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Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rero20

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To cite this article: Ghulam Mujtaba, Yasmeen Akhtar, Saira Ashfaq, Imran Abbas Jadoon & Syeda Mahlaqa Hina (2022) The nexus between Basel capital requirements, risk-taking and profitability: what about emerging economies?, Economic Research-Ekonomska Istraživanja, 35:1, 230-251, DOI: 10.1080/1331677X.2021.1890177

To link to this article: https://doi.org/10.1080/1331677X.2021.1890177

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ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2022, VOL. 35, NO. 1, 230–251
https://doi.org/10.1080/1331677X.2021.1890177

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The nexus between Basel capital requirements, risk-taking and profitability: what about emerging economies?

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ABSTRACT

The study examines the nexus between Basel capital requirements, banking sector risk-taking, and profitability in Asian emerging markets by using dynamic panel GMM methodology. The findings of the study suggest that regulatory capital positively affects risk-taking which validates the "regulatory hypothesis." The findings also reveal that regulatory capital positively while risk negatively affects the profitability in the banking sector. The current study finds the bidirectional causality between the regulatory capital and risk-taking, implying that banks with higher capital ratios are expected to increase in risk-taking and vice versa. The findings also suggest that managerial ownership positively affects while foreign ownership negatively impacts risk-taking consistent with the agency theory of corporate governance. The study proposes that ownership structure has a significant influence on bank risk and profitability, however, the combined impact of regulatory capital through its interaction with the ownership structure is not proved to be significant.

ARTICLE HISTORY
Received 24 August 2020
Accepted 9 February 2021

KEYWORDS
Basel capital requirements; ownership structure; risk-taking; profitability; Asian emerging markets

JEL CLASSIFICATION
G21; G32; G38

1. Introduction

Basel III was proposed in 2010, following the subprime mortgage crisis of 2007, to improve financial sector regulation in the areas of risk, capital and liquidity (Tanda, 2015). An important part of the third accord is the enhanced equity requirements, however, the economic aftermath of this development is still not apparent. Banking institutions have the option to extend their equity shares either through improving their capital base or a reduction in riskier investments (Admati et al., 2018). If a bank's risk exposure is decreased, the holding of its expensive capital funding sources can be reduced, which may impact its profitability. *Hence, the problem of how banks*

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alter their risk-taking in reaction to these equity requirements is critical. Thus, the present study recognizes the issue and endeavours to inform banks about how to amend their risk-taking behaviour in reaction to these equity requirements.

Previous literature studying the influence of equity capital on bank risk-taking has mixed findings. On one hand, regulatory capital and bank risk are positively related, which means governing authorities encourage the banking sector to amend equity capital in a way analogous to the risk-taken, known as the *regulatory hypothesis* (Altunbas et al., 2007; Iannotta et al., 2007; Ugwuanyi, 2015); while on the other hand, an inverse relationship is found between regulatory capital and bank risk-taking, referred to as the *moral hazard hypothesis*, in which banks have reasons to utilize current uniform deposit-insurance systems. The moral hazard hypothesis is especially important when risk and leverage levels in the banking system have previously been very high (Agoraki et al., 2011; Demirgüç-Kunt & Kane, 2002; Lee & Chih, 2013; Lee & Hsieh, 2013; Rahman et al., 2018a; Shim, 2013). The causal link similarly moves from bank capital to risk-taking and can be imitated by regulatory actions' (accidental) consequences.

High capital ratios are linked to higher costs for banks, because of imperfections in capital markets and tax privileges of debt, leading to a reduction in profitability, but the *trade-off hypothesis* states that it decreases risk and thus the payments essential to compensate investors for bearing distress costs. Regulatory equity requirements affect bank risk-taking exposure (i.e. through a reduction in risk-weighted assets) which in turn influences the banks' profitability level. There exists, however, mixed evidence regarding the relationship between firm capital and its worth based on a bank being either below or above its optimum capital level in the short-term. Equity requirements (if binding) over the long-run may surpass the optimum capital level and suggest an opposite relationship between equity capital and bank value (Osborne et al., 2012). Oino (2018) investigates the impact of equity requirements on banking performance in Europe in post-crisis periods. The findings show that capital ratios increase in post-crisis periods and there is a negative association between capital ratios and banking performance. Hence, the present study considers the simultaneous relation between bank equity requirements, risk-taking and profitability.

Repeated financial crunches during the previous thirty years have led to banking reforms that result in consolidation of the financial sector and transformation in patterns of ownership, mainly a rise in institutional owners, that end with adjustments in bank risk-taking (Barry et al., 2016). Earlier studies show that management and ownership separation in corporate forms create *agency problems*, which in turn affect risk-taking. Levine and Laeven (2008) state that regulatory reforms have a diverse impact on banking sector risk-taking, depending on ownership and governance structures. Therefore, we also incorporate bank ownership pattern as a factor of risk-taking and profitability. On the basis of the above discussion, we develop the following hypotheses:

Hypothesis 1: There exists a significant relationship between regulatory equity requirements and risk-taking in the banking sector.

Hypothesis 2: There exists a significant relationship between regulatory equity requirements and profitability in the banking sector.

Hypothesis 3: There exists a significant association between ownership structure and bank risk-taking.

Hypothesis 4: There exists a significant association between ownership structure and bank profitability.

Hypothesis 5: The regulatory capital effect on risk-taking is dependent on bank ownership structure.

Hypothesis 6: The regulatory capital effect on profitability is dependent on bank ownership structure.

This study makes several contributions to the literature. Firstly, previous literature suggests an endogenous relationship and mixed evidence regarding bank capital and risk-taking. Previous literature examines the influence of bank ownership structure on risk-taking and/or profitability (Akhtar et al., 2019; Al-Tamimi & Jellali, 2013; Barry et al., 2011; Ehsan & Javid, 2018; Hammami & Boubaker, 2015; Ozili & Uadiale, 2017; Sarker & Nahar, 2017; Saunders et al., 1990; Srairi, 2013). Further studies examine the links among banking sector regulation, risk-taking and ownership structures (Laeven & Levine, 2008; Rahman et al., 2012; Zheng et al., 2017). Thus, it is essential to address the impact of ownership patterns on bank risk and, in turn, profitability. The present study not only incorporates bank ownership structure as an independent factor of risk and profitability, but also considers its interaction with regulatory capital in order to examine the combined impact. This study contributes to and extends the earlier work of Lee and Hsieh (2013), Altunbas et al. (2007) and Casu and Girardone (2006) by examining the combined effect of regulatory capital through its interaction with ownership variables in emerging Asian markets.

Secondly, the introduction of the Basel accord III was a reaction to the economic crunch largely felt in developed western nations. However, the reforms do not merely counter the causes of the crisis but remove gaps in supervisory areas globally (Sheng & Li, 2013). The majority of previous literature associated with the Basel capital regulations emphasizes western nations such as the US and European markets, and there is limited literature focusing on Asian economies. As the reforms are enforced equally in Asian economies, while there is little impact of the mortgage crisis, there is a research gap concerning the influence of the subprime economic crunch in emerging Asian economies. Thus, we introduce a crisis dummy (CD), taking the value of 1 for the years 2008 to 2010 and 0 otherwise, in bank risk-taking and profitability models. Thirdly, to see the influence of the introduction of Basel III on profitability and risk in the banking sector, we introduce a Basel III introduction time dummy (BTD) that takes the value of 1 for years 2010 onwards and 0 otherwise. Both the crisis dummy and Basel III introduction dummy are used to determine whether bank risk-taking and profitability change after the crisis and Basel III introduction periods.

The study findings suggest that regulatory capital positively affects bank risk-taking, which validates the regulatory hypothesis. The results imply that regulatory officials support the banks in improving equity levels, which extends to risk-taking, as per the regulatory hypothesis (Altunbas et al., 2007; Iannotta et al., 2007; Ugwuanyi, 2015). In the case of bank profitability, the findings propose that regulatory capital positively affects bank profitability while risk has a negative effect on profitability and a rise in bank risk-taking is likely to reduce the profitability. In the ownership

structure case, the findings suggest a positive relationship with insider ownership, which implies that managerial owners tend to increase bank risk-taking consistent with the agency theory of corporate governance. Meanwhile, foreign investors negatively impact risk-taking, which suggests foreign-owned banks are inclined to decrease banking sector risk. However, the combined impact of regulatory capital through its interaction with ownership structure is not shown to be significant. The results relating to the impact of ownership variables on profitability also do not prove significant in any case.

The remainder of this study is organized as follows. A review of the literature is given in the second section. Section three contains the data description and sample selection. The econometric techniques and empirical models are given in the fourth section. The fifth section gives the results and discussion, and the conclusions are given in the last section.

2. Literature review

2.1. Regulatory capital requirements, bank risk-taking and profitability

The majority of previous literature investigates the impact of regulatory equity requirements on banking sector risk-taking and profitability simultaneously. It is therefore not surprising that the association between bank risk (profit) and capital has become a focus of interest recently; particularly as the equity level intensifies both the favourable and unfavourable impact on banking profitability. The mystery regarding bank equity and risk-taking is that both are inclined to be effected by the profitability level of the financial sector (Altunbas et al., 2007; Lee & Chih, 2013; Lee & Hsieh, 2013). From a regulatory viewpoint, ceteris paribus, regulatory supervisors may allow a competent business with superior administration more space for leverage. From the moral-hazard viewpoint, on the other hand, a less competent manager may be persuaded to take higher risk in order to reimburse lost returns. Bank efficiency may, in turn, be influenced by its risk level (Berger & Deyoung, 1997).

Altunbas et al. (2007) examine the nexus between regulatory equity, bank efficiency and risk-taking, using a sample of European banks between 1992 and 2000. The study shows an inverse relationship between bank inefficiency and risk-taking and a positive association between regulatory equity and bank risk, in the presence of high capital ratios. The findings show regulatory officials' partiality for bank capital as a technique to limit banking sector risk-taking. The findings also reveal that corporate financial strength directly affects and reduces banking sector risk-taking and equity levels. Agoraki et al. (2011) investigate whether the effect of regulation on bank risk-taking is direct or channelled through bank market power. The findings imply that market power is related negatively with credit risk and default probability. Capital requirements decrease risk generally, but the effect is notably weak, or even contrary, for banks with market power.

Lee and Hsieh (2013) use the generalized method of moments (GMM) for dynamic panels of bank level data of 42 Asian countries over the period 1994 to 2008, to examine the impact of capital on bank profitability and risk. The results reveal, firstly, that investment banks show the least, but positive, impact of capital on profitability, while commercial banks show the maximum reverse effect of capital on

risk. Secondly, banks in countries with lower incomes have a higher impact of capital on profitability, banks in countries with low to middle incomes have a maximum reverse effect of capital on risk, and banks in countries with higher income levels have the smallest values. Thirdly, banks in the Middle East region see the maximum positive effect of capital on profitability. Banks in Central Asia and the Far East region have a large reverse effect of capital on risk, while the smallest values occur for banks located in the Middle East region.

Allahrakha et al. (2018) examines the impact of high capital ratios under Basel accord in US repo market. The findings of the study show that high leverage ratios can increase the bank risk-taking. DeYoung et al. (2018) examines the joint impact of bank liquidity and capital requirements in US banking sector. The findings show that banking sector moved away from lending and advance commitments, which improve both their capital ratios and liquidity requirements. Oino (2018) investigates the impact of equity requirements on banking performance in Europe in post-crisis period. The findings show that capital ratios have increased in post-crisis period and there exists a negative association amid capital ratios and banking performance. Zheng et al. (2017) investigate the interaction between ownership structure, bank capital regulation and risk-taking by employing a sample 32 commercial banks operating in Bangladesh during 2006–15. The findings of study reveal that ownership structure has varied impact on risk-taking depending on ownership nature and concentration. The findings show that private and Islamic banks tend to be more stable and low risk taking than state-owned and commercial banks. On the other side banks with low ownership concentration tend to reduce risk. The study tests the nonlinear relation between bank capital, risk taking and ownership structure but finds no evidence in this regard.

Ashraf et al. (2016) investigate the impact of regulatory equity on risk by employing a dataset of listed Pakistani commercial banking institutions during period 2005 to 2012. The results show that banks with equity ratios either lower or higher than regulatory requisite parameters have reduced risk-taking in reaction to severe regulatory equity requirements. Rahman et al. (2018b) study the influence of regulatory equity on banking sector risk and intermediation cost. The results suggest a positive impact on intermediation cost and a negative impact on risk-taking in the banking sector. Mahdi and Abbes (2018) study the relationship between equity requirements, bank risk-taking and liquidity in the MENA region and find a bi-directional positive relationship between regulatory equity and risk in the Islamic banking sector. Bank liquidity positively impacts risk in both Islamic and conventional banks.

From the above discussion, we develop the following hypotheses:

Hypothesis 1: There exists a significant relationship between regulatory equity requirements and risk-taking in the banking sector.

Hypothesis 2: There exists a significant relationship between regulatory equity requirements and profitability in the banking sector.

2.2. Ownership structure, risk taking and profitability

Saunders et al. (1990) examine the relationship between ownership patterns and banking sector risk. The findings show that banks controlled by shareholders have a

higher propensity for taking risks compared to management owned banks, specifically during an era of relative deregulation, 1979 to 1982. The study shows that ownership patterns more significantly affect risk-taking in deregulation periods compared to regulatory times. Iannotta et al. (2007) examine the influence of ownership structure on profits, cost efficiency and risk in the European banking industry during the period 1999 to 2004. The study shows that state-owned and mutual banks have lesser profits in comparison to private banks, even at low cost levels. Banks in the public sector have low credit quality and high insolvency risk while mutual banks have low asset risk and better credit quality compared to public and private banks. Finally, ownership concentration has no impact on profits but has a positive impact on loan quality, with lower assets and insolvency risk.

Rahman et al. (2012) analyse the relationship between risk-taking, ownership structure and capital regulation in Malaysian banks during the period 1995 to 2008. The findings reveal that the existence of a major shareholder reduces risk and improves stability in the banking sector. Generally, the results do not support the role of equity requirements in risk reduction and negate the agency hypothesis of exploitation of creditors' interest by stockholders. Al-Tamimi and Jellali (2013) investigate the influence of ownership factors on bank risk in the UAE banking sector during 1998 to 2010. The results show that conventional sector banks are greater risk-takers than Islamic sector banks and conventional bank ownership concentration has an inverse relationship to risk-taking. Also, private ownership banks negatively affect risk-taking behaviour.

Srairi (2013) and Hammami and Boubakar (2015) study the impact of ownership variables on banking sector risk by employing a dataset of banks working in the MENA states, and conclude that concentrated ownership and foreign ownership positively impact banking sector risk. For listed banks, family ownership positively effects risk-taking, however there is a negative impact for unlisted banks. The study concludes that ownership structure's effect on bank risk is contingent on whether a bank is registered or not. Zheng et al. (2017) investigate the interaction between ownership structure, bank capital regulation and risk-taking by employing a sample of 32 commercial banks operating in Bangladesh during 2006 to 2015. The findings reveal that ownership structure has a varied impact on risk-taking depending on the nature of the ownership and the concentration. The findings show that private and Islamic banks tend to be more stable and lower risk taking than state-owned or commercial banks. On the other hand, banks with low ownership concentration tend to reduce risk. The study tests the nonlinear relationships between bank capital, risk taking and ownership structure, but finds no evidence in this regard.

From the above discussion, we develop the following hypotheses:

Hypothesis 3: There exists a significant association between ownership structure and bank risk-taking.

Hypothesis 4: There exists a significant association between ownership structure and bank profitability.

Hypothesis 5: The regulatory capital effect on risk-taking is dependent on bank ownership structure.

Hypothesis 6: The regulatory capital effect on profitability is dependent on bank ownership structure.

3. Sample selection and variables

Previous literature related to regulatory capital requirements mostly considers the developed western nations with little emphasis on emerging Asian markets. Hence, the present study investigates the effect of bank equity requirements on risk and profitability in emerging Asian markets. The Russell Financial Times Stock Exchange (FTSE) and Morgan Stanley Capital International (MSCI) emerging economies indexes are used to select the sample of emerging economies. We select economies which are included in both indexes. The economies selected comprise Pakistan, India, China, Indonesia, Thailand, Malaysia and Philippines.

The sample comprises commercial banks listed on the relevant countries' domestic exchanges. The selected banks are those that have at least ten years data available and for which data on regulatory capital ratios is available. The data range is from 2004 to 2017. In order to test the impact of the 2007 subprime crisis and the introduction of the Basel accord III in 2010, we use data from before and after both. We examine the panel bank-level data for the emerging Asian economies.

The sources of data are the S&P Capital IQ database, annual reports of sample countries, World-Bank development indicators (WDI) and the International Monetary Fund (IMF). The ownership variables include ownership type and ownership concentration, and data is gathered from the sample economies' banks' financial reports. The description of the variables employed is specified in Table 1.

4. Methodology and model

4.1. Estimation techniques

We have used the secondary panel dataset over the time period of 2004–17. There exists two types of panel methodologies, static and dynamic panel, and Dynamic panel models are suitable to address the problem of endogeniety bias. The causal linkage in dynamic panel model is usually dynamic across time for a given phenomenon. The dynamic panel estimation techniques employ dependent variable lags as instruments in model to avoid endogeniety bias (Ullah et al., 2018). The developments in dynamic Panel data analysis have offered new prospects in endogenous variable examination. In order to address the endogeniety problem, two key methods have been introduced in addition to conventional instrumental variable regression. The first technique known as Difference GMM, introduced in 1991 by Arellano and Bond (1991), uses the lags in difference as instruments. Later, the estimator is developed and it uses the lags in level and difference as instrumental variable and recognized as System GMM developed by Arellano & Bover in 1995. Further, the System GMM have choice to do analysis through two options i.e. One step GMM and Two step GMM, depending on the homocedasticity or hetrocedasticity of the weighting matrix. Academic Literature reveals that two step GMM method is more effective with use of hetrocedastic weighting matrix in the analysis. The two main issues related with use of two step GMM are the proliferation of instrument and auto-correlation of error terms. These issues are of special concern when panel data is

Table 1. Variables description.

Classification	Variables	Description
Profitability (PROF)	ROA	Return on assets
Risk (RISK)	Loan loss reserve ratio (LLRR)	Loan loss reserve ratio
	Ratio of non-performing loans (RNPL)	Non-performing loans to total loans ratio
Capital (CAP)	Regulatory capital (CAP)	Tier 1 Capital ratio (T1R) Total Capital ratio (TCR)
Bank Specific Control Variables (BANK)	Net loan to assets ratio (NLA)	Ratio of Net loans to total assets
	Noninterest expenses to revenue ratio (NIER)	Noninterest expenses to total revenue
	SIZE	Measured by natural log of total assets
	Net loans to total deposits ratio (NLTD)	Measured by taking ratio of net loans to total deposits
	Net interest income to total revenue ratio (NIITR)	Net interest income to total revenue ratio
Ownership Variables (OWN)	Ownership Concentration (OC)	% of shares held by top three shareholders who hold greater than or equal to 10% of shares (OC10). % of shares held by top five shareholders who hold greater than or equal to 5% of shares (OC5).
	Managerial Ownership (MO)	% of shares held by management and directors
	Foreign Ownership (FO)	% of shares held by foreign entities
Macroeconomic Variables (MACRO)	Inflation (INF)	Measured by Consumer Price Index
	Economic Growth (GDP)	GDP growth rate
	Domestic credit to private sector (DCPS)	Private Sector Domestic credit
	Real interest rate (RIR)	Real rate of interest
	Monetary policy indicator (MPI)	Monetary policy indicator is central bank policy rate between the Banks and other credit institutes
	Interest rate spread (IS)	Interest rate spread measured by the difference of bank lending and deposit rates
Regulatory Pressure Variables (RP)	Bank Market Power (BMP)	Ratio of bank i total assets in country j to total banking system assets in country *j*

Source: The Authors.

composed of a large time period and less number of cross-sections. (Labra Lillo & Torrecillas, 2018).

We used Arellano and Bover (1995) two step system dynamic panel technique for model estimation because of the problem of endogeniety, autocorrelation and hetrocedasticity. The dynamic models are appropriate to use in case of short panels with endogeneity and helpful to correct the bias created by omitted variables in cross section estimation. Dynamic models also control endogeneity bias created by reverse causation from risk to capital and profitability to capital or from other independent variables. The dynamic panel model entails that error terms don't have serial correlation and this can be checked by using Arellano and Bond autocorrelation test. The present study also have the number of cross-sections (banks) that are larger than number of instruments that is the most common data type in dynamic panel estimations, known as Short panels, in order to evade an over-identification problem. The study employs the Arellano and Bond autocorrelation test in order to test the serial correlation in error terms.

4.2. Empirical model

We used Arellano and Bover (1995) dynamic panel two-step system methodology for model estimation due to presence of endogeniety problem. The model that is used to

establish relation between regulatory equity, bank risk and profitability depends on previous academic literature. The study investigates the relation among regulatory capital, profitability and risk by using a latest dataset of Asian emerging economies during period of 2004 to 2017. The first set of equations is specified as following:

$$RISK_{it} = b_0 + b_1 RISK_{i\ t-1} + b_2 CAP_{it} + b_3\ PROF_{it} + b_4 BANK_{it} + b_5 MACRO_t + b_6 BMP_{it} + u_i + v_{it} \quad (1)$$

$$PROF_{it} = b_0 + b_1 PROF_{i\ t-1} + b_2 CAP_{it} + b_3 RISK_{it} + b_4 BANK_{it} + b_5 MACRO_t + b_6 BMP_{it} + u_i + v_{it} \quad (2)$$

$$CAP_{it} = b_0 + b_1 CAP_{i\ t-1} + b_2 RISK_{it} + b_3\ PROF_{it} + b_4 BANK_{it} + b_5 MACRO_t + b_6 BMP_{it} + u_i + v_{it} \quad (3)$$

where t and i represent the time period and cross-sections (i.e. banks) respectively. ui is the bank-related unobserved effect and vit is the error term. Equations (1) and (2) are used to study the effect of regulatory equity *(CAP)* on banking sector risk *(RISK)* and profitability *(PROF)* individually and third equation is developed to test the effect of risk and profitability on regulatory capital.

A second set of equations is specified by including the ownership structure as a factor of bank risk-taking and profitability. We also interact the regulatory capital with ownership structure in order to examine their combined impact. This study contributes and extends the earlier work of Lee and Hsieh (2013), Altunbas et al. (2007) and Casu and Girardone (2006) by examining the combined effect of regulatory capital through its interaction with ownership variables in case of Asian emerging markets.

$$RISK_{it} = b_0 + b_1 RISK_{i\ t-1} + b_2 CAP_{it} + b_3\ PROF_{it} + b_4 BANK_{it} + b_5 OWN_{it} + b_6 MACRO_t + b_7 CAP_{it} OWN_{it} + u_i + v_{it} \quad (1)$$

$$PROF_{it} = b_0 + b_1 PROF_{i\ t-1} + b_2 CAP_{it} + b_3 RISK_{it} + b_4 BANK_{it} + b_5 OWN_{it} + b_6 MACRO_t + b_7 CAP_{it} OWN_{it} + u_i + v_{it} \quad (2)$$

$$CAP_{it} = b_0 + b_1 CAP_{i\ t-1} + b_2 RISK_{it} + b_3\ PROF_{it} + b_4 BANK_{it} + b_5 OWN_{it} + b_6 MACRO_t + u_i + v_{it} \quad (3)$$

The bank-specific control variables (*BANK*), in accordance to Casu and Girardone (2006), comprise noninterest expense to revenue ratio (NIER), net-loans to total-assets ratio (NLA), net interest income to revenue ratio (NIITR) and bank size (SIZE). *OWN* refers to the ownership type measured by management possessions and overseas holding stakes, and concentrated ownership is measured by the quantity of

largest three block-holders' shares and also by quantity of largest five block-holders' shares.

The macroeconomic factors *(MACRO)* are put as associated external control factors: inflation (INF), domestic credit to private-sector (DCPS), GDP growth rate (GDP), monetary policy indicator (MPI), interest rate spread (IS) and real rate of interest (RIR). The coefficient of INF and RIR is indecisive. In higher inflation regions, financial institutes extra charge their clients and they suffer from unpaid loans at the same time that are contracting. A high GDP may entail that banks can create less risk and more profitability, but DCPS can go in another way. As a large DCPS denotes the competitive economic setting, so DCPS negatively (positively) relates to profit (risk).

Equation (1) describes banking segment risk, Eq. (2) describes determinants of profitability of banks and Eq. (3) explains bank capital. Equation (1) uses loan loss reserves ratio and fraction of nonperforming loan to total bank loans a measure of explained variable (RISK). In second equation, bank profitability (PROF) is explained variable and in third model regulatory bank equity is the explained variable (CAP). A range of macroeconomic and bank-related factors are also incorporated to clarify the deviation in banking sector risk-taking, profitability and capital in Asian banking segments.

5. Results and discussion

We examine the association amid capital requirements, risk-taking and profitability in emerging Asian markets during period of 2004 to 2017. The current study uses Arellano and Bover (1995) and Blundell and Bond (2000) system dynamic two-step panel methodology for model estimation because of the problem of endogeniety. The descriptive statistics are given in Table 2 and present the mean values, standard errors, lowest and highest values of all the variables used in combined Asian emerging market sample.

The system of equations include the three equations analyzing the effect of regulatory equity requirements on risk-taking and profitability in first two equations and in third equation the determinants of regulatory capital. The results reveal that regulatory equity ratio positively effects risk-taking, which validates the "regulatory hypothesis." The result implies that regulatory authorities motivate the banks to improve the equity level with extent to risk-taken known as "*regulatory hypothesis*" (Altunbas et al., 2007; Iannotta et al., 2007; Mahdi & Abbes, 2018; Ugwuanyi, 2015). When bank capital positions are deemed insufficient, the surge in equity level with extent to risk-taken could be partly because of efficient monitoring of markets (Berger, 1995; Calomiris & Kahn, 1991). Bank profitability is negatively related with risk-taking, implying that profits tend to reduce the risk-taking (see Table 3).

In terms of bank-specific control variables, net loan to deposits ratio (NLTD) and bank size (SIZE) are not proved to be significant in risk model. Net interest income to revenue (NIITR) positively effects the bank risk implying that financial institutes with more interest income as compared to total revenues have more investment in illiquid assets i.e. bank loans, which increase their risk. In case of macroeconomic

Table 2. Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
NPLR	2163	.044	.063	−.873	.520
LLRR	2065	.012	.020	−.107	.340
T1R	2163	.144	.282	−1.67	7.99
T2R	2011	.029	.035	−.047	.995
TCR	2163	.172	.281	−1.59	7.99
ROA	2163	.010	.012	−.111	.089
NLA	2163	.510	.171	−1.05	.859
NIER	2163	.618	2.01	−65.2	47.4
NIITR	2163	.957	1.71	−.574	57.2
BMP	2163	.324	.527	0.000	3.92
SIZE	2163	13.3	2.31	3.98	20.8
GDP	2163	6.60	2.53	−1.51	14.2
MPI	2163	9.06	3.27	4.33	16.0
INF	2163	5.43	3.56	−.900	20.3
IS	1540	4.03	1.33	1.45	7.68
DCPS	2163	67.1	43.7	15.4	156.0
RIR	2163	3.27	3.27	−6.77	11.8
MO	675	1.90	4.47	0	25.7
FO	799	18.8	17.4	0	96.7
OC5	971	61.6	22.5	0	100
OC10	954	56.9	24.1	0	100

Source: The Authors.

control variables, the findings show that gross domestic product (GDP), private-sector domestic credit (DCPS) and real rate of interest (RIR) have no significant relationship with bank risk-taking (see Table 3).

The profitability model results are reported in Table 4. The lag of the dependent variable (i.e. bank profitability) has proved significant in all cases and the results show the persistence of the relationship over time, meaning that previous period profits effect the next period profitability. The regulatory capital, measured by tier 1 capital ratio, positively effects bank profitability that confirms the previous studies findings (Iannotta et al., 2007; Lee & Chih, 2013; Lee & Hsieh, 2013; Shim, 2013). Risk has significant negative relation with profitability, whether it's measured by NPLR or LLRR and the result shows that a rise in risk-taking is expected to reduce the profitability.

The results related to internal control variables show that net loans to assets ratio (NLA) has significant negative while noninterest expense to revenue ratio (NIER) positively impact bank profitability. The findings imply that banks with more lending activity and illiquid investments are more likely to suffer losses and hence reduce profitability. Also the banks with more noninterest expenses as compared to total revenues are likely to increase their profitability. The non-interest expense ratio has a significant positive relation with profitability but the effect is very minimal. In case of macroeconomic control variables, gross domestic product (GDP), private sector domestic credit (DCPS), inflation (INF), monetary policy indicator (MPI) and real interest rate (RIR) are not proved significant in case of any model (see Table 4).

In case of capital model results (Table 5), the findings show that risk positively impact regulatory capital, measured by TCR. The finding is consistent with "regulatory hypothesis" which means regulatory authorities motivate the banks to improve the equity level with extent to risk-taken (Altunbas et al., 2007; Iannotta

Table 3. Risk model results.

	Risk model (1)		Risk model (1)		Risk model (1)		Risk model (1)	
RISK (LLRR)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.027	0.226	0.025	0.337	0.025	0.300	−0.004	0.924
RISK(t − 1)	0.042	0.533	0.045	0.523	0.043	0.548	0.011	0.872
CAP	0.014***	0.003	0.013***	0.003	0.013***	0.003	0.014**	0.014
PROF	−1.327***	0.000	−1.286***	0.000	−1.291***	0.000	−1.393***	0.000
NLTD	−0.007	0.202	−0.007	0.242	−0.007	0.197	−0.007	0.267
NIITR	0.001***	0.003	0.001***	0.003	0.001***	0.003	0.001*	0.073
SIZE	0.017	0.919	−0.033	0.841	−0.033	0.845	0.110	0.675
GDP	−0.011	0.379	0.004	0.827	−0.000	0.973	0.011	0.665
MPI	−0.033	0.312	−0.004	0.901				
DCPS			0.008	0.394	0.008	0.281	0.010	0.300
RIR					−0.012	0.391	0.179	
IS								0.202
AR1, AR2, (Prob)	0.029	0.846	0.029	0.839	0.028	0.880	0.042	0.969
Wald chi2 (Prob)	139.74***	0.000	111.84***	0.000	126.81***	0.000	100.18***	0.000
# of banks	155		155		155		117	
# of Obs.	1910		1910		1910		1423	

Table 3 presents the Risk model 1 results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro-robust errors are used to account the problem of heterogeneity. The explained variable is bank risk (RISK) measured by loan loss reserve ratio. Profitability (PROF) is measured by return on assets and CAP represents the tier 1 capital ratio. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * denotes level of significance at 1, 5 and 10 percentages respectively.
Source: The Authors.

et al., 2007). The finding is consistent with our risk model results, which also validates the "regulatory hypothesis." The lag of the dependent variable (regulatory capital) is proved significant and the result shows the persistence of the relationship over time, meaning that previous period capital effects the next period capital ratios. In case of internal control variables, net-loan-to-assets ratio (NLA) negatively impact regulatory capital. In case of macroeconomic variables, interest rate has a positive relationship with regulatory capital that implies a rise in interest rates is linked with increased capital ratios.

We incorporate the bank ownership structure, in form of ownership types and ownership concentration, as a factor of bank risk and profitability. Besides we include the interaction term of ownership structure with regulatory equity in our model to test the combined impact on banking sector risk and profitability. The findings related with the effect of ownership variables on risk are presented in Tables 6 and 7. The findings suggest a positive association with managerial ownership which implies that managerial owners tend to increase in bank risk consistent with agency theory of corporate governance. While overseas owners negatively impact risk that suggests foreign owners are inclined to decrease in bank risk. However, the indirect impact of regulatory capital through its interaction with ownership structure is not significant in any case. The ownership concentration has also not proved to be significant that confirms the findings of Iannotta et al. (2007) and Zheng et al. (2017). The results also suggest that a rise in economic growth is likely to decrease in bank risk. The inflation and interest rate spread have positive relation with risk. The findings suggest that rise in interest rate is likely to surge the risk-taking (i.e. rise in non-performing loan ratio).

The results related with the impact of ownership variables on profitability are presented in Tables 8 and 9 in appendix. However the findings don't prove the direct or

Table 4. Profitability model results.

	Profitability model (2)		**Profitability model (2)**		Profitability model (2)		**Profitability model (2)**	
PROF (ROA)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.016***	0.005	0.015**	0.006	0.018***	0.005	0.018***	0.003
PROF (t − 1)	0.412***	0.000	0.411***	0.000	0.412***	0.000	0.410***	0.000
CAP	0.003**	0.018	0.003**	0.013	0.003**	0.020	0.003**	0.014
RISK	−0.250***	0.000	−0.252***	0.000	−0.250***	0.000	−0.252***	0.000
NIER	0.0004**	0.052	0.0004**	0.052	0.0005**	0.054	0.0005**	0.054
NLA	−0.018**	0.009	−0.018***	0.005	−0.018**	0.008	−0.018***	0.004
BMP	−0.002	0.212	−0.002	0.335	−0.002	0.209	−0.002	0.308
GDP	0.004	0.583	0.003	0.662	0.004	0.645	0.002	0.765
DCPS	0.003	0.506	0.003	0.432	0.002	0.641	0.002	0.609
INF			0.013	0.199			0.013	0.184
MPI					−0.010	0.572	−0.016	0.342
AR1, AR2, (Prob.)	0.001	0.376	0.001	0.334	0.001	0.372	0.001	0.326
Wald chi2 (Prob)	322.25***	0.0000	353.06***	0.0000	334.08***	0.0000	350.63***	0.0000
# of banks	155		155		155		155	
# of Obs.	1910		1910		1910		1910	

Table 4 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account for the heterogeneity problem. The explained variable is bank profitability (PROF) and is proxied by return on assets. Risk (RISK) is measured by loan loss reserve ratio (LLRR) and capital (CAP) represents the tier 1 capital ratio. Capital (CAP) is considered as endogenous regressor. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicates significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Table 5. Regulatory capital model.

	Capital model (TCR) (3)		**Capital model (TCR) (3)**		Capital model (T1R) (3)		Capital model (T1R) (3)	
CAP	Coef.	Prob.	Coef.	Prob.	Coef.	Prob	Coef.	Prob.
Constant	0.095	0.155	0.087	0.204	0.078	0.555	0.096	0.398
CAP(t − 1)	0.733***	0.000	0.732***	0.000	0.725***	0.000	0.725***	0.000
PROF	0.082	0.812	0.082	0.818	1.107	0.250	1.186	0.208
RISK	0.163*	0.068	0.165*	0.073	1.003	0.171	1.044	0.140
NLA	−0.122***	0.003	−0.126***	0.004	−0.043	0.206	−0.056*	0.091
SIZE	−0.379	0.533	−0.424	0.498	−0.737	0.575	−0.656	0.578
BMP					0.024	0.233	0.022	0.220
NIER							−0.002	0.224
GDP	0.038	0.464	0.042	0.446	0.064	0.133	0.019	0.717
DCPS	0.066	0.117	0.076	0.100	0.028	0.356	0.026	0.500
INF	0.055	0.189	0.050	0.219			0.067	0.414
MPI			0.115	0.236	0.233**	0.028		
AR1, AR2, (prob.)	0.006	0.554	−0.006	0.552	0.035	0.733	0.029	0.530
Wald chi2 (Prob)	72,526.53***	0.0000	74,489.87***	0.0000	135,446***	0.0000	147,235.01***	0.0000
# of banks	162		162		155		155	
# of Obs.	2001		2001		1910		1910	

Table 5 gives the Regulatory capital model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank capital (CAP) and is proxied by total capital ratio (TCR) and tier 1 capital ratio (T1R). Risk (RISK) is measured by non-performing loans ratio in first two cases and by loan loss reserve ratio in last two models. PROF represents the return on assets and PROF and RISK both variables are considered as endogenous regressors. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicate the significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

indirect significance of ownership variables in any case. Table 10 presents the findings related with ownership variables impact on regulatory capital and the findings show the positive impact of profitability on capital which imply that financial institutes

Table 6. Ownership structure, regulatory capital and risk-taking.

	Risk model		Risk model		Risk model		**Risk model**	
RISK (NPLR)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.008	0.678	0.010	0.611	0.066	0.133	0.073	0.124
RISK(t − 1)	1.135***	0.000	1.127***	0.000	0.644**	0..036	0.641**	0.033
Risk(t − 2)	−0.238	0.110	−0.231	0.119	−0.092	0.349	−0.086	0.361
Risk(t − 3)	−0.029	0.797	−0.034	0.763				
CAP	0.064*	0.065	0.063*	0.065	−0.012	0.821	−0.051	0.578
PROF	−1.125*	0.059	−1.104*	0.067	−0.755**	0.032	−0.784**	0.035
BMP	0.004	0.378	0.005	0.404	0.011	0.125	0.012	0.169
NLTD	−0.021	0.361	−0.023	0.330	0.003	0.749	0.001	0.869
GDP	−0.011	0.780	−0.016	0.718	−0.095	0.272	−0.102	0.312
DCPS	0.014	0.369	0.013	0.212	−0.033	0.335	−0.034	0.323
INF	0.049	0.182	0.051	0.195	0.048	0.473	0.055	0.451
MAN	0.181**	0.009	0.399	0.333				
CAP*MAN			−1.416	0.578				
FOR					−0.079*	0.083	−0.108	0.148
CAP*FOR							0.204	0.593
AR2, AR3, (prob)	0.416	0.807	0.394	0.853	0.140	0.449	0.121	0.511
Wald chi2 (Prob)	1926.94***	0.0000	2137.24***	0.0000	163.45***	0.0000	194.75***	0.0000
# of banks	81		81		110		110	
# of Obs.	661		661		793		793	

Table 6 gives the Risk model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank risk (RISK) and is proxied by non-performing loan ratio (NPLR). Profitability (PROF) is measured by return on assets (ROA) and capital (CAP) represents the tier 1 capital ratio. Capital (CAP) is considered as endogenous regressor. We incorporate the second and third lag of explained variable in order to account autocorrelation problem. The Arellano and Bond autocorrelation method to check the presence of serial correlation. ***, **, * indicate the significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Table 7. Ownership structure, regulatory capital and risk-taking.

	Risk model		Risk model		Risk model		**Risk model**	
RISK (NPLR)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coeff.	Prob.
Constant	0.088	0.104	0.085	0.134	0.098*	0.086	0.098*	0.079
RISK (t − 1)	0.667***	0.005	0.662***	0.004	0.649***	0.002	0.650***	0.002
Risk(t − 2)	−0.010	0.929	−0.010	0.932	0.001	0.992	−0.001	0.989
CAP	−0.005	0.170	−0.073	0.262	−0.006	0.168	−0.049	0.211
PROF	−0.577	0.104	−0.601*	0.097	−0.578	0.104	−0.601*	0.077
NIER	−0.002	0.269	−0.002	0.290	−0.001	0.346	−0.001	0.382
SIZE	−0.006	0.135	−0.005	0.172	−0.006	0.128	−0.006	0.143
BMP	0.013**	0.037	0.014*	0.066	0.013**	0.046	0.013*	0.051
GDP	−0.113*	0.064	−0.115	0.105	−0.130**	0.047	−0.132*	0.061
INF	0.128	0.167	0.138	0.140	0.114	0.207	0.127	0.175
IS	0.518**	0.026	0.578**	0.022	0.511**	0.025	0.520**	0.013
CON5	−0.022	0.123	−0.028	0.100				
CAP*CON5			0.068	0.281				
CON10					−0.021	0.137	−0.029	0.110
CAP*CON10							0.044	0.234
AR2, AR3, (prob)	0.100	0.423	0.100	0.432	0.072	0.359	0.075	0.392
Wald chi2 (Prob)	976.15***	0.0000	1155.65***	0.0000	987.27***	0.0000	1156.98***	0.0000
# of banks	103		103		101		101	
# of Obs.	750		750		733		733	

Table 7 gives the Risk model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic system GMM methodology and hetro-robust errors are used to account the heterogeneity problem. The explained variable is bank risk (RISK) and is proxied by non-performing loan ratio (NPLR). Profitability (PROF) is measured by return on assets (ROA) and capital (CAP) represents the tier 1 capital ratio. Capital (CAP) is considered as endogenous regressor. We incorporate the second lag of dependent variable in order to account autocorrelation problem. The Arellano and Bond autocorrelation test is employed to check the presence of serial correlation. ***, **, * indicate significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Table 8. Ownership structure, regulatory capital and profitability.

	Profitability model		Profitability model		Profitability model		Profitability model	
PROF (ROA)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	−0.001	0.892	−0.001	0.895	−0.002	0.764	−0.002	0.810
PROF (t − 1)	0.526***	0.000	0.534***	0.000	0.569***	0.000	0.572***	0.000
CAP	0.019	0.101	0.018	0.107	0.017	0.152	0.012	0.508
RISK	−0.024	0.269	−0.022	0.234	−0.028	0.227	−0.030	0.260
NLA	−0.004	0.754	−0.002	0.831	−0.003	0.719	−0.003	0.706
NIITR	−0.002***	0.000	−0.002***	0.000	−0.003***	0.000	−0.003***	0.000
NIER	0.001*	0.072	0.001*	0.083	0.002***	0.001	0.002***	0.000
GDP	0.002	0.863	0.003	0.831	0.030**	0.011	0.033**	0.020
MPI	0.029	0.326	0.027	0.371	0.063	0.214	0.068	0.247
DCPS	0.005	0.455	0.004	0.528	−0.000	0.942	−0.000	0.949
MAN	0.090	0.256	0.045	0.655				
CAP*MAN			0.298	0.714				
FOR					0.008	0.114	−0.001	0.971
CAP*FOR							0.056	0.790
AR1, AR2, (prob)	0.026	0.160	0.028	0.160	0.052	0.199	0.050	0.194
Wald chi2 (Prob)	541.43***	0.0000	531.28***	0.0000	369.12***	0.0000	403.04***	0.0000
# of banks	81		81		110		110	
# of Obs.	673		673		797		797	

Table 8 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank profitability (PROF) and is proxied by return on assets. Risk (RISK) is measured by non-performing loan ratio (NPLR) and capital (CAP) represents the total capital ratio. Capital (CAP) is considered as endogenous regressor. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicate significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Table 9. Ownership structure, regulatory capital and profitability.

	Profitability model		Profitability model		Profitability model		Profitability model	
PROF (ROA)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.009	0.417	0.005	0.719	0.008	0.490	0.007	0.636
PROF (t − 1)	0.479***	0.000	0.485***	0.000	0.470***	0.000	0.474***	0.000
CAP	−0.001	0.532	0.013	0.496	−0.000	0.641	0..002	0.877
RISK	−0.039	0.132	−0.038	0.150	−0.036	0.185	−0.035	0.194
NLA	−0.012	0.233	−0.011	0.300	−0.012	0.245	−0.012	0.299
NIITR	−0.003***	0.001	−0.003***	0.001	−0.003***	0.001	−0.003***	0.001
NIER	0.002***	0.001	0.002***	0.001	0.002***	0.002	0.002***	0.002
GDP	0.025**	0.023	0.027**	0.011	0.027**	0.038	0.028**	0.030
LI	0.036	0.288	0.043	0.218	0.040	0.267	0.044	0.226
DCPS	0.001	0.774	0.002	0.605	0.002	0.714	0.002	0.637
CON5	−0.000	0.975	0.003	0.725				
CAP*CON5			−0.014	0.468				
CON10					−0.000	0.880	0.000	0.971
CAP*CON10							−0.003	0.843
AR1, AR2, (prob)	0.041	0.137	0.044	0.135	0.043	0.146	0.048	0.146
Wald chi2 (Prob)	302.20***	0.0000	289.46***	0.0000	254.16***	0.0000	224.69***	0.0000
# of banks	128		128		126		126	
# of Obs.	970		970		953		953	

Table 9 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank profitability (PROF) and is proxied by return on assets. Risk (RISK) is measured by non-performing loan ratio (NPLR) and capital (CAP) represents the total capital ratio. Capital (CAP) is considered as endogenous regressor. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicate significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Table 10. Ownership structure and regulatory capital.

	Capital model (T1R)		Capital model (T1R)		Capital model (T1R)	
CAP	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.049**	0.039	0.045*	0.072	0.036	0.103
CAP(t − 1)	0.781***	0.000	0.700***	0.000	0.698***	0.000
RISK	0.051	0.277	0.176	0.250	0.163	0.248
PROF	0.623***	0.004	0.823**	0.027	0.794**	0.037
NLA	−0.019	0.499	−0.013	0.676	−0.012	0.682
NIER	−0.002	0.425	−0.001	0.651	−0.001	0.591
GDP	0.017	0.776	−0.028	0.551	−0.058	0.165
MPI	−0.160	0.156	−0.426	0.130	−0.424	0.118
FOR	−0.032	0.174				
CON5			0.029	0.428		
CON10					0.053**	0.052
AR1, AR2, (prob)	0.000	0.682	0.375	0.355	0.367	0.342
Wald chi2 (Prob)	181.23***	0.0000	207,339***	0.0000	210,340***	0.0000
# of banks	110		128		126	
# of Obs.	797		970		953	

Table 10 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) Two-step dynamic panel system GMM methodology to estimate the model and hetro robust errors are used to account for the heterogeneity problem. The explained variable is bank capital (CAP) and is proxied by tier 1 capital ratio. Risk (RISK) is measured by non-performing loan ratio (NPLR) and profitability (PROF) represents the return on assets. PROF and RISK are considered as endogenous regressor. The Arellano and Bond autocorrelation method is employed to test the presence of serial correlation in error-terms. ***, **, * indicate the significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

with higher returns produce additional liquidity, as the rise in bank profits may influence bank equity positively (Flannery & Rangan, 2008; Gropp & Heider, 2010). The ownership concentration has also positive relation with regulatory capital ratios implying that banks with concentrated ownership are expected to increase the capital ratios.

5.1. Robustness tests

The robustness tests are performed in several ways. First, we incorporate two proxies for regulatory equity requirements i.e. tier 1 capital ratio (T1R) and total capital ratio (TCR) and both positively affect risk-taking that validates the "regulatory hypothesis." Second, risk is measured by two proxies i.e. NPLR and LLRR, both of them have significant positive relationship with regulatory capital ratios, which also validates the "regulatory hypothesis." The results prove the validation of "regulatory hypothesis" whether we test the causality from capital to risk-taking or from the other way i.e. from risk-taking to capital.

Third, we add crisis dummy (CD), taking value of "1" for years 2008 to 2010 and "0" else, in bank risk-taking and profitability models. In bank risk model, the crisis dummy and its interaction term with regulatory capital have not proved significant. In profitability model, the crisis dummy negatively effects bank profitability, which implies that in crisis times the profitability of banks is reduced. Fourth, we incorporate the time period of Basel III introduction by introducing a dummy variable (BTD) that takes value of "1" for periods 2010 onwards and "0" else, however the results are only significant in profitability model case. The Basel time dummy positively impact bank profitability that implies profitability has significantly increased subsequent to

Table 11. Risk model (robustness tests).

	Risk model		Risk model		Risk model	
RISK (NPLR)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.077	0.102	0.071	0.126	0.084*	0.077
RISK (t − 1)	0.666***	0.000	0.663***	0.000	0.675***	0.000
CAP	−0.010	0.123	−0.009	0.129	−0.011	0.133
PROF	−1.000***	0.000	−0.997***	0.000	−1.000***	0.000
NLA	−0.050***	0.001	−0.049***	0.002	−0.049**	0.005
SIZE	−0.224	0.495	−0.170	0.589	−0.301	0.375
BMP						
GDP	−0.071**	0.010	−0.078***	0.001	−0.072**	0.008
INF	0.024	0.542	0.021	0.596	0.011	0.768
MPI	0.088	0.347	0.076	0.430	0.091	0.309
CD	−0.003	0.199	−0.002	0.266		
CAP*CD			−0.005	0.620		
BTD					0.004	0.113
AR1, AR2, (prob.)	0.016	0.354	0.016	0.360	0.017	0.375
Wald chi2 (Prob)	405.43	0.0000***	546.16	0.0000***	443.73	0.0000***
# of banks	162		162		162	
# of Obs.	2001		2001		2001	

Table AI4 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank Risk (RISK) and is proxied by non-performing loan ratio (NPLR). Profitability (PROF) is measured by return on assets and CAP represents the tier 1 capital ratio. CD represents the crisis dummy that takes the value of 1 from period 2008–10 and 0 else. BTD represents the Basel III dummy, which takes the value 1 from 2010 onwards and zero else. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicate significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

Basel III institution. The remaining findings are similar as base model estimations that prove the significance of overall model (see Tables 11 and 12).

6. Conclusion

This study analyzes the association amid capital requirements, risk-taking and profitability in emerging Asian markets during period of 2004 to 2017. The study uses Arellano and Bover (1995) and Blundell and Bond (2000) system dynamic two-step panel methodology for model estimation because of the problem of endogeniety. In case of risk model, the results reveal that regulatory equity ratio positively effects risk-taking, which validates the "regulatory hypothesis." The result implies that regulatory authorities motivate the banks to improve the equity level with extent to risk-taken known as "*regulatory hypothesis*" (Altunbas et al., 2007; Iannotta et al., 2007; Mahdi & Abbes, 2018; Ugwuanyi, 2015). Bank profitability is negatively related with risk-taking, implying that profits tend to reduce the risk-taking. In terms of internal control variables, net interest income to revenue (NIITR) positively effects risk-taking that implies banking institutes with more interest income as compared to total revenues have more investment in illiquid assets i.e. bank loans, which increases their risk.

In case of bank profitability model, the results suggest that regulatory capital positively effects bank profitability that confirms the previous studies findings (Iannotta et al., 2007; Lee & Chih, 2013; Lee & Hsieh, 2013; Shim, 2013). Risk has significant

Table 12. Profitability model (robustness tests).

	Profitability model		Profitability model		Profitability model	
PROF (ROA)	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Constant	0.024*	0.077	0.025*	0.069	0.025	0.116
PROF (t − 1)	0.518***	0.000	0.522***	0.000	0.531***	0.000
CAP	−0.001	0.114	−0.002	0.154	−0.001	0.107
RISK	−0.032*	0.087	−0.033*	0.066	−0.030*	0.097
NLA	−0.005	0.455	−0.006	0.368	−0.004	0.574
SIZE	−0.120	0.227	−0.134	0.125	−0.169	0.147
BMP	−0.003	0.107				
GDP	0.009	0.334	0.009	0.364	0.009	0.466
INF	0.008	0.539	0.011	0.451	0.005	0.804
MPI	0.014	0.586	0.023	0.422	0.037	0.100
CD	−0.001**	0.039	−0.001**	0.033		
CAP*CD			0.070	0.609		
BTD					0.002**	0.028
AR(1), AR(2), (p-value)	0.001	0355	0.001	0.355	0.001	0.369
Wald chi2 (Prob)	174.01	0.0000***	149.78	0.0000***	165.80	0.0000***
# of banks	162		162		162	
# of Obs.	2001		2001		2001	

Table AI3 gives the Profitability model results by using Asian emerging markets sample. We use the Arellano and Bover (1995) panel dynamic two-step system GMM methodology and hetro robust errors are used to account the heterogeneity problem. The explained variable is bank profitability (PROF) and is proxied by return on assets. Risk (RISK) is measured by non-performing loan ratio (NPLR) and capital (CAP) represents the tier 1 capital ratio. Capital (CAP) is considered as endogenous regressor. CD represents the crisis dummy that takes the value of 1 from period 2008–10 and 0 else. BTD represents the Basel III dummy, which takes the value 1 from 2010 onwards and zero else. The Arellano and Bond autocorrelation method is employed to check the presence of serial correlation. ***, **, * indicate significance level at 1, 5 and 10 percentages respectively.
Source: The Authors.

negative relation with profitability and the result shows that a rise in risk-taking is expected to reduce the profitability. The findings imply that banks with more lending activity and investment in illiquid assets are more likely to suffer losses and hence reduce profitability. In case of capital model results, the findings show that risk positively impact regulatory capital. The finding is consistent with "regulatory hypothesis" which means regulatory authorities motivate the banks to improve the equity level with extent to risk-taken (Altunbas et al., 2007; Iannotta et al., 2007).

The findings related with the effect of ownership variables on risk suggest a positive relation with managerial ownership, while overseas owners negatively impact risk. However, the combined impact of regulatory capital through its interaction with ownership structure is not significant in any case. The ownership concentration has positive relation with regulatory capital which implies banks with ownership concentration are expected to improve their capital ratios.

The current study implies important policy implications as it finds the bidirectional causality between the regulatory capital and risk-taking implying banks with higher capital ratios are expected to increase in their risk-taking. Also the study implies that regulatory authorities motivate the banks to improve the equity level with extent to risk-taken. The study also suggests that ownership structure has a significant influence on bank risk and profitability, however, the combined impact of regulatory capital through its interaction with ownership structure is not proved to be significant in most of the cases in Asian emerging economies. Thus the Asian emerging economy must perform its role in confirming the fact that the new

regulatory financial design encounters the challenges of both the globalization of finance and the regional financial risk and growth challenges.

The study has also certain limitations which suggest the future research directions. First, the present study is a multi-country case. There are certain country-specific issues and characteristics that are not accounted for by the empirical model because of the unavailability of the complete data. Also, the current study employs bank ownership structure as a part of corporate governance variables, but there also exist other features of corporate governance mechanism. So the current study presents several directions, in case of regulatory capital requirements and corporate governance, for future researchers.

References

Admati, A. R., DeMarzo, P. M., Hellwig, M. F., & Pfleiderer, P. (2018). The leverage ratchet effect. *The Journal of Finance*, *73*(1), 145–198. https://doi.org/10.1111/jofi.12588

Agoraki, M. E. K., Delis, M. D., & Pasiouras, F. (2011). Regulations, competition and bank risk-taking in transition countries. *Journal of Financial Stability*, *7*(1), 38–48. https://doi.org/10.1016/j.jfs.2009.08.002

Akhtar, Y., Kayani, G. M., & Yousaf, T. (2019). The effects of regulatory capital requirements and ownership structure on bank lending in emerging Asian markets. *Journal of Risk and Financial Management*, *12*(3), 142. https://doi.org/10.3390/jrfm12030142

Al-Tamimi, H. A. H., & Jellali, N. (2013). The effects of ownership structure and competition on risk-taking behavior: Evidence from UAE conventional and Islamic banks. *The International Journal of Business and Finance Research*, *7*(2), 115.

Allahrakha, M., Cetina, J., & Munyan, B. (2018). Do higher capital standards always reduce bank risk? The impact of the Basel leverage ratio on the US triparty repo market. *Journal of Financial Intermediation*, *34*, 3–16. https://doi.org/10.1016/j.jfi.2018.01.008

Altunbas, Y., Carbo, S., Gardener, E. P., & Molyneux, P. (2007). Examining the relationships between capital, risk and efficiency in European banking. *European Financial Management*, *13*(1), 49–70. https://doi.org/10.1111/j.1468-036X.2006.00285.x

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, *58*(2), 277–297. https://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Ashraf, B., Arshad, S., & Hu, Y. (2016). Capital regulation and bank risk-taking behavior: Evidence from Pakistan. *International Journal of Financial Studies*, *4*(3), 16. https://doi.org/10.3390/ijfs4030016

Barry, T. A., Lepetit, L., & Tarazi, A. (2011). Ownership structure and risk in publicly held and privately owned banks. *Journal of Banking & Finance*, *35*(5), 1327–1340. https://doi.org/10.1016/j.jbankfin.2010.10.004

Barry, T. A., Lepetit, L., & Strobel, F. (2016). Bank ownership structure, lending corruption and the regulatory environment. *Journal of Comparative Economics*, *44*(3), 732–751. https://doi.org/10.1016/j.jce.2015.08.003

Berger, A. N., & Deyoung, R. (1997). Problem loans and cost efficiency in commercial banks. *Journal of Banking & Finance*, *21*(6), 849–870. https://doi.org/10.1016/S0378-4266(97)00003-4

Blundell, R., & Bond, S. (2000). GMM Estimation with persistent panel data: an application to production functions. *Econometric Reviews*, *19*(3), 321–340. https://doi.org/10.1080/07474930008800475

Calomiris, C. W., & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *The American Economic Review*, 497–513.

Casu, B., & Girardone, C. (2006). Bank competition, concentration and efficiency in the single European market. *The Manchester School*, *74*(4), 441–468. https://doi.org/10.1111/j.1467/9957.2006.00503.x

Demirgüç, A., & Kane, E. J. (2002). Deposit insurance around the globe: Where does it work? *Journal of Economic Perspectives*, *16*(2), 175–195. https://doi.org/10.1257/0895330027319

DeYoung, R., Distinguin, I., & Tarazi, A. (2018). The joint regulation of bank liquidity and bank capital. *Journal of Financial Intermediation*, *34*, 32–46. https://doi.org/10.1016/j.jfi.2018.01.006

Ehsan, S., & Javid, A. Y. (2018). Bank ownership structure, regulations and risk-taking: Evidence from commercial banks in Pakistan. *Portuguese Economic Journal*, *17*(3), 185–209. https://doi.org/10.1007/s10258-018-0147-3

Flannery, M. J., & Rangan, K. P. (2008). What caused the bank capital build-up of the 1990s? *Review of Finance*, *12*(2), 391–429. https://doi.org/10.1093/rof/rfm007

Gropp, R., & Heider, F. (2010). The determinants of bank capital structure. *Review of Finance*, *14*(4), 587–622. https://doi.org/10.1093/rof/rfp030

Hammami, Y., & Boubaker, A. (2015). Ownership structure and bank risk-taking: Empirical evidence from the Middle East and North Africa. *International Business Research*, *8*(5), 271. https://doi.org/10.5539/ibr.v8n5p271

Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership structure, risk and performance in the European banking industry. *Journal of Banking & Finance*, *31*(7), 2127–2149. https://doi.org/10.1016/j.jbankfin.2006.07.013

Labra Lillo, R., & Torrecillas, C. (2018). Estimating dynamic Panel data. A practical approach to perform long panels. *Revista Colombiana De Estadística*, *41*(1), 31–52. https://doi.org/10.15446/rce.v41n1.61885

Lee, T.-H., & Chih, S.-H. (2013). Does financial regulation affect the profit efficiency and risk of banks? Evidence from China's commercial banks. *The North American Journal of Economics and Finance*, *26*, 705–724. https://doi.org/10.1016/j.najef.2013.05.005

Lee, C. C., & Hsieh, M. F. (2013). The impact of bank capital on profitability and risk in Asian banking. *Journal of International Money and Finance*, *32*, 251–281. https://doi.org/10.1016/j.jimonfin.2012.04.013

Levine, R., & Laeven, L. (2008). *Bank governance, regulation, and risk taking*. National Bureau of Economic Research.

Mahdi, I. B. S., & Abbes, M. B. (2018). Relationship between capital, risk and liquidity: A comparative study between Islamic and conventional banks in MENA region. *Research in International Business and Finance*, *45*, 588–596.

Oino, I. (2018). Impact of regulatory capital on European banks financial performance: A review of post global financial crisis. *Research in International Business and Finance*, *44*, 309–318. https://doi.org/10.1016/j.ribaf.2017.07.099

Osborne, M., Fuertes, A., & Milne, A. (2012). Capital and profitability in banking: Evidence from US banks. In *3rd Emerging Scholars in Banking and Finance Conference*, Cass Business School (pp. 1–54).

Ozili, P. K., & Uadiale, O. (2017). Ownership concentration and bank profitability. *Future Business Journal*, *3*(2), 159–171. https://doi.org/10.1016/j.fbj.2017.07.001

Rahman, M. M., Chowdhury, A. A., & Mouri, D. E. Y. (2018a). Relationship between risk-taking, capital regulation and bank performance: Empirical evidence from Bangladesh. *Eurasian Journal of Business and Economics*, *11*(22), 29–57. https://doi.org/10.17015/ejbe.2018.022.02

Rahman, M. M., Zheng, C., & Ashraf, B. N. (2018b). Capital requirements, the cost of financial intermediation and bank risk-taking: Empirical evidence from Bangladesh. *Research in International Business and Finance*, *44*, 488–503. https://doi.org/10.1016/j.ribaf.2017.07.119

Rahman, N. A. A., Ahmad, N. H., & Abdullah, N. A. H. (2012). Ownership structure, capital regulation and bank risk taking. *Journal of Business and Economics*, *3*(3), 176–188. https://doi.org/10.15341/jbe(2155-7950)/03.03.2012/003

Sarker, N., & Nahar, S. (2017). The impact of ownership structure on bank credit risk: Evidence from Bangladesh. *Eurasian Journal of Business and Economics*, *10*(19), 19–36. https://doi.org/10.17015/ejbe.2017.019.02

Saunders, A., Strock, E., & Travlos, N. G. (1990). Ownership structure, deregulation, and bank risk taking. *The Journal of Finance*, *45*(2), 643–654. https://doi.org/10.1111/j.1540-6261.1990.tb03709.x

Sheng, A., & Li, S. Y. (2013). Asian banking: Moving beyond Basel III. *Fung Institute Issue Brief*,

Shim, J. (2013). Bank capital buffer and portfolio risk: The influence of business cycle and revenue diversification. *Journal of Banking & Finance*, *37*(3), 761–772. https://doi.org/10.1016/j.jbankfin.2012.10.002

Srairi, S. (2013). Ownership structure and risk-taking behaviour in conventional and Islamic banks: Evidence for MENA countries. *Borsa Istanbul Review*, *13*(4), 115–127. https://doi.org/10.1016/j.bir.2013.10.010

Tanda, A. (2015). The effects of bank regulation on the relationship between capital and risk. *Comparative Economic Studies*, *57*(1), 31–54. https://doi.org/10.1057/ces.2014.35

Ugwuanyi, G. O. (2015). Regulation of bank capital requirements and bank risk-taking behaviour: Evidence from the Nigerian banking industry. *International Journal of Economics and Finance*, *7*(8), 31–37. https://doi.org/10.5539/ijef.v7n8p31

Ullah, S., Akhtar, P., & Zaefarian, G. (2018). Dealing with endogeneity bias: The generalized method of moments (GMM) for panel data. *Industrial Marketing Management*, *71*, 69–78. https://doi.org/10.1016/j.indmarman.2017.11.010

Zheng, C., Moudud-Ul-Huq, S., Rahman, M. M., & Ashraf, B. N. (2017). Does the ownership structure matter for banks' capital regulation and risk-taking behavior? Empirical evidence from a developing country. *Research in International Business and Finance*, *42*, 404–421. https://doi.org/10.1016/j.ribaf.2017.07.035

Appendix:

Table 13. Correlation matrix.

	NPLR	LLRR	T1R	T2R	TCR	ROA	NLA	NIER	NIITR	SIZE	BMP	GDP	IS	LI	DCPS	INF	MAN	FOR	CON5	CON10
NPLR	1																			
LLRR	0.225*	1																		
T1r	0.047*	0.095*	1																	
T2R	−0.286*	0.024	−0.205*	1																
TCR	0.045*	0.095*	0.991*	−0.176*	1															
ROA	−0.318*	−0.442*	0.077*	0.008	0.086*	1														
NLA	−0.052	−0.124*	−0.221*	0.094*	−0.229*	−0.137*	1													
NIER	−0.136	−0.044*	−0.056*	0.162*	−0.053*	0.082*	0.028	1												
NIITR	−0.069	0.211*	−0.099*	0.194*	−0.099*	−0.217*	0.050*	0.557*	1											
SIZE	−0.065	0.022	−0.142*	0.039	−0.141*	0.017	0.375*	0.003	0.029	1			*							
BMP	0.010	−.061*	−0.044*	0.073*	−0.038	0.145*	0.155*	−0.010	−0.037	0.403*	1									
GDP	−0.214*	−0.067*	−0.057*	−0.001	−0.056*	0.050*	−0.097*	−0.005	0.022	−0.083*	−0.212*	1								
IS	0.224*	0.117*	0.102*	−0.050	0.099*	−0.044	−0.071*	0.018	0.031	0.208*	−0.173*	−0.281*	1							
LI	0.143*	0.125*	0.098*	−0.043	0.105*	−0.060*	−0.060*	0.020	0.025	0.226*	−0.203*	−0.199*	0.830*	1						
DCPS	−0.244	−0.079*	−0.100*	0.051*	−0.104*	0.019	0.086*	−0.033	−0.000	−0.071*	0.105*	0.217*	−0.787*	−0.811*	1					
INF	0.127*	0.060*	0.032	−0.020	0.036	−0.046*	−0.038	0.033	0.009	−0.009	−0.183*	−0.156*	0.629*	0.678*	−0.571*	1				
MAN	0.016	−0.126*	0.013	0.038	0.009	−0.001	−0.039	0.038	−0.022	−0.169*	−0.061	−0.254*	0.173*	0.116*	−0.166*	0.095*	1			
FOR	−0.279	−0.052	−0.067	0.125*	−0.032	0.262*	0.174*	−0.079*	−0.111*	0.260*	0.242*	0.074*	−0.280*	−0.172*	0.120*	−0.158*	0.048	1		
CON5	0.137*	0.031	0.132*	−0.126*	0.122*	−0.120*	−0.019	0.079*	0.042	0.099*	0.062	0.023	0.192*	0.183*	−0.251*	0.083*	−0.178*	−0.372*	1	
CON10	0.159*	0.065*	0.130*	−0.126*	0.120*	−0.113*	0.030	0.089*	0.051	0.125*	0.095*	−0.000	0.193*	0.186*	−0.251*	0.092*	−0.269*	−0.353*	0.945*	1

Represents the level of significance at 5%.
Source: The Authors.