The Interdependence between Capital and Profitability in Banking Industry of Asia: A Comparative Study of Developed and Developing Economies

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Abstract

The purpose of this study is to explore how in current conditions of the developed and developing economies in Asia capital and profitability of commercial banks influence each other simultaneously. This study uses data for 294 commercial banks from the developed and developing nations of Asia covering the period from 2012 to 2017. The Simultaneous Equations Model Two-Stage Least Square (2SLS) is used to find out the unbiased structural parameters. The impact of bank capital is more significant to influence the profitability of banks in developed economies whereas profitability is more significant to influence the bank capital of commercial banks in developing economies. There is positive causality running from profitability to capital of large, medium and smaller-sized banks in developed and developing economies. The impact of bank capital is not similar to influence profitability in developed and developing economies. In developed economies, banks capital has a positive impact on the profitability of large, medium and smaller-sized banks. The impact of bank capital on profitability is negative in developing economies larger and smaller size banks whereas the results are insignificant in the case of smaller size banks. There is a negative causality running from bank capital to the profitability of large and small size banks. In medium commercial banks of developed and developing economies the bank capital performs a positive and similar role. The findings of this research have valued information for policy makers of developed and developing economies in Asia and they can formulate new guidelines for commercial banks regarding bank capital requirement and profitability.

Keywords: Bank capital, Bank profitability, Commercial Banks, and Asian Economies

Introduction

Research conducted on the relationship between bank capital, risk-taking and profitability has focused on developed economies (Abbas, Butt, Masood, & Javaria, 2019; Abbas & Masood, 2020b; Aggarwal & Jacques, 1998b; Altunbas, Carbo, Gardener, & Molyneux, 2007; Berger, 1995; Ding & Sickles, 2019; Jacques & Nigro, 1997; Peltzman, 1970; Rime, 2001; Shrieves & Dahl, 1992). However, the evidence from Asian developed and developing economies commercial banks are limited, particularly for post-crisis era (Abbas, Iqbal, & Aziz, 2019, 2020; Gul, Awan & Ahmad, 2015; Lee & Hsieh, 2013; Mahdi & Abbes, 2018; Mongid, Tahir, & Haron, 2012).

The primary aim of this analysis is to investigate how bank capital and commercial bank profitability affect each other simultaneously under the current circumstances of the developing and developed economies of Asia. The researchers,

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analysts, regulators, and managers have been trying since many decades to find an optimum capital required to maintain a higher rate of returns. This need is more pronounced in developed economies of the world like the USA and the UK. Berger's (1995) research work is the motivation for this study and it aims to investigate the simultaneity between bank capital and profitability in developing and developed economies of Asia particularly in current conditions of globally integrated banking sectors. Recently,Tran, Lin, and Nguyen (2016) conducted a study to investigate the simultaneity between bank capital, bank liquidity creation and bank profitability in the USA banking industry. There are many other studies conducted in the United States to investigate the connection among bank capital, risk-taking and efficiency. These include work done by Shrieves and Dahl (1992), Berger (1995) and Aggarwal and Jacques (1998a). Similarly in the United Kingdom Altunbas *et al.* (2007) and Goddard, Molyneux, and Wilson (2004) conducted studies to find out the empirical evidence among bank capital, bank risk and efficiency. These are the most important studies in the literature regarding bank capital, risk and efficiency. Shrieves and Dahl (1992) pointed out in their study that the previous papers, focused on bank risk-taking and bank capital, have contradictory results regarding the connection of risk and capital. The particular focus of study of Shrieves and Dahl was to investigate the relationship between risk and capital under the condition of simultaneity assumption and they found that capital and risk are related and should be managed simultaneously. In a similar study done later by Aggarwal and Jacques (1998a) it is validated that capital and risk are related and should be managed simultaneously. Berger (1995) provides empirical evidence in his study regarding the simultaneity of capital and return on equity in the USA.

In recent literature, numerous studies explore the interrelationship among bank capital level, risk-taking and profitability for conventional banks (Balla & Rose, 2019; Bitar, Pukthuanthong, & Walker, 2018; Bitar, Saad, & Benlemlih, 2016; Deelchand & Padgett, 2009; Dias, 2020; Ding & Sickles, 2018; Paroush & Schreiber, 2019). The recently conducted studies in Asian context like in Bangladesh (Robin, Salim, & Bloch, 2018), in China (Dong, Girardone, & Kuo, 2017; Wang, Jiang, Lin, Xie, & Stanley, 2018; Tan & Floros, 2018; Tan & Floros, 2013), in ASEAN countries (Nguyen, 2018; Mongid *et al.*, 2012), in MENA countries (Bougatef & Mgadmi, 2016; Mongid *et al.*, 2012), and others (Awdeh, El-Moussawi, & Machrouh, 2011). Although in recent years different researchers (Abbas, Iqbal, *et al*., 2019; Abbas *et al.*, 2020; Lee & Hsieh, 2013) have investigated the impact of liquidity, profitability, bank capital and risk of commercial banks in the Asian context but the interrelationship between profitability and bank capital has remained neglected. These studies cover the context of bank capital, capital, risk, and profitability in Asian economies. Researchers also ignore the banking

industry of risk-taking, and efficiency of financial institutions in Asian countries. These studies also explore the relationship between risk and capital and capital and efficiency but not the simultaneity of developed as well as developing economies of Asia. There are limited studies that explore the connection between bank capital, risk, and profitability in Asian countries. Lee and Hsieh (2013) provide empirical results of bank capital, risk, and profitability of commercial banks in Asian countries. However, the following questions still remain unanswered: Are banks capital and bank profitability interdependent? If yes then what is the causality between them? What is the lead lag relation? Is the causality similar in both developed and developing economies? Is the causality similar in case of large, medium and smaller sized banks? How are banks capital and bank profitability simultaneously determined in commercial banks?

Theoretically, higher capital is connected with lower returns and this argument recommends inverse relationship between capital and profitability. This hypothesis is applicable to the commercial banks of developing economies according to the findings of this paper. This hypothesis is proved in large, medium-sized, and small banks. This argument also favors the recommendations of regulators to increase the bank capital for the sake of lowering the risk of banks. The findings indicate that in the case of developed economies in Asia bank capital has a positive impact on profitability and this result is similar to the findings of Berger (1995) for the USA banking industry. Theoretically, Berger (1995) says that there is a different explanation for the positive connection between bank capital and bank return on equity. He argues that perfect market and symmetric information increase the capital. In this situation, banks retain the higher proportions of earnings or cut down the rate of dividend to zero which improves the capital ratio of banks. Berger (1995)'s findings represents the commercial banks of the US in 1980s whereas the banking of today is entirely different. The positive causality running from profitability to capital indicates that banks cut down their dividend and increase the stockholder equity by increasing the retained earnings. Whereas the positive causality from bank capital to profitability inviting the regulations to reconsider their regulations for future recommendations for bank capital. According to Berger (1995) positive connection of capital and return on assets and return on equity may be due to higher capital. It decreases the risk of banks insolvency and banks invest in a more risky line of business thus earning more return. Theoretically, this relationship can be positive in some conditions like when the bank has an opportunity to invest at a higher return than debts saving amount. This is possible for those banks that have higher debts and lower capital. The second justification is that banks have greater influence to charge interest to borrowers under some particular conditions. The other argument states that banks might be paying a higher cost on debts which lower their profitability and under such conditions

if the banks raise capital to pay high interest bearing debts they can raise their profitability.

The impact of bank capital is more significant to influence the profitability of banks in developed economies whereas profitability is more significant to influence the bank capital of developing economies. There is a positive causality running from profitability to capital in case of large, medium and smaller-sized banks in developed and developing economies. The impact of bank capital on profitability is not the same in developed and developing economies. In developed economies banks' capital have a positive impact on the profitability of large, medium and smaller banks. The impact of bank capital on profitability is negative in developing economies in larger and smaller-sized banks whereas the coefficient is insignificant in the case of smaller-size banks. The causality is negative from bank capital to the profitability of large and small size banks. The role of bank capital is positive and similar in the case of medium banks in developed and developing economies.

This study contributes to the literature in many ways. Most of the studies explore determinants of bank capital, profitability and risk-taking behavior of commercial banks in Asia. No study is conducted to test the hypothesis of Berger (1995) in the post-crisis era in developed and developing economies. In addition, this study is not similar to that done by Berger (1995) due to the following reasons. The first difference occurs due to measurement and proxy of profitability. This study uses return on average assets instead of return on equity as a proxy of profitability. This study is based on Asian sample including commercial banks in developed as well as developing economies whereas Berger used only the commercial banks of developed economy. This study also provides a comparative analysis of developed and developing economies in the current conditions. This is the first study that highlights the simultaneity between bank capital and bank profitability in commercial banks of developed and developing economies of Asia. This study provides a comparative analysis of developed and developing economies commercial banks. This study provides evidence of simultaneity between profitability and bank capital in large, medium and small size commercial banks of developing and developed economies in post-crisis period. The results of this study are more robust because it uses developed and developing economies separately to validate the findings of previous studies like the one done by Berger (1995). This study contributes to the literature to provide evidence of commercial banks for the post-crisis period.

The rest of the study is arranged as follows. The next section contains the relevant literature about bank capital and profitability, the third section discusses the data collection sources and the econometrics model, the fourth section presents and discusses results, and the final section consists of conclusions and recommendations.

Literature Review

There are plenty of studies that explore the relationship between bank profitability and bank capital. The findings are contradictory and required revision to reach the more rigorous conclusion. The literature under consideration in this study is particularly about bank capital and bank profitability. Due to the lack of extensive studies in Asia, we have to take literature irrespective of the focus region and just considered the key proxies to build consensus in this paper. This literature contains conflicting commentary about the relationship of bank capital and bank risk-taking. Some empirical studies favor positive relationship and others provide negative co-movement between risk-taking and bank capital ratios. On the contrary, some studies conclude that bank capital and risk-taking are interrelated and should be determined simultaneously (Raj Aggarwal & Kevin Jacques, 1998b; Bitar *et al*., 2018; Ding & Sickles, 2018; Jacques & Nigro, 1997; Rime, 2001; Shrieves & Dahl, 1992).

In the previous studies, researchers have claimed that the relationship between bank capital and bank profitability is not clear. For instance Barth, Caprio, and Levine (2008) and (Berger & Bouwman, 2013). Robin *et al.* (2018) conducted a study to investigate the financial performance of major financial institutions in Bangladesh and used data ranging from 1983 to 2012. They concluded in their study that the strength of capital is a key determinant to influence the profitability of major commercial banks in Bangladesh. This study provides the latest insights in banks' financial performance in the context of South Asian economies. Berger (1995) investigated the correlations between profitability and capital and concluded that bank capital has a positive causality to influence profitability whereas the bank profitability is also effecting bank capital significantly and positively. This was the first study that investigated the simultaneity between return on equity and bank capital in the US banking industry in the 1980. Tran *et al*. (2016) explored the interrelationship between bank capital and profitability in US banks. This study argues that relationship between bank capital and bank performance is nonlinear. It concludes that bank capital has a negative impact on the profitability of greater capitalized banks and it positively influences the profitability of lower capitalized banks. These findings validate the results of Berger (1995)'s study for smaller sized banks and contradictory for larger banks. The findings of Tran et al. (2016) advise the regulators to think about this connection under the new conditions of the USA banking industry. Färe, Grosskopf, and Weber* (2004) also investigated the impact of risk-based capital on the profit efficiency of the US banks covering the time period from 1990-94. They used a newly developed methodology to calculate the profit efficiency to test the impact of risk-based capital on profit efficiency. They concluded that risk-based capital has an influence on profit efficiency whereas this impact is more in case of allocative

inefficiency. They also concluded that the selection of input and output is important to manage the profitability of banks. They argued that allocative inefficiency has a greater impact on profit efficiency as compared to technical inefficiency. Altunbas *et al.* (2007) conducted a study to investigate the connection of bank capital, bank risk and bank efficiency in European Banking industry for the period ranging from 1992 to 2000. They document the contradictory results in their study for bank risk, capital and efficiency of European banks as compared to the results of the USA banking industry. This study concluded that commercial banks and saving banks have similar results whereas the cooperative banks in Europe show different results in findings about capital, risk, and efficiency. Ozili (2017)'s study used data from listed as well as non-listed banks of different African countries from 2004 to 2017. The study found the determinants of profitability and concluded that regulatory capital had a positive impact on the profitability of listed banks of Africa. Lee and Hsieh (2013) conducted a study using the data from 42 banks in Asian countries covering the period from1994 to 2008 and concluded that capital has a positive impact on the profitability of investments in banks. They divided the population in low, model and high-income countries and they argued that bank capital had a significant impact on the profitability of commercial banks working in low-income economies. They also found that bank capital had a positive influence on the profitability of commercial banks situated in Middle Eastern economies. Shim (2010) conducted a study to investigate the impact of bank capital and risk in the US and used the three-stage least squares technique to investigate the data. He found that banks normally use retained earnings to manage their capital.

Iannotta, Nocera, and Sironi (2007) conducted a study in Europe and collected data from 181 larger banks from 1999 to 2004. They concluded that higher ownership concentration had a positive influence on risk-reducing activities. Rime (2001) conducted a study in Switzerland and used simultaneous equation model like Shrieves and Dahl (1992) and concluded that higher capitalized banks managed their retained earnings to boost their capital ratio. This study was also conducted in response to the regulatory requirements of capital to mitigate the risk of financial institutions. Molyneux and Forbes (1995) provided findings in their study that banks having more equity face lower cost of funding as compared to external funding thus has a positive impact on the profitability of banks. Hughes and Mester (1998) concluded that bank capital and risk influence the profitability of banks. Similarly Moon and Hughes (1997) also claimed in their study that capital and risk influence the profitability of banks. The findings of these studies provide results for 1990s era and after the first regulation of Basel-I. The dynamics are not similar in current conditions due to world globalization and international integration of economies which enable them to exchange their required commodities to facilities each

other. Bourke (1989) examined the profitability of North America and Australian banks in his paper. He found that regulatory capital had a positive influence on different countries. He argued that higher capitalized banks had access to financial markets and could manage liquidity at a lower cost. The following studies have concluded a positive association between bank capital and profitability (Athanasoglou, Brissimis, & Delis, 2008), and (Ozili, 2015).

Methodology

Data

The sample of this study includes only commercial banks of developed and developing economies of Asia during the post-crisis period ranging from 2012 to 2017. This period is a true representation of the implementation of regulatory recommendations as developed in Basel-III regarding bank capital requirements and higher needs of liquid assets for banks. We excluded investment banks, saving institutions, Islamic banks, and cooperative banks from our sample due to different reasons. The first reason is that the dynamics of all banks are not similar. The second reason is that our main objective is to investigate the behavior of commercial banks' capital and profitability. The third reason is that not all the banks are involved in international banking transactions. We collected data from only those commercial banks that are deposit-taking institutions and involve in lending of money. The commercial banks are taken based on parent/ head office, not based on subsidiaries. The banks having missing values for more than half-time period were also excluded. The source of data collection is a Banks cope database and financial statements of commercial banks. Thus data was collected from 294 banks including 238 banks from developing countries and 56 from the developed economies of Asian region.

Econometric Model

We used a most consistent technique in this study as reported in the previous literature for interrelationship purposes like Berger (1995), R AGGARWAL and K Jacques (1998) and Shrieves and Dahl (1992). We develop a model by modifying the equations for bank capital and bank profitability to investigate the interdependence in this paper. As the literature reviewed suggests that capital and profitability have a causal relationship and they influence each other so in order to explore this concern, we develop equations as under:

$$\Delta \boldsymbol{Y}_{i,t} = \Delta \boldsymbol{dY}_{i,t} + \boldsymbol{\mu}_{it} - (1)$$

$$\Delta \boldsymbol{X}_{i,t} = \Delta \boldsymbol{dX}_{i,t} + \boldsymbol{e}_{it} - (2)$$

Where Y_{it} indicates the bank capital and X_{it} is the national form of bank profitability. In the above equations, change for bank capital and profitability are known. The sign of i represents cross-section and t represents period. Where $\Delta dX_{i,t}$ and $\Delta dY_{i,t}$ are used for discretionary changes in bank capital and bank profitability whereas μ_{it} and

e_{it} represent exogenous variables. This model explains that bank capital and bank profitability are endogenous variables and determined within the model whereas the exogenous variables are determined from the outside the model. We bend the model further according to our requirements. We first manage the pre-assumption of simultaneous equations to run the model for structural parameters.

$$\Delta Y_{i,t} = \Delta X_{i,t} + \Delta Z_{i,t} + \mu_{it} - (3)$$

$$\Delta X_{i,t} = \Delta Y_{i,t} + \Delta P_{i,t} + e_{it} - (4)$$

Here the P represents the set of exogenous variables to influence profitability and include loan growth, liquidity, and size of banks, whereas Z represents the set of exogenous variables to influence the bank capital which includes efficiency, credit risk, and market funding. The final shape of the model is as under:

$$Capital_{i,t} = \phi + \delta 1 Profitability_{i,t} + \delta 2 Loan\ Growth_{i,t} + \delta 3 Liquidity_{i,t} + \delta 4 Bank\ Size_{i,t} + V_{it} - (5)$$

$$Profitability_{i,t} = \alpha + \beta 1 Capital_{i,t} + \beta 2 Efficiency_{i,t} + \beta 3 Credit\ Risk_{i,t} + \beta 4 Market\ Funding_{i,t} + E_{it} - (6)$$

The final model proves the assumptions of simultaneous equations and it is required to apply three or two-stage least squares, as the above model equations are over-identified. Both techniques are very sensitive to apply and the results of both the equations are close to each other with the similar sign of structural parameters. We applied two-stage least squares in this study for reported results.

Post-diagnostics tests

In order to perform empirical analysis we have to conduct some test to validate the basic assumption of the panel regression. First of all the multicollinearity is tested for the commercial banks of developed and developing economies with the help of variance inflation factors. The multicollinearity diagnostic proposition confirms that there is no problem of high correlation among explanatory variables and the value of VIF is in required range.

Table 1: *Multicolinearity Checks*

Variable Name	Developed Economies Banks (VIF)	Developing Economies Banks (VIF)
Bank Profitability	1.01	1.00
Bank Capital	2.01	1.01
Loans growth	1.01	1.03
Liquidity	1.00	1.02
Bank Size	1.01	1.34
Bank Efficiency	1.02	1.00
Credit risk	1.00	1.01

Secondly, the panel autocorrelation is checked for commercial banks of developed and developing countries equation-wise. The Wooldridge test for autocorrelation in panel data set is used and results are reported. The Wooldridge test confirms that there is no problem of autocorrelation in data series.

Table 2: *Panel Data Autocorrelation Check*

Equations	Developed Economies	Developing Economies
Wooldridge Test for autocorrelation in panel data	Ho: no first-order autocorrelation	
Capital- equation	F(1, 160)= 0.06 (P=0.80)	F(1,305)=0.16 (P=0.60)
Profitability-equation	F(1, 161)=2.8 (P=0.9)	F(1, 305)=3.8 (P=0.85)

Thirdly, the study tests the heteroscedasticity problem in data for which the white test for panel heteroscedasticity is applied. The white test confirms that there is no problem of heteroscedasticity.

Table 3: *Panel Data Heteroscedasticity Check*

Equations	Developed Economies	Developing Economies
White Test for Heteroscedasticity in panel data	Ho: homoscedasticity	
Capital- equation	3.06 (P=0.80)	2.06 (P=0.90)
Profitability-equation	2.70 (P=0.91)	3.70 (P=0.71)

Results and Discussions

Table 4: *Developing Economies Banks Data Descriptive Statistics*

Variable	Obs	Mean	S.Dev.	Min	Max
Profitability-1	2005	.008	.014	-.131	.433
Profitability-2	1705	.112	.162	-.997	4.797
Capital ratio	1901	.104	.082	0.01	.987
Credit Risk	1428	.045	.376	-.192	7.911
Liquidity	1824	.178	.143	.006	.945
Loans Growth	1902	.496	.187	0.04	.916
Efficiency	1702	.557	.275	-.570	4.151
Size	1823	15.99	2.23	7.705	21.97
Market Funding	1820	16.52	23.55	.012	43.29

Table 4 contains information about the descriptive statistics of commercial banks of developing economies of Asia. There are two measures of profitability used in this study. Profitability-1 represents a return on average assets and profitability-2 represents a return on average equity. The mean value of return on assets is .008 and the standard deviation is 0.14. The mean value of return on average equity is 0.112 and a standard deviation is 0.162. There are 1901 observations of capital and mean value is 0.104 and standard deviation value is 0.082. The descriptive information is in line with previous studies (Abbas *et al*., 2020; Abbas & Masood, 2020a).

Table 5: *Developing Economies Banks Variables Correlation Matrix*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Profitability	1.000							
Capital Ratio	.045	1.000						
Liquidity	-.020	.281	1.000					
Credit Risk	.011	.073	.176	1.000				
Efficiency	-.057	.041	-.034	.014	1.000			
Loans Growth	.003	.005	-.011	-.088	.055	1.000		
Market Funding	-.016	-.076	-.035	-.044	.085	.032	1.000	
Size	.054	-.033	-.092	-.012	-.091	-.086	0.052	1. 000

Table 5 consists of the results of the correlation matrix. This table provides information about the relationship and intensity of correlation among variables. This table also provides valued information about the connection between dependent and explanatory variables. The statistics indicate that there is no issue of multicollinearity due to higher correlation among explanatory variables. The signs of correlation are according to the economic theory (Abbas & Masood, 2020a, 2020b).

Table 6: *Developed Economies Banks Data Descriptive Statistics*

Variable	Obs	Mean	Std.Dev.	Min	Max
Profitability-1	1074	.005	.007	-.045	.055
Profitability-2	983	.068	.045	-.171	.296
Liquidity	986	.138	.162	0	1
Capital Ratio	982	.093	.112	.015	1
Size	982	17.08	1.596	8.665	21.46
Market Funding	960	2.867	41.508	.016	802.337
Loan Growth	1065	.54	.217	0	.91
Efficiency	979	.65	.183	.082	1.855
Credit Risk	362	.038	.206	-.029	3.537

Table 6 contains information about the descriptive statistics of commercial banks of developed economies of Asia. There are two measures of profitability used in this study. Profitability-1 represents a return on average assets and profitability-2 represents a return on average equity. The mean value of return on assets is .005 and a standard deviation is 0.007. The mean value of return on average equity is 0.068 and a standard deviation is 0.045. There are 982 observations of capital and mean value is 0.093 and standard deviation value is 0.112.

Table 7: *Developing Economies Banks Variables Correlation Matrix*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Profitability	1.000							
Capital	.292	1.000						
Liquidity	.291	.068	1.000					
Credit Risk	.021	.054	0.075	1.000				
Efficiency	-.084	.027	-0.047	.044	1.000			
Loan Growth	-.063	-.021	-0.710	-.000	-.048	1.000		
Market Funding	.088	.008	0.320	.041	.018	-.036	1.000	
Size	-.013	-.077	-0.393	.005	-.014	.014	-0.020	1.000

Table 7 consists of results of the correlation matrix. This table provides information about the relationship and intensity of correlation among variables. This table also provides valued information about the connection between dependent and explanatory variables. The statistics indicate that there is no issue of multicollinearity due to higher correlation among explanatory variables. The signs of correlation are according to the economic theory (Abbas & Masood, 2020b).

Table 8 shows Overall Data Results of Developed and Developing Economies Commercial Banks. Profitability (Measured as Return on Average Assets) and capital (Measured as Equity to Total Assets) are endogenous variables. Credit risk, Loans Growth, Liquidity, Market Funding, Cost efficiency, and Bank Size are used as exogenous variables. Simultaneous Equations Model (Two-Stage least squares) is applied.

Table 8: *Overall Data Results of Developed and Developing Economies Commercial Banks*

Variables	Developed Economies Banks		Developing Economies Banks	
	Profitability	Capital Ratio	Profitability	Capital Ratio
Capital	.0199***			
	(.0073)			
Efficiency	-.0221***		-.0250***	
	(.0008)		(.0015)	
Credit Risk	.0003		.0010	
	(.0005)		(.0013)	
Market Funding	-.0000		-.0020***	
	(.0000)		(.0007)	
Profitability		.9078***		.1754
		(.2275)		(.6455)
Loans Growth		.0429***		-.1878***
		(.0099)		(.0266)
Liquidity		.1368***		.0475
		(.0117)		(.0315)
Size		-.0158***		-.0258***
		(.0007)		(.0016)
Capital			.0444***	
			(.0070)	
Constant	.0200***	.3062***	.0179***	.6641***
	(.0009)	(.0134)	(.0010)	(.0371)
Observations	1,428	1,428	347	347
R-squared	.3610	.3641	.4981	.6294

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Table 8 contains the overall findings of banks of developing economies in Asia. The results indicate that bank capital and profitability are interdependent which is in line with (Shrieves & Dahl, 1992). The bank capital has a positive impact on profitability whereas the profitability also has a positive influence on bank capital. Both bank capital and profit of the bank positively influence each other Berger (1995). These findings confirm that capital and profitability are interdependent and must be determined simultaneously in banks in developing countries in Asia. These findings are consistent with (Lee & Hsieh, 2013; Shrieves & Dahl, 1992). The findings apart from the main objective explore that loans growth and liquidity of banks have a positive connection with bank capital. This means that banks provide loans out of capital. The positive relationship between capital and profitability is due to the availability of opportunities for investment as argued by (Bitar, Madiès, & Taramasco, 2017). This relationship has a theoretical meaning that most of the developing countries in Asia are emerging and growing.

Table 8 also contains the results of commercial banks working in developed economies of Asia. The results are not similar in case of developed nation's commercial banks. The signs of coefficients are similar but the coefficients are insignificant. In the case of developed economies banks finding capital influence the profitability positively but profitability has no impact on bank capital. These findings may be due to the distribution of profit in terms of a dividend. However, the cost to income ratio, credit risk and size have similar behavior as is in commercial banks in developing economies similar to the study of Abbas *et al.,* (2020). In case of developed economies, commercial banks' profitability depends on capital and should be managed accordingly.

Table 9 contains the results of banks (large, medium and small) in developing economies and profitability (measured as return on average assets) and capital (measured as equity to total assets) are endogenous variables. Credit risk, Loans' growth, liquidity, market funding, cost efficiency, and bank size are used as exogenous variables. Simultaneous Equations Model (Two-Stage least squares) is applied.

Table 9: *Results of Developing Economies Banks*

Variables	Larger Banks		Medium Banks		Small Banks	
	Profitability	Capital	Profitability	Capital	Profitability	Capital
Capital	-.0285*		.1774***		-.0097	
	(.0161)		(.0176)		(.0107)	
Efficiency	-.0146***		-.0216***		-.0207***	
	(.0020)		(.0014)		(.0015)	
Credit Risk	.0003		-.0011**		.0927***	
	(.0006)		(.0005)		(.0099)	
Market Funding	-.0000***		.0000***		-.0000	
	(.0000)		(.0000)		(.0000)	
Profitability		1.4323*		1.3902***		1.6456***
		(.8097)		(.2739)		(.3354)
Loan Growth		.0204		.0496***		.0257
		(.0217)		(.0070)		(.0223)
Liquidity		.0872***		.0185**		.2950***
		(.0218)		(.0091)		(.0251)
Size		-.0122***		-.0080***		-.0274***
		(.0014)		(.0012)		(.0027)
Constant	.0218***	.2659***	.0050***	.1786***	.0225***	.4502***
	(.0015)	(.0259)	(.0016)	(.0204)	(.0022)	(.0428)
Observations	264	264	734	734	429	429
R-squared	.2741	.4045	.3432	.2637	.4853	.3986

*Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1*

Table 9 contains the results of commercial banks in developing economies during the post-crisis period. In case of large banks of developing economies, capital has a negative impact on profitability the negative relationship is supported by the following

literature (Babihuga, 2007; Berger & Di Patti, 2006; Maudos, 2017) whereas profitability has a positive impact on bank capital. These findings are in line with the following studies (Berger, 1995; Bitar *et al.*, 2017; Bougatef & Mgadmi, 2016). The findings suggest that this relationship is significant but weak because the coefficient and standard error provide significance at ten percent level of confidence. In the case of medium size banks, profitability influences the bank capital positively whereas bank capital also positively influences the profitability of banks in developing economies. This means that bank capital and profitability are interdependent and influence each other simultaneously. In small size banks, the capital has a negative but insignificant coefficient against profitability whereas in smaller banks profitability has a positive impact on capital.

Table 10 contains the results of banks (large, medium and small) in developed economies. Profitability (measured as return on average assets) and capital (measured as equity to total Assets) are endogenous variables. Credit risk, loans growth, liquidity, market funding, cost efficiency, and bank size used as exogenous variables. Simultaneous Equations Model (Two-Stage least squares) is applied.

Table 10: *Results of Developed Economies Banks*

Variables	Large Banks		Small Banks		Medium Banks	
	Profitability	Capital	Profitability	Capital	Profitability	Capital
Capital	.0993*		.0573*		.0354*	
	(.0594)		(.0297)		(.0209)	
Efficiency	-.0204***		-.0175***		-.0387***	
	(.0047)		(.0048)		(.0096)	
Credit Risk	-.0002		-.0003		.0490***	
	(.0008)		(.0034)		(.0120)	
Market Funding	-.0024		-.0045***		-.0006	
	(.0026)		(.0017)		(.0004)	
Profitability		2.9317***		6.6133***		1.6882
		(.2383)		(1.1767)		(1.3273)
Loans Growth		.0122		-.1864***		-.5445***
		(.0098)		(.0410)		(.0963)
Liquidity		-.0012		-.1535***		-.4858***
		(.0154)		(.0565)		(.0921)
Size		-.0031***		-.0033		-.0682***
		(.0010)		(.0071)		(.0160)
Constant	.0116	.1053***	.0130**	.2355**	.0242***	1.6351***
	(.0075)	(.0221)	(.0056)	(.1166)	(.0030)	(.2367)
Observations	141	141	145	145	55	55
R-squared	.7366	.6591	.5685	.3421	.5308	.7523

*Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1*

Table 10 contains the results of large, medium and small banks of developed economies. In case of large banks, capital and profitability are interdependent and this is

in line with (Raj Aggarwal & Kevin Jacques, 1998b; Jacques & Nigro, 1997; Shrieves & Dahl, 1992). This means capital has a positive impact on profitability whereas profitability also has a positive impact on bank capital (Berger, 1995; Bitar *et al*., 2017). The findings also explain that the intensity of profitability to influence capital is greater. The reason for this relationship may be a distribution of lower dividends to stakeholders. The results also indicate that credit risk, the cost to income ratio and bank size remains similar to the findings of overall banks. The findings of medium banks indicate that profitability and capital influence each other positively. There is also interdependence between capital and profitability and both influence each other positively whereas the intensity of profitability is greater than capital consistent with (Lee & Hsieh, 2013; Shrieves & Dahl, 1992). In the case of medium-sized banks and smaller banks, the liquidity has a negative impact on capital as concluded by (Abbas *et al.*, 2020). In case of smaller banks capital influence, profitability positively whereas profitability has no impact on bank capital in developed economies. The findings also indicate that credit risk plays a positive role in the promotion of the profitability of smaller banks in developed economies.

Conclusions

The objective of this study is to test and compare the interdependence of bank capital and profitability of developed and developing economies commercial banks in Asia for the post-crisis period ranging from 2012 to 2017. The conclusions are very interesting regarding bank capital and bank profitability. The impact of bank capital is more significant to influence profitability in case of developed economies whereas the profitability is significant to influence the bank capital of developing economies.

The impact of profitability is positive and significant on bank capital except for smaller banks of developed economies that is positive but insignificant. There is a positive causality running from profitability to capital in case of large, medium and smaller banks in developed as well as developing economies. The impact of bank capital is not similar to influence profitability of commercial banks in developed and developing economies. In the case of developed economies, commercial banks' capital has a positive impact on the profitability of large, medium and small-sized banks. The impact of capital in case of commercial banks in developing economies is not similar to the commercial banks of developed economies. The impact of bank capital on profitability is negative in case of large and small-sized banks of developing economies whereas the results are insignificant in the case of smaller banks. The negative causality is running from capital to profitability in case of large and small size banks. The capital of medium-sized banks has a positive impact on the profitability of commercial banks in developed and developing economies.

Our results remain limited to the analysis of quantitative information for commercial banks in developed and developing economies listed only at Bankscope. Here, we are still unable to collect data for a longer period and the banks that are not listed at Bankscope. Future research could be conducted to study the interrelationship between bank capital, risk-taking, and profitability of commercial banks by incorporating the mediating/moderating role of other economic variables and bank regulations to get better in-depth insights.

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