Determining Systemic Risk of Banks, Financial Services, and Insurance Firms of Pakistan

Shumaila Zeb[1]
Abdul Rashid[2]

ABSTRACT

This paper contributes on the literature of systemic risk by investigating the extent of financial distress injected by banks, financial services, and insurance firms in the financial system of Pakistan. Furthermore, the paper aims to investigate the empirical determinants of systemic risk. The systemic risk is calculated by using the Delta Conditional Value at Risk (ΔCoVaR) methodology. The panel regression is used to investigate the determinants of systemic risk for the period 2000- 2015. We find that top most systemically important financial institutions of Pakistan are National Bank of Pakistan (NBP), Allied Bank Limited (ABL), and Habib Bank of Pakistan (HBP). Furthermore, size of financial institution, the loan ratio, the leverage ratio, the tier1 ratio, the operating profit margin ratio appears positively and significantly related to the systemic risk of financial institutions. The identification of systemically important financial institutions and its empirical determinants is important for devising the financial regulations and financial reforms.

Keywords: *Systemic Risk, Value at Risk, Conditional Value at Risk, Quantile Regression*

INTRODUCTION

Financial stability is considered as a prime concern for the financial institutions around the globe. Various mechanism and regulations are imposed by the regulators to maintain the stability of financial system (Acemoglu, Ozdaglar, and Tahbaz-Salehi, 2015). These mechanisms also include financial incentives in the form of bail outs or guarantees to financial establishments, institutions, and the markets (Rodriguez-Moreno, Pena, 2013). Instability in any financial system calls for the systemic risk generation. In principle, systemic risk is a threat to an entire financial system.

Nevertheless, systemic risk as a term still remains ambiguous (Renn, Klinke, and Van Asselt, 2011). The previous literature defines the two key aspects of systemic risk. The first aspect of systemic risk refers a "big" astonishment in the real economy resulting in immediate collapse of all or major financial institutions within or outside the economy. At this point, systemic risk refers to "an event having effects on the entire banking, financial, or economic system, rather than just one or a few financial or non-financial institutions" (Bartholomew & Whalen, 1995). The second aspect emphasizes on the micro level of economy. It denotes the apparent spillover consequences from one financial institution to others. In spill-over phase, all interconnected financial or non-financial institutions experience collapse immediately. This breakdown has a far-reaching effect simultaneously at local, national, and international levels. Therefore, it is very important to identify the financial institutions contributing most towards the systemic risk. Furthermore, it is also important to identify the potential determinants which can help the financial systems to decrease the systemic risk.

1. Shaheed Zulfikar Ali Bhutto Institute of Science and Technology, Islamabad.
Email: Shumaila.zeb@gmail.com
2. International Institute of Islamic Economics, International Islamic University, Islamabad.

Pakistan, despite running in a developing phase with challenges on the global front, has a growing financial system. The establishment of China Pakistan Economic Corridor (CPEC) has opened new avenues for Pakistan. For example, Bank of China (BoC) has obtained license from the State Bank of Pakistan (SBP) to start its operation in Pakistan. SBP is also on its way to implement Basel III to bring its financial institutions at par with the financial institutions of the world. Systemic risk is one of the concerns of Basel III as well. Therefore, it becomes very pertinent for Pakistan to identify systemically important financial individual financial institutions. The identification and measures to refrain those financial institutions from default will increase the overall stability of the financial system of Pakistan. It would definitely have macro-economic implications as well.

The banking sector of Pakistan has a dominant share in overall financial system of the country. However, financial services and insurance firms of Pakistan also play an important role in the development of economy. Therefore, it is equally important to identify not only systemically important banks but systemically important financial services and insurance firms as well. Therefore, the main objective of this study is to investigate the systemically important banks, financial services , and insurance firms of Pakistan. Furthermore, this study also present top three banks, financial services, and insurance firms of Pakistan, injecting maximum systemic risk in the financial system of Pakistan. The present study estimates the systemic risk contribution of individual financial institutions (banks, financial services, insurance firms) using the ΔCoVaR systemic risk measure (Adrian & Brunnermeier, 2016). In addition, this study also identifies the potential determinants of systemic risk. The identified determinants will help the policy makers to regulate the systemic risk in banks, financial services, and insurance firms of Pakistan. The panel regression approach is used to identify the potential determinants of systemic risk.

This study is important for the regulators and policy makers as it provides the new insight of systemically important financial institutions of Pakistan. The present study is meaningful and relevant for policy-makers and financial regulators of Pakistan as it promotes understanding on the subject of identification of systemically important financial institutions and determinants of systemic risk of Pakistan. The central regulatory authorities impose certain regulation on the financial institutions. The identification of determinants of systemic risk can help to reduce the systemic risk in the financial system. The paper is divided in five sections. After the introduction of the main topic, the relevant literature review is described in Section 2. Section 3 elaborates the data description and methodological framework of the study. The empirical analysis is given in Section 4. Section 5 presents the concluding remarks on the paper.

LITERATURE REVIEW

The present study relates to the three strands of literature on systemic risk. The first strand of literature deals with the definition and different proposed methodologies for the estimation of systemic risk of financial sector. The Global Financial Stability Report proposed by International Monetary Fund (2009) elaborates the term systemic risk as a disruption in financial services due to mutilation of all or key areas of the financial system. Systemic risk

1- Financial services include mutual funds, leasing companies, and brokerage houses
2- In similar way, the estimates of other banks included in the sample can be interpreted. However, we leave this on the researcher to economize.

can potentially cause grave consequences for the entire economic structure. This section highlights major studies of literature for systemic risk measurements.

One of the crucial inadequacies of systemic risk measures is data availability. However, researchers managed to develop fine indicators of fragility. Some authors like Elsinger et al. (2006), Gauthier et al. (2012), in order to detect the level of distress exerted on financial institutions, also used network analysis for the British and Canadian Banks and inter markets. Their analysis rely more on the existing linkages between the agents. Network analysis focused mainly on the financial statements data of financial institutions. The balance sheet data is easily obtainable, though, the problem is the quantification of linkages between various financial institutions within or outside the respective economy. Like, Cerutti, Claessens, and McGuire (2012) proposed a reporting template for the identification of systemically important financial institutions. Few other authors used Credit Default Swaps (CDS) for the calculation of systemic risk contribution of financial institutions. Furthermore, Segoviano and Goodhart (2009) constructed a stability index to measure interdependence of various financial institutions using the CDS data. Non-availability of data for Pakistan, however, restricts researchers to use this measure to identify systemic risk contribution of various financial institutions within the economy. Similarly, López-Espinosa, Moreno, Rubia, and Valderrama (2015) also proved that CDS could be a superior source of systemic risk measurement. Billio, Getmansky, Lo, and Pelizzon (2012) measured interconnectedness between the various financial institutions, using the Principal Component Analysis and Granger causality tests.

Similarly, Acharya, Pederson, Philippon and Richardson (2017) proposed Systemic Expected Shortfall (SES) and Marginal Expected Shortfall (MES) to measure the systemic risk contribution of financial institutions. They measured the systemic risk contribution of a financial institution during the times of financial distress. They further proved that SES of financial institution increases with the increase in control of the firm. Here it is noteworthy that this approach determines the impact of financial distress in a financial system at an individual level. Similarly, Acharya, Engle, and Richardson (2012) developed Systemic Risk Index (SRISK), which calculated the capital shortfall of individual institutions conditional on market stress. SRISK was a function of size, leverage, and risk. They measured systemic risk contributions of top financial institutions of the United States. They further proved that aggregate SRISK also provides early warning signs of distress in financial markets.

In contrast, Adrian and Brunnermeier (2016) introduced ΔCoVaR as a systemic risk measurement tool of financial institutions. The most important aspect of this systemic risk measure is that it analyzed that how a financial institution contributes towards the systemic risk of financial system or real economy during the times of financial distress. It covers the element of spillover effect as well. The main feature of the ΔCoVaR measure is that it used quantile regression to estimate the conditional models. They used accounting data, market prices, and state variables data for the timeperiod1986- 2010. The study included commercial banks, insurance firms, broker dealers, and real estate companies for United States. Their main findings indicated that institution size, the leverage ratio, the market to book value ratio, and maturity mismatch are imperative factors contributing significantly towards the systemic risk generation.

The second strand of the literature deals with the identification of systemically important financial institutions of different economies. However, the literature on the identification of systemically important financial institutions is scarce. Likewise, whatsoever literature is available for systemically important financial institutions, it mostly commits to the systemically important banks of developed countries like Australia, the United States, and the United Kingdom. Even less attention is given to the financial services and insurance firms of developed or developing economies. In addition to the identification of systemically important banks, this study is specifically aimed to fill this gap. In this study, we do not only identify systemically important banks of Pakistan but also identify systemically important insurance firms and financial services of Pakistan.

Brämer and Gischer (2012) identified systemically important banks of Australia. They used assessment methodology introduced by Basel Committee on Banking Supervision to do so. The study covered the time period starting from 2002 to 2011, and empirics revealed that four banks contribute highly towards systemic risk. The five categories investigated in the study were size, interconnectedness, substitutability, complexity, and cross-jurisdictional activity of a financial institution. The topmost systemically important banks of Australia were Westpac Banking Corp, Commonwealth Bank, National Australia Bank, and ANZ Banking Group.

Similarly, Chen, Shi, Wei, and Zhang (2014) identified systemically important banks of China, using approach given by the Basel Committee. The study was conducted for the time period 2008 to 2012. They identified that Industrial and Commercial Bank of China is the topmost systemically important bank of China. Likewise, they identified top 16 systemically important banks of China. The third strand of literature deals with the important determinants of systemic risk in the financial systems. Following the important studies like Nell and Kleinow (2015), Moore and Zhou (2013), Brunnermier (2012), and Adrian and Brunnermeir (2016), the recent study used the following variables to be tested in the context of Pakistan. This study is the pioneer studies to investigate the determinants of systemic risk for the whole financial sector and separately for banks, financial services, and Insurance firms of Pakistan. The findings of the study provide useful insights for the policy makers and regulators that increase or decrease of these financial characteristics can help to decrease of systemic risk faced by the country.

According to Benoit, Colliard, Hurlin, & Pérignon, (2016), and Adams, Füss, & Gropp, (2014) large sized banks has more chances towards the failure. These studies concluded that size of the bank have positive effect on the systemic risk. Therefore we hypothesized that:

H_1: There is a positive relationship between systemic risk and size of financial institutions of Pakistan.

The larger portfolio of loans can increase the vulnerability of the financial institutions. It is evident from the empirical literature (Laeven & Levine, 2009; Beltratti and Stulz, 2012 and Weiß and Neumann, 2014) that lower loan ratio is an indicator of innovative business model. They result in reducing the systemic risk. Therefore we hypothesized that:

H_2: There is a positive relationship between systemic risk and loan ratio of financial institution Pakistan.

Loan loss provision captures the influence of credit risk on the loan portfolio. Weiß and Neuman (2014) proved that more risky financial institutions affect the financial system more negatively than the others. Therefore we hypothesized that:

H3: There is a negative relationship between systemic risk and loan loss provision ratio of financial institutions of Pakistan.

The leverage ratio is used as a proxy of capital structure. The high leverage ratio of a financial institution means that probability of default of a financial institution is high. The cushion to sustain and survive becomes low because of high debts thus leading towards the systemic risk generation (Acharya, 2014; Beltratti and Stulz 2012; Laeven, Ratnovski, & Tong, 2016; Weiß & Neumann, 2014). Therefore we hypothesized that:

H4: There is a positive relationship between systemic risk and leverage ratio of financial institutions of Pakistan.

Next we employ the regulatory measure proposed by Basel Committee as Basel core capital ratio. As per Basel III, this ratio is considered to have high capacity of loss absorption. Laeven et al. (2014) concluded that highly capitalized financial institutions are less risky thus reducing the overall systemic risk contribution. Therefore we hypothesized that:

H5: There is a negative relationship between systemic risk and tier1 ratio of financial institutions of Pakistan.

The large portion of free cash and tradable securities help financial institutions to survive in negative shocks in the financial system (Brunnermeier & Pedersen, 2009). This means that more cash would help the financial institutions to survive in bad market conditions. Therefore we hypothesized that:

H6: There is a negative relationship between systemic risk and liquidity ratio of financial institutions of Pakistan.

The market to book value ratio is applied to capture the element of market capitalization. The high market to book value ratio means high earnings. On the other hand higher earnings are also related with the higher risk associated with it (Keelay, 1990; and Weiß et al., 2014). Therefore we hypothesized that:

H7: There is positive relationship between systemic risk and market to book value ratio of financial institutions of Pakistan.

The operating costs of a financial institution are counted as the noninterest expenses. Noninterest expenses usually include the employee salaries and benefits, the equipment costs, the cost of the property, and the leases, taxes, loan loss provisions and professional service fees. The empirical studies (like Demir, Mahmud & Babuscu, 2005; Laeven & Levine, 2009; and Brunnermeier, Eisenbach, & Sannikov, 2012) suggest that banks earning high from their non core activities are contributing more towards systemic risk. Therefore we hypothesized that:

H8: There is positive relationship between systemic risk and non interest ratio of financial institutions of Pakistan.

The operating profit margin ratio is used a proxy of the profitability of financial institutions. The high operating profit margin ratio can be considered as a shield for the financial institutions thus preventing them to default (Kleinow & Nell, 2015). Therefore we hypothesized that:

H9: There is positive relationship between systemic risk and operating profit margin ratio of financial institutions of Pakistan.

The deposit ratio is used as an explanatory variable to capture the liability portfolio. It is expected that financial institutions with high deposits engage less in interconnected activities of other financial institutions or institutional investors. Therefore we hypothesized that:

H10: There is negative relationship between systemic risk and deposit ratio of financial institutions of Pakistan.

The main purpose of this study is to assess the contribution of banks, financial services, and insurance firms towards the systemic risk. Pakistan is a growing economy. It needs to enhance the stability of its financial system. The instability in the financial system leads towards the negative growth in the economy. The instability of the financial system gives rise to systemic risk. To boost the economic growth of the country, it becomes very important to identify the most riskiest and vulnerable financial institutions. Moreover, it is also equally important to investigate the potential determinants whose increase or decrease can help to reduce the systemic risk generated by banks, financial services, and insurance firms of Pakistan. The Δ CoVaR systemic risk measure is used to estimate the systemic risk. The panel regression is used to identify determinants of systemic risk of Pakistan.

DATA DESCRIPTION AND EMPIRICAL FRAMEWORK

Data Description and Sample

The main purpose of this study is to assess the contribution of banks, financial services, and insurance firms towards the systemic risk. Pakistan is a growing economy. It needs to enhance the stability of its financial system. The instability in the financial system leads towards the negative growth in the economy. The instability of the financial system gives rise to systemic risk. To boost the economic growth of the country, it becomes very important to identify the most riskiest and vulnerable financial institutions. Moreover, it is also equally important to investigate the potential determinants whose increase or decrease can help to reduce the systemic risk generated by banks, financial services, and insurance firms of Pakistan. The Δ CoVaR systemic risk measure is used to estimate the systemic risk. The panel regression is used to identify determinants of systemic risk of Pakistan.

Systemic Risk Measurement

Adrian and Brunnermeier (2016) introduced the concept of ΔCoVaR to estimate the systemic risk faced by the financial institution or financial system. The authors developed this measure by extending the concept of traditional Value at Risk (VaR). As per Jorion (1997), the VaR (α) is the worst expected loss of a financial institution i over a specified time period, having a given confidence level (1- α). $CoVaR_q^{a|i}$ is basically VaR_q^a of financial institution a conditional on an event Ev (R^i) affecting adversely the stock returns of financial institution i. The affected stock returns of the financial institution are defined as the returns equal to its VaR level, i.e., ($Ev^i = VaR_q^i$). Similarly, $CoVaR_q^{a|i}{}_q$ is defined as the q^{th} quantile of the conditional probability distribution of stock returns of financial institution a:

$$\text{Probability,} \quad R_j \leq CoVaR_i^{a|Ev(R^i)} \left| Ev\left(R^i\right) \right) = q \tag{1}$$

Using the same context of Adrian and Brunnermeier (2016) , we define ΔCoVaR measure as the difference between the CoVaR of the financial system s when the underlying financial institution i is in worst conditions values(i.e., 1%) and the CoVaR when the same financial institution i is at its normal or median state (i.e., 50%):

$$\Delta CoVaR_q^{a|i} = CoVaR_{q=1\%}^{a|i} - CoVaR_{q=50\%}^{a|i} \tag{2}$$

The ΔCoVaR systemic risk measure presented in equation (2) measures the marginal contribution of a financial institution towards the financial system when the same financial institution is in financial distress. In order to estimate the $\Delta CoVaR_q^{a|i}$, we first need to calculate the $Ev^i = VaR_q^i$ and $CoVaR_q^{a|i}$ for both the normal and median states. Following the previous literature, we use market weighted monthly stock returns of individual financial institutions. We also used quantile regression introduced by Koenker and Basset (1978) at both the 1% and 50% quantile level. A brief description of the whole procedure which we followed is given below.

Individual returns variable R_t^i is the monthly returns of each individual financial institution. We consider a 1% quantile to present the worst case scenario and 50% for the normal conditions. Specifically, we estimate the following regression for each of our sample selected individual financial institutions at 1% and 50% quantile to get the predicted VaR estimates.

$$R_{t(q)}^i = a_q^i + \beta_q^i SV_{t+\epsilon_t^i} \qquad \text{where q= 1\% and 50\%} \tag{3}$$

We estimate equation (3) for both the 1% and 50% quantile level. a_q^i is constant, $R_{t(q)}^i$ is the monthly market return of individual financial institution, and SV_t is the vector of state variables. After estimating equation (3), we use the estimated parameters to get the VaR estimates. The $\widehat{VaR_t^i}(q)$ is calculated using predicted values of the above regression.

$$\widehat{VaR_t^i}(q) = \widehat{R_t^i(q)} = \hat{\alpha}_q^i + \hat{\beta}_q^i SV_t \qquad \text{where q= 1\% and 50\%} \tag{4}$$

$\widehat{\alpha_q^i}$ and $\widehat{\beta_q^i}$ are estimated parameters from equation (3). While estimating equation (3), we consider the equity market returns as the market valued returns of all the financial institutions of the country. However, following the Bernal, Gnabo, & Guilmin (2014), we set the value of equity market return at 0 when predicting the VaR for a specific institution. We do so to get the non-biased VaR predicted values. The next step involves the estimation of $CoVaR$ at the 1% and 50% quantile levels. The return of the whole financial system R_t^{system} is calculated using the equation (5).

$$R_t^{system} = \sum_{i=1}^{N}((\ Mkt\ Cap_{i,t-1} \times R_{it})/(\sum_{i=1}^{N} Mkt\ Cap_{i,t-1})) \tag{5}$$

R_t^{system} is monthly returns of financial system. $Mkt\ Cap_{i,t-1}$ is one month lag current market capitalization of each financial institution (i= 1, 2, 3, N). Similarly for calculation of the $CoVaR$ we use following regression.

$$R_t^{system} = \propto_q^{system|i} + \beta_q^{system|i} SV_t^{system} + \delta_q^{system|i} R_t^i + \varepsilon_t^{system|i}$$
where q=1% and 50% (6)

R_t^{system} is the monthly returns of financial system, $\propto_q^{system|i}$ is constant, SV is vector of state variables, R_t^i is returns of individual financial institutions and $\varepsilon_t^{system|i}$ is error term.

$$\widehat{CoVaR}_t^{system|i}(q) = \hat{\alpha}_q^{system|i} + \hat{\beta}_q^{system|i} SV_t^{system} + \hat{\delta}_q^{system|i} \widehat{VaR}_t^i(q)$$
where q=1% and 50% (7)

$\widehat{CoVaR}_t^{system|i}(q)$ is the predicted value of $CoVaR$. As a final step, we calculate the marginal contribution of the underlying financial institution towards systemic risk of the financial system.

$$\Delta\widehat{CoVaR}_t^{system|i}(q) = \widehat{CoVaR}_t^{system|i}(q = 1\%) - \widehat{CoVaR}_t^{system|i}(q = 50\%) \quad (8)$$

Eventually, the $\Delta\widehat{CoVaR}_t^{system|i}(q)$ is amount at which an individual financial institution transmit risk to the whole financial system of the country at the 1% quantile. Empirically, the $\Delta\widehat{CoVaR}_t^{system|i}(q = 1\%)$ gives negative values because it is computed from the worst 1% returns of individual banks, financial services, and insurance firms. Therefore, we can infer that the individual financial institution either bank, financial service, or insurance firm with the largest $\Delta\widehat{CoVaR}_t^{system|i}(q = 1\%)$ absolute value contributes more towards the systemic risk of financial system during the times of financial distress.

State Variables

The following state variables are used in this study for the calculation of: $\Delta\widehat{CoVaR}_t^{system|i}(q)$

i. Equity volatility is calculated as the standard deviation of daily returns of financial system.
ii. Liquidity spread is calculated by taking the difference between 3-month repo rate and 3-month Treasury bill rates.
iii. Change in three month yield is calculated as the change in 3-month Treasury bill rates.
iv. Change in the slope of the yield curve is calculated by taking difference between long term government bond's yield and 3 month Treasury bills rates.
v. Change in credit spread is calculated by taking the difference between B grade corporate bonds and the long term government bond.
vi. Financial System (equity) returns are calculated as in Equation (5).

Determinants of Systemic Risk

The following regression equation is separately used to estimate the systemic risk for the selected panel of financial institutions, banks, financial services, and insurance firms of Pakistan.

$$\Delta\widehat{CoVaR}_{it} = \beta_i + \beta_1 Size_{it} + \beta_2 LR_{it} + \beta_3 LL_{it} + \beta_4 LEV_{it} + \beta_5 TR1_{it} + \beta_6 LQR_{it} + \beta_7 MTBV_{it} + \beta_8 NINT_{it} + \beta_9 OPM_{it} + \beta_{10} DR_{it} + \epsilon_{it} \quad (9)$$

In the above equation, for ith financial institution over tth time period, $\Delta\widehat{CoVaR}_{it}$ is the systemic risk measure obtained from equation (8), Size stands for the size of financial institution measured in terms of log of total assets, *LR* is the loan ratio, *LL* is the loan loss provision ratio, *LEV* is the leverage ratio, *TR1* is the tier1 ratio, *LQR* is the liquidity ratio, *MTBV* is the market to book value ratio, *NINT* is the non interest ratio, *OPM* is the operating profit margin ratio, and *DR* is the deposit ratio.

We predict the expected relationship between systemic risk and financial characteristics is presented in Table 1.

Table 1
Variable Construction and Expected Signs

Variable	Description	Expected Sign	Symbol
Size	Log of total assets	+	Size
Loan ratio	Total loans to total assets	+/-	LR
Loan loss provision ratio	Loan loss provisions to total loans	+	LL
Leverage ratio	Debt to equity	+	LEV
Tier 1 ratio	Core equity capital to total risk weighted assets	-	TR1
Liquidity ratio	Ratio of cash and tradable securities to total deposits	-	LQR
Market to book value ratio	Market value to book value	+/-	MTBV
Non-Interest ratio	Noninterest income to total income	+/-	NINT
Operating profit margin ratio	Operating income to net sales	+/-	OPM
Deposit ratio	Ratio of deposits to total liabilities	-	DR

Empirical Results and Analysis

The empirical results of this study include summary statistics of state variables, systemically important financial institutions, and summary statistics of financial characteristics and regression results of all financial institutions of Pakistan

Summary Statistics of State Variables

Table 2 presents summary statistics i-e mean, standard deviation (Std. Dev.), minimum value (Min), and maximum value (Max) of state variables employed in the study.

Table 2
Summary Statistics of State Variables of Financial Institutions of Pakistan

Variable	Obs	Mean	Std Dev	Min	Max
Equity Volatility	6144	0.68	1.48	0.00	0.49
Change in 3-month rate	6144	-0.09	0.02	-1.68	1.67
Change in slope of Yield Curve	6144	0.26	0.58	-0.66	1.75
Liquidity Spread	6144	0.88	2.20	-1.27	13.22
Credit Spread Change	6144	0.68	1.69	-1.80	2.29
System Returns	6144	0.61	1.10	-0.18	2.34

The summary statistics of state variables of Pakistan reveals that mean values of all state variables are positive except the Change in 3-month rate. A lower volatility of the state variables of Pakistan shows that for a longer time period market prices are changing at a steady rate. A higher liquidity spread means that market has large number of buyers and sellers available. The high mean value of Change in Credit spread gives investors a fair idea that market conditions are favorable for buying stock, on average. The mean value of liquidity spread is high for the financial institutions of Pakistan. The mean value of the equity volatility of financial institutions of Pakistan is 0.640 with the standard deviation of 1.45. The high mean value of Equity Volatility indicates that high volatility results in more risk taking activities.

Systemically Important Financial Institutions of Pakistan

This section highlights the most systemically important financial institutions of Pakistan. The three most systemically risky financial institutions of whole financial system, banks, financial services, and insurance firms of Pakistan listed in PSX are reported in Table 3

Table 3
Systemically Important Financial Institutions of Pakistan

Name of financial institution	1% VaR	50% VaR	1% CoVaR	50% CoVaR	ΔCoVaR
Financial System					
NBP	-0.68	-0.47	-0.57	-0.37	-0.50
ABL	-0.65	-0.38	-0.49	-0.34	-0.45
HBL	-0.52	-0.25	-0.38	-0.21	-0.39
Banks					
NBP	-0.68	-0.47	-0.57	-0.37	-0.50
ABL	-0.65	-0.38	-0.49	-0.34	-0.45
HBL	-0.52	-0.25	-0.38	-0.21	-0.39
Financial Services					
Orix	-0.37	-0.18	-0.42	-0.38	-0.29
Jahangir and Siddique	-0.34	-0.22	-0.33	-0.17	-0.20
Invest Capital	-0.28	-0.17	-0.30	-0.17	-0.18
Insurance					
New Jubilee Life Insurance	-0.49	-0.33	-0.49	-0.40	-0.38
EFU Life Assurance Ltd	-0.32	-0.28	-0.40	-0.26	-0.25
IGI Insurance Ltd	-0.36	-0.31	-0.38	-0.34	-0.24

The very first observation from the Table 3 is that most vulnerable financial institutions of Pakistan are three banks. NBP, ABL, and HBL appear to inject maximum risk in the financial system of Pakistan. Our results indicate that NBP has the most negative 1% VaR at -0.68 as well as the most negative 50% VaR at -0.47 units, implying that NBP is the riskiest bank among all the listed financial institutions of Pakistan in isolation. ABL has the second most negative 1% VaR at -0.65 units as well as 50% VaR at -0.38 units. Finally, HBL has the third large 1% VaR at -0.52 and 50% VaR is -0.25 units. In simple words, our estimation indicates that the probability is 1% that NBP, ABL, and HBL will lose more than 0.68, 0.65, and 0.52 units, respectively, and the probability is 50% that they will lose more than 0.47, 0.38, and 0.25 units a month, respectively. The next observation is that the VaR of these three banks in isolation exceeds the VaR of the financial system as a whole, which suggests that these three banks, when examined in isolation, are more vulnerable than the whole financial system when measured in isolation.

At the same quantile levels, the $CoVaR$ are estimated for all the sample selected financial institutions of Pakistan. The estimates show that the $CoVaR$ of NBP at the 1% and 50% quantiles are -0.57 and -0.37 units, respectively. $\Delta CoVaR^{system|financial\ institution\ i}$ shows that how a specific financial institution i is vulnerable to the financial system. As an example, $\Delta CoVaR^{system|NBP} = 0.50$. This values shows that NBP adds 50% loss to the financial system of Pakistan when the bank moves from its normal condition to 1% VaR level. It is the maximum loss added in the financial system by any of the individual financial institution of Pakistan. The systemic risk contribution (ΔCoVaR) of NBP is highest followed by ABL and HBL. It indicates that NBP contributes the maximum loss to the financial system. The results suggest that the distress of ABL leads to the negative outcome of the financial system of Pakistan by adding a

loss of 0.45 units. In other words, we can say that $\Delta CoVaR^{system|\overline{ABL}} = 0.45$ units, adds a loss of 0.45 units or 45% in the financial system of Pakistan during the times of financial distress[2]. Furthermore, our risk estimates show that the most risky and vulnerable financial services of Pakistan are Orix, Jahangir and Siddique, and Invest Capital. These financial services add negative outcome of -0.29, -0.20, and -0.18 units, respectively, to the systemic risk of financial system of Pakistan. For example, $\Delta CoVaR^{system|Orix} = 0.29$ units, adds a loss of 0.29 units in the systemic risk of financial system of Pakistan during the times of financial distress.

Our estimates show that EFU is slightly more systemically important than the other insurance companies of Pakistan. Our estimates rank New Jubilee, EFU, and IGI as most risky insurance firms of Pakistan. The insurance firms individually are more vulnerable than the financial services of Pakistan. The VaR estimation indicates that the probability is 1% that New Jubilee, EFU, and IGI will lose more than -0.49, -0.32, and -0.36 units, respectively, and the probability is 50% that they will lose more than –0.33, -0.28, and -0.31 units, respectively. The CoVaR estimation indicates that the probability is 1% that New Jubilee Life Insurance, EFU Life Assurance, and IGI Insurance will lose more than -0.49, -0.40, and -0.38 units, respectively condition on the financial system, and the probability is 50% that they will lose more than –0.40, -0.26 and -0.34 units conditional on the financial system respectively. The systemic risk contribution of New Jubilee Life Insurance, EFU Life Assurance, and IGI Insurance is negative outcome of -0.38, -0.25, and -0.24 units, respectively.

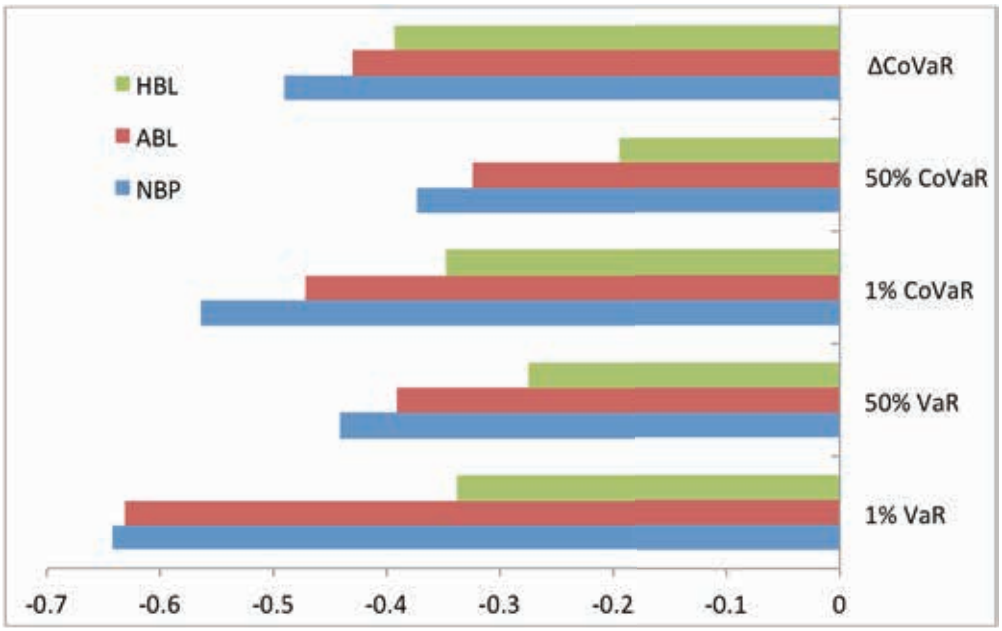

Figure 1: Estimated Risk Measures of Systemically Important Banks of Pakistan

2- In similar way, the estimates of other banks included in the sample can be interpreted. However, we leave this on the researcher to economize.

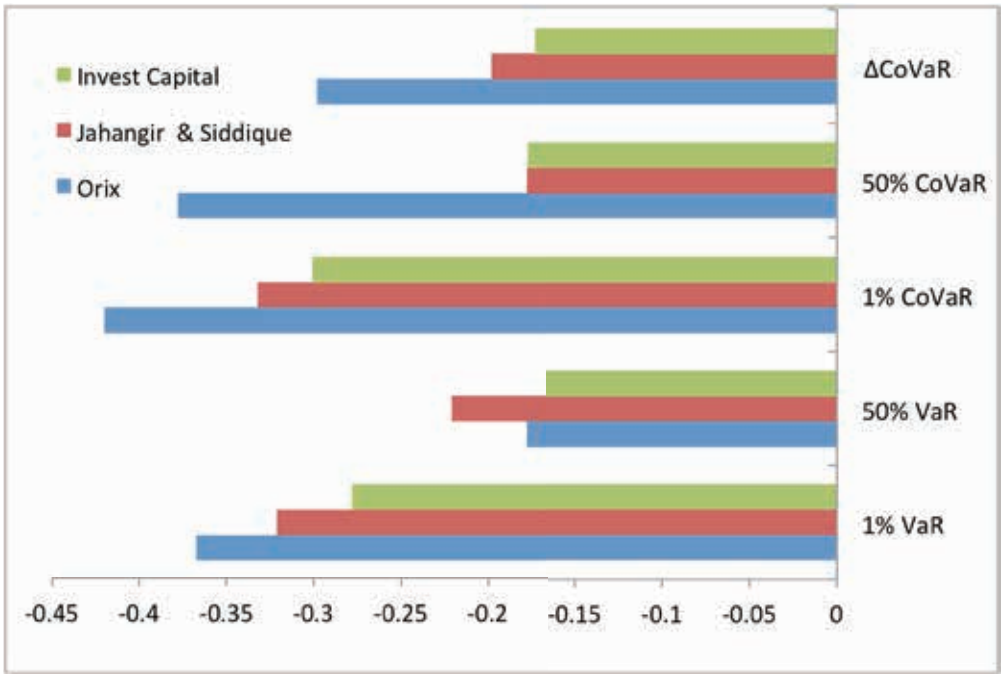

Figure 2: Estimated Risk Measures of Systemically Important Financial Services of Pakistan

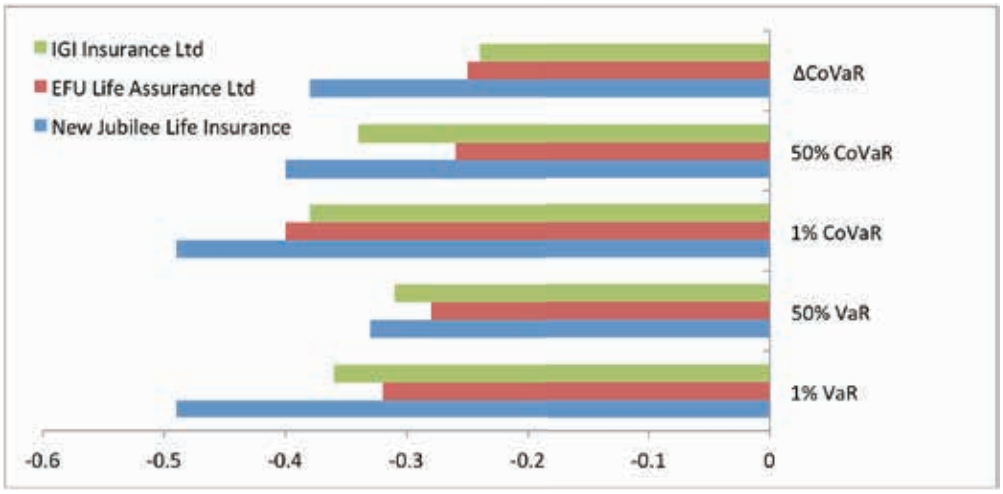

Figure 3: Estimated Risk Measures of Systemically Important Insurance Firms of Pakista

Figure 1 ranks NBP as the most systemically important bank of Pakistan. HBL is less systemically important than the NBP by 0.10 units. ABL appears more systemically important in isolation than HBL at both the 1% and 50% quantile. Figure 2 ranks Orix the most systemically important financial services of Pakistan. It appears to be most risky financial service of Pakistan is isolation. It also appears to induce more risk in the distress of financial system. The Jahangir and Siddique is more risky in isolation at the 50% quantile. Similarly, it produces more risk in the financial system distress when measured at the 50% quantile. The Invest Capital appears to be less systemically important than Orix by 0.10 units. Figure 3 clearly show that New Jubilee Life Insurance, EFU Life Assurance, and IGI Insurance top most systemically insurance firms of Pakistan. IGI Insurance appears the most risky insurance firm when measured in isolation at the 1% quantile level. It also appears to inject more risk when financial system is in distress at both the 1% and 50% quantile levels. IGI Insurance is less slightly systemically important than the EFU Insurance.

Summary Statistics of Financial Characteristics of Pakistan

The financial institutions listed at PSX are taken as the sample for Pakistan. The summary statistics of financial characteristics employed in the study are given in Table 3.The mean value of size of banks of Pakistan is high followed by financial services and insurance firms of Pakistan. The large banks are considered to be more interconnected within and outside the financial system, making them very difficult to replace. The large banks receive incentives from the government. That is why the systemic risk becomes a public concern. The high loan ratio of banks indicates that financial institutions may have to deal with high credit risk. The banks have more loan ratio so that mean they have to maintain a high loan loss provision ratio as well. The high mean value of leverage ratio of banks operating in Pakistan suggests high default risk followed by financial services and insurance firms of Pakistan. The mean value of the tier1 ratio of banks, financial services, and insurance firms is smaller in comparison with the mean values of other ratio. The high mean value of the liquidity ratio of banks suggests that banks have more cash available which can be utilized in the distress.

Table 4
Summary Statistics of Financial Institutions of Pakistan

	Financial System			Banks			Financial Services			Insurance		
Variable	Obs	Mean	Std.Dev	Obs	Mean	Std.Dev	Obs	Mean	Std.Dev	Obs	Mean	Std.Dev
Size	352	8.42	8.57	187	8.64	8.40	88	7.23	7.10	77	6.99	7.00
Loan ratio	320	0.623	0.546	165	0.712	0.698	78	0.675	0.521	77	0.665	0.509
Loan loss provision ratio	320	0.242	0.325	165	0.371	0.309	78	0.324	0.298	77	0.292	0.237
Leverage ratio	352	0.365	0.354	187	0.427	0.587	88	0.392	0.495	77	0.356	0.498
Tier1 ratio	352	0.204	0.476	187	0.265	0.458	88	0.219	0.389	77	0.209	0.388
Liquidity ratio	352	0.443	0.565	187	0.498	0.599	88	0.316	0.309	77	0.358	0.474
Market to book value ratio	352	2.342	2.492	187	2.041	2.098	88	1.261	1.676	77	2.012	2.139
Non-Interest ratio	352	0.604	0.776	187	0.541	0.729	88	0.455	0.643	77	0.528	0.611
Operating profit margin ratio	352	0.543	0.612	187	0.599	0.677	88	0.413	0.592	77	0.543	0.611
Deposit ratio	352	0.412	0.498	187	0.565	0.657	88	0.467	0.589	77	0.422	0.566
ΔCoVaR	352	-0.134	0.346	187	-0.182	0.546	88	-0.061	0.389	77	-0.085	0.324

The mean value of the market to book value ratio of banks of Pakistan is higher than the insurance firms and financial services. The market to book value ratio of insurance firms is higher than the financial services of Pakistan. Similarly, the mean value of the non-interest ratio of insurance firms is higher than the financial services. The high mean value non-interest ratio of insurance firms suggests that insurance firms earn more from the non-banking activities. The standard deviation of banks s of Pakistan is also high indicating that banks is more vulnerable than the other sample selected financial sectors of Pakistan.

Regression Results

In this subsection, we present the fixed effect model estimation results for the effects of financial characteristics on the systemic risk of financial institutions of Pakistan. To examine the effect of financial characteristics, we also estimated ΔCoVaR regression separately for a panel of banks, financial services, and insurance firms. We do so to examine the empirical determinants of systemic risk differs across these types of financial institutions. The results are given in Table 4.The adjusted R-squared and F-statistics indicate that all the estimated models are a good fit to the data and estimated models explain a substantial variation in the dependent variable. Although, autocorrelation and heteroscedasticity are not severe issues in the panel for fewer years, we examine them anyway. Wooldridge test is use to examine autocorrelation while Huber White test is used to check heteroscedasticity. The results confirm that there is no autocorrelation in the data.

Table 5
Results of Regressions for Financial Institutions of Pakistan

Dependent Variable ΔCoVaR				
Variable	Financial System	Banks	Financial Services	Insurance
Size	0.762**	0.736***	0.389	0.346***
	(0.354)	(0.332)	(0.304)	(0.050)
Loan ratio	0.259***	0.226***	0.109**	0.998***
	(0.114)	(0.044)	(0.052)	(0.217)
Loan Loss Provision ratio	0.277	0.152**	0.956*	0.112**
	(0.267)	(0.074)	(0.479)	(0.030)
Non-Interest ratio	0.794**	0.311***	0.528*	0.325***
	(0.437)	(0.042)	(0.160)	(0.155)
Leverage ratio	0.375***	0.397***	0.346	0.801*
	(0.132)	(0.169)	(0.220)	(0.427)
Deposit ratio	-0.251	-0.561	-0.285	-0.186
	(0.223)	(0.448)	(0.365)	(0.825)
Tier1 ratio	-0.342**	-0.302***	-0.595*	-0.170***
	(0.073)	(0.127)	(0.289)	(0.051)
Liquidity ratio	0.203**	0.239***	-0.283	-0.596
	(0.056)	(0.037)	(0.945)	0.389
Operating Profit Margin ratio	0.436***	0.251**	0.268	0.240**
	(0.184)	(0.113)	(0.311)	(0.097)
Market to Book Value ratio	0.715***	0.517*	0.723	0.203**
	(0.182)	(0.303)	(0.716)	(0.079)
Observations	327	185	77	65
Adjusted R^2	0.654	0.629	0.498	0.532
F-stat	21.78	15.67	56.87	26.45
Prob (F stat)	0.000	0.000	0.000	0.000
Hausman (p)	0.000	0.001	0.008	0.005
DW	1.923	1.891	2.041	1.951
Autocorrelation (Wooldridge test) (p)	0.222	0.136	0.453	0.391
Heteroscedasticity (Huber/White test)	Heteroscedasticity robust standard error estimates are used			

Note: The table presents the results of panel data regression of financial system, banks, financial services, and insurance firms. The heteroscedasticity robust White (1980) standard error has been used for the estimation of linear panel. . The coefficients are presented. The standard errors are given in the parenthesis. The Wooldridge test is used for the autocorrelation. The p values are given in parenthesis. Hausman test is applied to select fixed effect or random affects estimator. Hausman test p value is also given. *, **, *** indicate the significance at the 10 percent, 5 percent and 1 percent level, respectively.

Examining the estimated coefficient for a sample of all financial institutions, we find that that financial institution size, the loan ratio, the non interest ratio, the leverage ratio, the liquidity ratio, the operating profit margin ratio, and the market to book value ratio have statistically significant impact on the systemic risk of all the financial institutions. In contrast, the tier1 ratio appears to be negatively and significantly related to the systemic risk. The loan loss provision ratio and the deposit ratio are statistically insignificantly related to the systemic risk.

We also examine the effect of financial characteristics on the systemic risk of banks, financial services, and insurance firms of Pakistan. The estimated coefficients of size for banks and insurance firm suggest that increases in the size of financial institutions will increase systemic risk contribution of the financial institutions. Yet, the estimated coefficient of financial services Pakistan appears statistically insignificant. The results of our study are consistent with the findings of Moore and Zhou (2013) and Kleinow and Nell (2015).

The loan ratio shows a positive and significant relationship with the systemic risk for banks, and insurance firms of Pakistan. The contribution of loan loss provision ratio is positive for the banks, financial services, and insurance firms with the coefficient values of 0.15, 0.95, and 0.112 units, respectively. The results indicate the more is the non performing loans, the more is the systemic risk. The non-interest ratio for the banks, financial services, and insurance firms show a positive and significant relationship with the systemic risk. Our findings suggest that increases in the non interest income increase the systemic risk.

The leverage ratio clearly shows a positive and significant relationship with the systemic risk for both banks and insurance firms. This implies that more use of debt in the capital structure will increase the systemic risk. The tier1 ratio shows a significant negative relationship with the systemic risk. This implies that higher tier1 ratio will reduce the systemic risk contribution of financial institutions to the whole system. Our findings are consistent with the findings of Kleinow and Nell (2015).

The liquidity ratio shows a positive and significant relationship with the systemic risk for the banks of Pakistan. The findings suggest that excess cash means bank is not utilizing its capital effectively and efficiently. This scenario ultimately adds on the systemic risk of the bank when the financial system is in financial distress. The estimated coefficient value of the operating profit margin ratio for the banks, and insurance firms of Pakistan shows a positive significant relationship with the systemic risk. The estimated coefficient values of the market to book value of banks and insurance firms of Pakistan show a positive and significant relationship with the systemic risk. The magnitude of the estimated coefficient value indicates that the effect of market to book value ratio is higher for banks followed by insurance firms. On the other hand, the estimated coefficient value of the market to book value of financial services of Pakistan appears statistically insignificant at any acceptable level of significance. The results are consistent with the Brunnermeier (2012), Weiß and Neuman (2014) and Kleinow, &Nell (2015).

CONCLUSION

This study was carried out to estimate the systemic risk contribution of individual financial institutions of Pakistan. The most risky and vulnerable banks, financial services, and insurance firms are reported. Systemic risk contributions have been measured by employing the Δ

CoVaR measure, using quantile regressions. This study specifically focused on identification of not only systemically important banks but also financial services and insurance firms of Pakistan as well. This identification has received relatively less attention in the existing literature. Our empirical results suggest banks as the riskiest and most vulnerable financial institutions of Pakistan. As per estimates, systemically important banks of Pakistan are NBP, ABL, and HBL. The individual level estimation suggests that systemically important financial services of Pakistan are Orix, Jahangir and Siddique, and Invest Capital. The individual financial institution estimation also puts forward systemically important insurance firms of Pakistan as: EFU Life Assurance, New Jubilee Life Insurance, and IGI.

The individual level estimation provides evidence that the banks of Pakistan contribute more towards systemic risk followed by insurance and financial services. The empirical findings regarding the effects of financial characteristics on the systemic risk of financial system of Pakistan suggest that institution size, the tier1 ratio, the liquidity ratio, the operating profit margin ratio and the market to book value ratio statistically and significantly related to the systemic risk of financial system. The results also suggest that although the most of determinants affect the systemic risk contribution to different types of financial institutions (banks, financial services, and insurance firms). In the similar way, the size of estimated coefficients varies considerable across the types of financial institutions.

The results of this study emphasize the need for regulatory authorities and policymakers to adopt a straightforward approach for implementation of systemic risk measure in Pakistan. Regulatory authorities and policymakers need to consider that different financial institutions have different contribution towards systemic risk. The regulatory requirements must be designed by taking in consideration systemically risky nature of financial institutions. The determinants highlights that increase or decrease of a specific financial characteristics helps to mitigate the systemic risk faced by the financial system. The regulations catering the important determinants of systemic risk helps the financial system to decrease the systemic risk overall.

REFERENCES

Acemoglu, D., Ozdaglar, A., & Tahbaz-Salehi, A. (2015). Systemic risk and stability in financial networks. *The American Economic Review*, 105(2), 564-608.

Acharya, V. V., Pedersen, L. H., Philippon, T., & Richardson, M. (2017). Measuring systemic risk. *The Review of Financial Studies*, 30(1), 2-47.

Acharya, V., Engle, R., & Richardson, M. (2012). Capital shortfall: A new approach to ranking and regulating systemic risks. *The American Economic Review*, 102(3), 59-64.

Adams, Z., Füss, R., & Gropp, R. (2014). Spillover effects among financial institutions: A state-dependent sensitivity value-at-risk approach. *Journal of Financial and Quantitative Analysis*, 49(03), 575-598.

Adrian, T., & Brunnermeier, M. K. (2016). CoVaR. T*he American Economic Review*, 106(7), 1705-1741.

Bartholomew, P. F., & Whalen, G. (1995). Fundamentals of systemic risk. *Research in financial services: Banking, financial markets, and systemic risk*, 7(1), 3-18.

Beltratti, A., & Stulz, R. M. (2012). The credit crisis around the globe: Why did some banks perform better?. *Journal of Financial Economics*, 105(1), 1-17.

Benoit, S., Colliard, J. E., Hurlin, C., & Pérignon, C. (2016). Where the risks lie: A survey on systemic risk. Review of Finance, 26.

Bernal, O., Gnabo, J. Y., & Guilmin, G. (2014). Assessing the contribution of banks, insurance and other financial services to systemic risk. *Journal of Banking & Finance*, 47(1), 270-287.

Billio, M., Getmansky, M., Lo, A. W., & Pelizzon, L. (2012). Econometric measures of connectedness and systemic risk in the finance and insurance sectors. *Journal of Financial Economics*, 104(3), 535-559.

Brämer, P., & Gischer, H. (2012). *Domestic systemically important banks: An indicator-based measurement approach for the australian banking system*. Univ., Faculty of Economics and Management.

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial studies*, 22(6), 2201-2238.

Brunnermeier, M. K., Eisenbach, T. M., & Sannikov, Y. (2012). *Macroeconomics with financial frictions: A survey* (No. w18102). National Bureau of Economic Research.

Cerutti, E., Claessens, S., & McGuire, P. (2012). Systemic risk in global banking: what can available data tell us and what more data are needed?. *Available at SSRN*.

Chen, Y., Shi, Y., Wei, X., & Zhang, L. (2014). Domestic systemically important banks: a quantitative analysis for the Chinese banking system. *Mathematical Problems in Engineering*, 2014.

De Jonghe, O. (2010). Back to the basics in banking? A micro-analysis of banking system stability. *Journal of Financial Intermediation*, 19(3), 387-417.

Demir, N., Mahmud, S. F., & Babuscu, S. (2005). The technical inefficiency effects of Turkish banks after financial liberalization. *The Developing Economies*, 43(3), 396-411.

Elsinger, H., Lehar, A., & Summer, M. (2006). Systemically important banks: an analysis for the European banking system. *International Economics and Economic Policy*, (1), 73-89.

Gauthier, C., Lehar, A., & Souissi, M. (2012). Macroprudential capital requirements and systemic risk. *Journal of Financial Intermediation*, 21(4), 594-618.

Jorion, P. (1997). *Value at risk: the new benchmark for controlling market risk*. Irwin Professional Pub.

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *The American Economic Review*, 1183-1200.

Kleinow, J., & Nell, T. (2015). Determinants of systemically important banks: the case of Europe. *Journal of Financial Economic Policy*, 7(4), 446-476.

Knaup, M., & Wagner, W. (2010). Measuring the tail risks of banks. S*wiss National Centre of Competence in Research on Trade Regulation Working Paper*, (2009/14).

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, 93(2), 259-275.

Laeven, L., Ratnovski, L., & Tong, H. (2016). Bank size, capital, and systemic risk: ome international evidence. *Journal of Banking & Finance*, 69, S25-S34.

López-Espinosa, G., Moreno, A., Rubia, A., & Valderrama, L. (2015). Systemic risk and asymmetric responses in the financial industry. *Journal of Banking & Finance*, 8(1), 471-485.

Moore, Kyle, and Chen Zhou. 2013. 'Too Big to Fail' or 'Too Non-Traditional to Fail?' The Determinants of Banks' Systemic Importance. *MPRA Paper 45589; Munich: University Library of Munich*.

Renn, O., Klinke, A., & van Asselt, M. (2011). Coping with complexity, uncertainty and ambiguity in risk governance: A synthesis. *Ambio*, 40(2), 231-246.

Segoviano, M. A., & Goodhart, C. A. E. (2009). *Banking stability measures* (No. 627). International Monetary Fund.
Weiß, G. N., Bostandzic, D., & Neumann, S. (2014). What factors drive systemic risk during international financial crises?. *Journal of Banking & Finance*, 41, 78-96.
Weiß, G. N., Neumann, S., & Bostandzic, D. (2014). Systemic risk and bank consolidation: international evidence. *Journal of Banking & Finance*, 40, 165-181.