooled ordinary least square (OLS) balanced panel regression model. To have deep analysis, tests were conducted using the fixed effect and random effect approach and the generalized method of moments test. Within the systemic risk literature we selected two mostly used measure of systemic risk. The marginal Expected Shortfall of a bank is its short-run expected equity loss conditional on the market, taking a loss greater than its Value-at-Risk (Acharya *et al*., 2010; Brownlees and Engle, 2017 [6]). It is constructed using bank-level stock returns at time t as well as market returns r_{mt} and estimated considering tail risk in the market. We first calculate the value of Expected Shortfall (ES) for the market, volatility of the bank's returns and correlation between market and bank's returns, and then take a product of all of these terms. LRMES (Long-run marginal expected shortfall) is fundamental to systemic risk measure (Engle, 2018) and is defined as the expected fractional loss of bank equity in stress situation when the aggregate market declines significantly in six-months period (Halili *et al*., 2021) [13]. For LRMES calculation we inculcate beta which is ratio of market variance to covariance of bank returns with market returns.

3.1 Models being tested

This study used MS-Excel, E-views and Stata softwares to have results of the study.

Model 1

Impact of derivatives, other bank specific variables and macroeconomic variables on marginal expected shortfall (MES) of individual banks

$$MES = \beta_o + \beta_1 CD_{t-1} + \beta_2 NPL_{t-1} + \beta_3 Ln\ of\ MC_{t-1} + \beta_4 STD_{t-1} + \beta_5 Lev_{t-1} + \beta_6 M2 + \beta_7 CA + \beta_8 \frac{Debt}{GDP} + \beta_9 ExR + \varepsilon it \quad (1)$$

Model 2

Impact of derivatives, other bank specific variables and macroeconomic variables on long-run marginal expected shortfall (LRMES) of individual banks

$$LRMES = \beta_o + \beta_1 CD_{t-1} + \beta_2 NPL_{t-1} + \beta_3 Ln\ of\ MC_{t-1} + \beta_4 STD_{t-1} + \beta_5 Lev_{t-1} + \beta_6 M2 + \beta_7 CA + \beta_8 \frac{Debt}{GDP} + \beta_9 ExR + \varepsilon it \quad (2)$$

Whereas,

MES= Marginal Expected Shortfall
LRMES = Long-run Marginal Expected Shortfall
CD = Credit derivatives
NPL = Non-performing loans
Lev = Degree of financial leverage
MC = Market capitalization
STD = Short term debt
M2 = Money Supply
CA = Current account deficit
D/GDP = Debt to GDP ratio
ExR = Exchange rate
ε_{it} = Error term

Table 1: Correlation results for the data

	MES	CES	LR MES	Lev	NPL	CD	STD	M. Cap	CA	M2	ExR	D/GDP
MES	1											
CES	.99**	1										
LRMES	.45**	.45**	1									
Lev	0.25*	0.22*	0.17	1								
NPLs	-0.23*	-0.23*	-0.26*	-0.03	1							
CD	0.10	0.10	0.06	-0.06	-0.09	1						
STD	0.22*	0.22*	-0.05	-0.10	-.34*	.69**	1					
M.Cap	-0.18	-0.15	-0.03	0.06	-0.00	-0.03	-0.01	1				
CA	-0.27*	-0.27*	0.21*	0.10	0.07	-0.01	0.00	0.03	1			
M2	0.01	0.01	.30*	0.16	0.03	0.13	0.06	-0.01	.80**	1		
ExR	-0.03	-0.02	0.27*	0.14	0.03	0.16	0.05	-0.03	.75**	.98**	1	
D/GDP	-0.01	-0.01	0.26*	0.14	0.03	0.18	0.05	-0.05	.71**	.96**	.99**	1

Table 2: Description of derivative instruments

Sold	Bought
1. Guarantees; both Financial and Performance (Forward contract) + Letters of Credit (Forward contract) 2. Commitments in respect of: – Forward foreign exchange contracts (Sale) 3. Commitments in respect of: – Forward Govt. securities transactions (Sale)	1. Interest rate swaps (Purchase) 2. Commitments in respect of: – Forward foreign exchange contracts (Purchase) 3. Commitments in respect of: – Forward Govt. securities transactions (Purchase)

Table 3: Description of independent variables

Variables	Proxies	Source
Financial Derivatives	Notional principal amount of derivatives, taking values $_{t-1}$ and dividing by total assets.	Banks' annual reports from SBP
Market capitalization	Measured by the stock price multiplied by shares outstanding and taking change in MC i.e. current year value less previous year value divided by previous value.	Banks' annual reports from SBP
Financial leverage	Taken as EBIT divided by EBIT less net income	Banks' annual reports from SBP
Short term debt	Short term debt$_{t-1}$ / total assets	Banks' annual reports from SBP
Non-performing loans	Total amount of loans classified as non-performing$_{t-1}$ /total assets	Banks' annual reports from SBP
Macroeconomic variables	Exchange rate, debt-to-GDP ratio, M2 and current account deficit	World bank's website

Table 4: Descriptive Statistics for 2017-2021

	Mean	Med.	Max.	Min.	Std.D	Obs.
MES	-0.00043	-0.0003	-0.00004	-0	0.0003	50
LRMES	0.5033	0.4405	2.0376	0.144	0.323	50
CD	0.4126	0.3416	1.4716	0.152	0.297	50
NPLS	0.0728	0.0641	0.1858	0.013	0.046	50
STD	0.0114	0.0108	0.0591	0.003	0.009	50
LEV	1.2722	1.2743	1.5478	0.645	0.173	50
M_CAP	0.0025	-0.032	2.3951	-2.38	0.53	50
M2	30.565	30.56	30.821	30.33	0.173	50
CA	-3.1	-3.6	-0.8	-5.4	1.726	50
EXR	143.40	150.04	177.84	105.5	26.63	50
D_GDP	0.8094	0.856	0.927	0.671	0.098	50

Tables 1, 2, and 3 report our variables, their sources, and the measures we constructed as well as descriptive statistics for data set. We reproduce our variables included in the Halili *et al*. (2021) [13], Mayordomo *et al*. (2014) [21] and Li & Marinc (2018) study. We select such variables as they are common across a number of studies and represent how banks interact with systemic risk measures.

4. Results

The systemic risk measures reported in Table 4 indicate a positive and significant relation to banks' holding of financial derivatives.

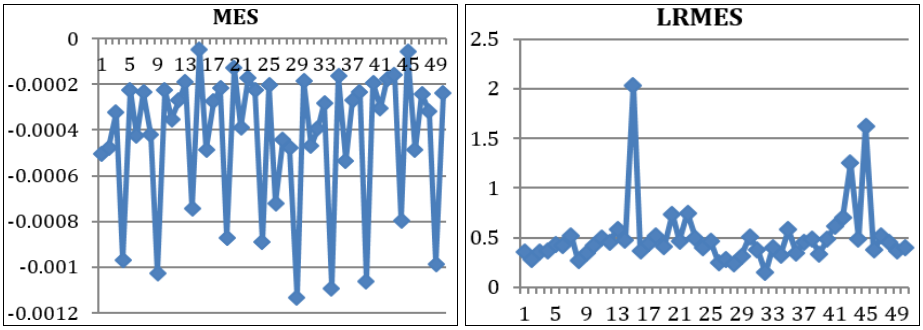

Table 5: Estimation results of model 1

Variables	POLS	FEM	REM	GMM
CD	0.000157**	0.0000420	0.00009880***	0.0000987***
	(0.000062)	(0.000059)	(0.0223)	(0.000053)
STD	-0.005154**	-0.001443	-0.002915	-0.002913
	(0.00216)	(0.002)	(0.0018)	(0.0018)
NPLs	-0.001297*	0.0000993	-0.001035*	-0.001035*
	(0.00028)	(0.00068)	(0.00029)	(0.000294)
LEV	0.000183**	0.000182**	0.000165**	0.000165**
	(0.00007)	(0.000079)	(0.000064)	(0.000064)
M_CAP	-0.0000263	-0.000033	-0.0000250	-0.0000251
	(0.000023)	(0.000019)	(0.000018)	(0.000018)
M2	0.018877*	0.018447*	0.0186*	0.018597*

	(0.00095)	(0.00075)	(0.00074)	(0.00074)
CA	-0.000181*	-0.000188*	-0.000183*	-0.000183*
	(0.000012)	(0.000009)	(0.000009)	(0.000009)
D_GDP	0.034125*	0.033293*	0.033682*	0.033677*
	(0.00209)	(0.0016)	(0.001615)	(0.001615)
EXR	-0.000237*	-0.000231*	-0.000234*	-0.000234*
	(0.000013)	(0.00001)	(0.00001)	(0.00001)
Constant	-0.571742	-0.558916	-0.563422	-0.563343
R-squared	0.937789	0.971812	0.952235	0.952234
Adjusted R	0.923792	0.955445	0.941488	0.941487
F-statistic	66.99737	59.37624	88.60327	J-0.010216
Prob.	0.000	0.000	0.000	---
Durbin-Watson stat	1.696561	2.243456	1.820689	1.820602

*, **, *** represent significance level at less than 1%, 5% and 10% respectively. This table gives the values of estimated coefficients of MES (Marginal expected shortfall) on financial derivatives and macroeconomic variables alongwith other internal variables. These values are given for all four tests applied i.e. pooled ordinary least square, fixed effect model, random effect model and GMM technique. Derivatives are lagged by 1 year and divided by total assets. Other internal variables are similarly lagged by 1 year. NPLs are divided by total loans. The total observations, r-squared, adjusted r-squared, F-stat, P-value and Durbin-Watson stat values are reported. Standard error is given in parenthesis.

Table 6: Estimation results of model 2

Variables	POLS	FEM	REM	GMM
CD	0.491258**	0.223137	0.491258**	0.492264**
	(0.206)	(0.2446)	(0.193)	(0.1938)
STD	-22.43971*	-11.05189	-22.43971*	-22.48656*
	(7.25)	(8.342)	(6.80)	(6.8099)
NPLs	-2.959508*	-1.69007	-2.959508*	-2.961388*
	(0.938)	(2.8147)	(0.880)	(0.8801)
LEV	0.009164	-0.169696	0.009164	0.008247
	(0.240)	(0.3270)	(0.2250)	(0.22511)
M_CAP	0.011814	0.027101	0.011814	0.012035
	(0.077)	(0.0800)	(0.0723)	(0.0723)
M2	10.90114*	9.723262*	10.90114*	10.95685*
	(3.188)	(3.116)	(2.9906)	(2.9983)
CA	-0.034386	-0.041614	-0.034386	-0.034617
	(0.041)	(0.0409)	(0.039)	(0.0391)
D_GDP	17.95976**	16.09272**	17.95976*	18.0637*
	(7.011)	(6.6905)	(6.5757)	(6.5879)
EXR	-0.130568*	-0.115468**	-0.130568*	-0.131292*
	(0.044)	(0.04228)	(0.0411)	(0.0412)
Constant	-328.352	-292.9115	-328.352	-330.0341
R-squared	0.403831	0.593637	0.403831	0.403826
Adjusted R-squared	0.269693	0.357685	0.269693	0.269687
F-statistic	3.010563	2.515917	3.010563	0.000305
Prob.	0.00774	0.011654	0.00774	-
Durbin-Watson stat	2.310428	2.38547	2.310428	2.310602

*, **, *** represent significance level at less than 1%, 5% and 10% respectively. This table gives the values of estimated coefficients of LRMES (Long-run marginal expected shortfall) on financial derivatives and macroeconomic variables alongwith other internal variables. These values are given for all four tests applied i.e. pooled ordinary least square, fixed effect model, random effect model and GMM technique. Derivatives are lagged by 1 year and divided by total assets. Other internal variables are similarly lagged by 1 year. NPLs are divided by total loans. The total observations, r-squared, adjusted r-squared, F-stat, P-value and Durbin-Watson stat values are reported. Standard error is given in parenthesis.

Challenging the traditional role of banks, these are the non-traditional activities that cause higher systemic risk. According to results increase in financial derivatives utilization increase banks' systemic risk in Pakistan because they are still traded and exchanged through over-the-counter mechanisms and there is no central clearing system for the derivatives products. These results are in confirmation with the findings of Halili *et al.*, (2021) [13], Li & Marinc and Mayordomo *et al.*, (2014) [21]. However, it is still unclear how this market is being monitored and valued. Derivatives have the ability to change the risk in complex ways that may be difficult to comprehend. They have potential to produce counterparty risk, which must be controlled.

With respect to other bank-specific variables, short-term debt to total assets ratio is significant at 5% level of significance and negatively related with systemic risk. For the purpose of maintaining adequate liquidity levels, banks borrow short-term loans. These are short-term interbank loans secured by the promissory note of the bank and the pledging of government securities. The shorter maturity date makes these less dangerous. The likelihood that a borrower won't be able to repay a debt in a timely manner decreases. Therefore, this is often less risky for the firms. Non-performing loans ratio is highly significant in explaining variations in MES. We can say that a declining non-performing loan ratio may indicate that the economy is overheating, which could pose a risk to the health of the banking industry. Increasing NPLs cause lower creditworthiness of the institutions which limit the interconnectedness in financial system which lowers the

systemic risk. This outcome supports the findings of the Festic *et al*., (2011).

Financial leverage is significant at 5% level of significance in explaining MES for firms and showed a positive relationship. This result approves with the conclusions of studies of Mendonca & Silva, (2018), Mayordomo *et al*., (2014) [21], Adrian & Shin (2010) [4] and Tram & Hoai (2021) [25]. Finally, higher leverage and increased maturity mismatch have been shown by Brunnermeier (2016) and Acharya *et al*. (2017) [2] to tend to enhance the risk contribution. The firm is more susceptible to economic instability with larger financial leverage, which raises systemic risk. Financial companies depend on stable economic conditions to be able to leverage their activities, which could damage their balance sheets once the economy starts to deteriorate. Market capitalization has negative impact on banks' systemic risk. Because increase in value (market capitalization) causes lower risk associated with firms. As the financial system of Pakistan is not much complex and banks are not larger enough to be a cause of risk.

When evaluating risks, we cannot overlook the influence of macroeconomic forces (Fang *et al*., 2018) [11]. When disaster myopia is at play, common patterns in how individual banks react to external shocks can enhance systemic risk (Jain and Gupta, 1987; Pecchino, 1998; Borio *et al*., 2001; Hyytinen *et al*., 2003). In macro-environment, selected economic variables gave outstanding relation with banks' systemic risk. Money supply M2 is highly significant at significance level of 1% and a positive coefficient value of 10.9 confirmed by Screpanti (1997) who analyzed a theory of banking that identifies the transformation of generic risk as the primary business of bank activity yields a growing money supply curve. Exchange rate results gave a negative and highly significant relationship with systemic risk measure at significance level of 1%. As increasing exchange rate decreases the economic efficiency and the element of interconnectedness is exacerbate. Limited connections in financial systems mean lower systemic risk. These results are consistent with those of (Hausmann *et al*., 2005) and (Di Nino *et al*., 2011). It point towards the importance of financial supervision.

Debt-to-GDP ratio is positively and highly significant at 1% level of significance which explains that higher the debt in relation to GDP cause higher systemic risk because it increases servicing the debt in terms of interest expense. Current account deficit also gave highly significant role in determining systemic risk of the banks at 1% level of significance and a negative relationship exists. This result confirms the findings of (Baltaci and Akyol, 2016). A country's economic activity can be inferred from its BOP's current account balance by looking at it. It covers activity related to an economy's industries, capital market, services, and money coming into the nation. Since it is impossible for the current account balance to be zero, it actually indicates whether a country is in a surplus or deficit. A deficit raises a country's debt, which boosts financial activity and lowers risk.

In model 2, dependent variable is LRMES (Long-run Marginal Expected Shortfall). By concentrating on the co-movement of a specific bank and the market, Engle (2018) claimed that this association conveys the market perception of the rate at which a contracting economy results in lowering bank asset prices and subsequent equity returns. This measure is also used in the study of Acharaya (2011), and Halili *et al*., (2021) [13]. Regressing bank specific and macroeconomic variables with LRMES values in linear regression model gave significance of the statistical results. LRMES gave similar results to MES only leverage and current account deficit showed non-significant results with LRMES.

5. Conclusions and Policy Implications

After working on the objective and design of a systemic risk model, the basic question was whether we should aim to entirely eradicate financial risk, abandoning popular risk management techniques that have failed to serve their purpose. Appropriate answer would be that "Attempting to eliminate all systemic risk is neither practicable nor desirable - risk is a vital ingredient for true economic growth. As a result, the goal of this study was not to advocate that financial institutions should not engage in dangerous activities, but rather to broaden the discourse on recognizing, assessing, and managing system-wide risks in addition to managing risk in individual activities and institutions.

The positive relationship between variables of interest is palatable to a number of variables, including alternative measures of systemic risk and bank-specific variables like Short-term debt, non-performing loans, and financial leverage. Market capitalization in systemic risk determination triggers the role of derivatives in systemic risk determination. Derivatives showed contribution to bank's tail risk. These results showed that leverage has positive impact on systemic risk. Macroeconomic variables like exchange rate, debt-to-GDP ratio, money supply and current account deficit play significant role in determining systemic risk of the banks.

Regulation policy of banks must be synchronized with monetary policy at the same time. All of the designated banks must adhere to stricter supervision standards. Create a thorough framework for risk appetite that encompasses the risk boundaries the bank is keen to accept in order to accomplish its strategic goals and business plans. Additionally, the banks must perform macro stress tests and scenario analyses appropriate to the size, complexity, and business lines of the banks. The Internal Capital Adequacy Assessment Process (ICAAP), which documents the pertinent sections, must take into account both the risk appetite framework and the findings of the macro stress tests. The ICAAP statement must be submitted annually to SBP by the SIBs. Effective recovery plans that are appropriate for the size and complexity of the bank should be prepared by banks. Plans must be submitted by the banks on an annual basis. Enhanced supervisory interaction with bank's senior management and meeting with board of directors and risk committee must be assured in controlling systemic risk.

These findings support the need for authorities to keep a close eye on bank risk. Clearly, not only is it important to screen and tighten risk taking requirements at banks, but also to consider how derivatives are used in a bank's risk strategy. Overall, our findings suggest that banking supervisors and regulators conduct more oversight and monitoring, resulting in greater openness and, as a result, better-informed decisions by stakeholders, particularly for over-the-counter transactions. Derivatives contribute to a bank's tail risk and, hence, may intensify losses during

unrest. Stakeholders are concerned about the reported connection between the bank specific variables and macroeconomic environment. Banks were able to control the adverse selection dynamic while expanding their portfolios over time. Derivatives have now become an inextricable part of a bank's risk management strategy. Pakistani banks should intensify use of structured derivative products as higher risk results in higher returns but portfolios without endangering the health of the whole economy. Consistent monitoring and assessment of systemic risk should be done and a central clearing system of derivative products should be introduced in Pakistan to avoid any kind of inconsistencies in derivative instruments' management.

6. References

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