Product diversification and Bank risk taking behavior: An empirical evidence from Indian banking system

Jugnu Ansari*

Abstract

This study examines the relationship between product diversification and bank risk taking behavior in India over the period of 2001–2014. Our analysis shows clear evidence that the effect of risk taking behavior through product diversification depends highly on the bank's size and ownership. The degree of product diversification is negatively associated with bank risk taking behavior for small-sized banks as compared large-sized banks. We found that ownership does matter in the pursuit of product diversification. Relative to private domestic banks, public sector banks earn significantly less fee-income but more income from other off-balance sheet activities. From a regulatory perspective, it appears that diversification benefits public sector banks. This finding suggests that deregulation encouraging banks to become more involved in non-traditional activities may have an adverse effect on the overall banking system where large-sized banks are playing a significant role in India.

JEL classification : G15, G21, G28
Keywords : Non-interest income, Diversification, Risk in banking, Ownership

1. Introduction

The combination of regulatory reform, product market innovation and technological change has dramatically altered Indian commercial banks. They have become bigger, operate in more markets, offer more products, and exhibit a more diversified stream of revenue. Banking system now engage in a broad range of financial activities like securities underwriting, insurance underwriting, and merchant banking, and income from activities that generate noninterest income accounting for over 14% on an average of net operating revenue for the industry. This increased scope has clearly made banks broader and more complex, but has it made them safer?

Conventional wisdom in banking argues that diversification tends to reduce bank risk and improve performance. In contrast, the recent worldwide financial crisis raises serious concerns among legislators, regulators, practitioners, and academics as to whether banking institutions have outgrown their optimal scope and whether aggressive diversification strategies

* Jugnu Ansari is Assistant Adviser in the Centre for Advanced Financial Research and Learning (CAFRAL), Reserve bank of India, Mumbai. The views expressed in the paper are of the author only.

may have led some banks to be exposed to much higher risk instead of lower risk. This question is important because it not only demands ex post evaluations of the economic impacts of changes in legislation and regulatory environment on the banking industry, which might provide an exogenous motive for banks to diversify, but it also mandates careful investigation of the effects of diversification strategies on the risk-return tradeoff of banking institutions.

Existing studies of the performance effects of bank diversification, although many in number, have not yet come to a consensus. Moreover, most of these studies are based on a simple model which assumes a linear relationship between the bank's risk-return tradeoff and its diversification strategy (Acharya et al. 2006 is an exception). Ignoring the possibility that a bank's risk-return tradeoff might depend non-monotonically on its diversification strategy may be misleading and could jeopardize the validity of the policy implications of these studies. Moreover, this line of research is heavily saturated in studies that focus on banks in developed markets, while leaving the banking industry in emerging and transitional economies largely unexamined (an exception is Berger et al. (2010)).

We analyze banks in one emerging economy, India. This nation has been characterized by a dramatically improving macroeconomic environment, rapid development of its banking sector, and changes in banking regulations that have led to lower barriers to foreign investment and acquisitions. The ongoing structural change of Indian economy – e.g., the growth of small business and entrepreneurial activities – has increased the demand for financial services and led to intensified competition in the market. This competition compelled Indian banks to change or to contemplate restructuring their asset-liability strategies. With different size, ownership, and business strategy, India provides a rich test case for analyzing the impact of banks' diversification strategies on its risk-taking behavior.

The existence of a risk-taking channel is generated by the behavior of banks when their costs of funding remain low for long periods of time. Sustained low short-term interest rates induce financial imbalances as a result of a reduction in banks´ risk aversion and a more intensive search for yield. In such an environment there is a disproportionate increase in the demand for riskier assets with higher expected returns. Additionally, low interest rates induce banks to take more risks through their impact on asset valuations, incomes and cash flows. Several empirical analyses find evidence of the existence of a risk-taking channel (for instance see Jiménez et al. (2009) and Ioannidou et al. (2009) for the cases of Spain and Bolivia). Tenjo et al (2012) use hazard duration models to show that banks operating in the Colombian banking system take on more risks when the level of interest rates is too low.

Following the work of Lepetit et al. (2008) on the European banking industry, this study empirically investigates the relationship between non-interest income activities and bank risk by utilizing alternative ways to measure bank risks based on income structure over the period of 2001–2014. This analysis also examines how the relationship is associated with bank size and bank ownership. Since fixed costs associated with fee-based financial services may enable large-sized banks to take a more aggressive position on non-interest services than small-sized banks, bank size might influence a banks' behavior in regards to noninterest income activities. In this study, to better understand the role of non-interest income activities, non-interest income is divided into two components: trading activities and commission and fee activities. Indian commercial bank annual report data is used and covers year-end balance sheets and income statements for 45 banks.

The analysis shows that bank size and ownership are crucial factors determining how non-interest income activities are associated with bank risk. More precisely, a higher reliance on non-interest income activities entails a lower level of bank risk for relatively small-sized banks but entails a higher level of bank risk for relatively large-sized banks. The large-sized bank observation is consistent with the results of Kwan (1998), De Young and Roland (2001), Stiroh (2004), and Lepetit et al. (2008) in that nonbanking activities increased bank risk. Furthermore, our results of size-dependent responses of bank risk for small-sized banks are in contrast to those of Lepetit et al. (2008) in that the positive link between non-interest income and bank risk is more significant for small-sized banks in the European banking industry.

This document is structured in five sections. The first one is this introduction. The second one presents the literature review. The third section describes the data and methodology used in the empirical analysis. The fourth section presents and discusses our main results, and the last section concludes.

2. Literature Review

A review of the financial literature reveals numerous attempts to quantify and explain the risk-taking behaviour of financial intermediaries. The topic of risk-taking incentives is receiving heightened attention. Although much of what is said also applies to banks, it is true that the banking firm has important specific characteristics that justify a special interest in the analysis of its risk-taking incentives (Crespi, Garcia-Cestona, & Salas, 2004; Esty, 1997). Also, in the bank sector, in addition to information asymmetry between owners and managers, there are at least three additional kinds of asymmetric information: between "depositors, the bank and the regulator", between "owner, managers and the regulator", and between "borrowers, managers and the regulator". For example, shareholders are willing to take on high-risk projects that increase share value at the expense of the value of deposits (contrary to the interests of depositors). Although mechanisms such as flat rate deposit insurance are an effective device to avert bank runs, some authors such as Merton (1977) claim that deposit insurance can generate problems of moral hazard in the behaviour of banks, raising the shareholders' incentives to take risk above the optimal level. The owner–manager agency conflict coexists with this problem of moral hazard, and this causes a twofold effect on the "organisational form-risk taking behaviour" relationship that is not easily predictable. This has given rise to a large number of empirical studies. Verbrugge and Goldstein (1981), Cordell et al. (1993), Lamm-Tennan and Starks (1993) and Esty (1997) find a direct relationship between the two. Other authors find links between managerial ownership and risk-taking (Anderson & Fraser, 2000; Chen, Steiner, & Whyte, 1998; Gorton & Rosen, 1995; Saunders, Strock, & Travlos, 1990).

The z-score is defined as the sum of the Return on Assets (ROAs) plus the Equity/Assets ratio divided by the standard deviation of ROA. This score is negatively related to default risk, suggesting that an increase in z-score is equivalent to a decrease in default risk and vice versa. The measure of default risk (i.e. the z-score) is dependent upon ROA, which is a measure of bank performance, we need to take into account variables which possibly affect bank performance.

The bigger banks may be better diversified, meaning less concern about the idiosyncratic risks at each bank, but greater size also means that analysts must consider managers' ability to cope with more complex, less focused operations. To conduct robustness checks, we also consider as control variables the real GDP growth and the inflation. Specifically, Bikker and Metzemakers (2005) find that for the US, there exists a significant relation between cyclical movements captured by real GDP growth and ROA. This evidence strongly justifies the use of real GDP growth and the PCA-defined tier 1 leverage ratio as additional control variables for robustness checks. Loans growth and ROA affect credit risk, with the former exercising a positive effect and the latter a negative effect. Finally, the z-score (which is negatively related to default risk) is affected by the credit risk and ROA, with both variables exercising a positive effect.

While the causes of the 2007–2009 financial crisis were multifaceted, it has often been argued that monetary policy has been one of the factors contributing to excessive risk-taking by banks (Taylor, 2009). As a result, a number of authors have referred to a new transmission mechanism of monetary policy, coining the term: ''the risk-taking channel'' (Adrian and Shin, 2009; Borio and Zhu, 2008). Expressed simply, this channel exists where ''low interest rates for too long'' lead to an increase in ''risk tolerance'' by banks. The risk-taking channel operates in two main ways. First, in periods of low interest rates there might be incentives for banks to ''search for yield'' more aggressively. In other words, when interest rates are subdued, banks might be more willing to invest in riskier assets, thereby lowering the yield from these assets. This could be due to contractual, behavioral or institutional reasons (Rajan, 2005). For instance, managers' compensation could be linked to absolute returns, raising the incentives for managers to move towards riskier assets when rates are low. Second, the positive effect of low interest rates on investment valuations and cash flows could also induce banks to take on more risks (Adrian and Shin, 2009). If bank incentives are at the center of the working of the risk-taking channel, it would be expected that individual bank characteristics would have an impact on the effect of monetary policy on the banks' exposure to risk. The aim of our study is to provide an analysis of the effects of these characteristics on risk exposure.

Findings indicate that banks with more Tier I capital and more liquid assets performed better in the initial stages of the crisis (Beltratti and Stultz, 2009; Demirguc- Kunt et al., 2010). Focusing on the impact of capital on bank risk, the theory offers contradictory results. In principle, robust capital levels offer a stronger buffer to withstand losses. More capital also reduces risk-shifting incentives for shareholders towards riskier projects (Mehran and Thakor, 2011). In contrast, a positive relationship between capital and risk can also exist if agency problems between shareholders and managers lead to excessive risk-taking via managerial rent-seeking, or if regulators (or the markets) force riskier banks to build up capital. Overall, the empirical literature tends to support the view that more capital helps banks to increase their probability of survival and their profitability during crises (Berger and Bouwman, 2010).

Altunbas et al. (2012) finds that the interaction between monetary policy looseness and bank characteristics (liquid assets over total assets, core capital-to-asset ratio, market to book value of equity, securitization activity and loan growth) indicates banks with different characteristics adopted different risk positions in the period of unusually accommodative monetary policy. The findings suggest that the insulation effects produced by capital and liquidity buffers against bank risk were lower in countries that experienced a prolonged period of low interest rates and they find that banks that were well-capitalized and highly liquid prior to the crisis suffered a lower level of erosion of their solvency during the 2007–2009 financial crisis. However, the insulation effects produced by capital and liquidity buffers were lower in those countries that, prior to the crisis, experienced a particularly prolonged period of low interest rates. A reduction in illiquidity increases the banking sector's willingness to provide risk capital for real sector investment. On the other hand, it does not imply that banks will become more risky. Rather, there exists a trade-off between external shock risk, which is alleviated by increased asset liquidity, and the risk taking by banks on the returns of their assets, which is encouraged by these market changes. (Santomero and Trester, 1995).

The substantial resources devoted to the design of a Capital Adequacy Framework by central bankers and regulators in the Basel Committee indicate that there is a strong concern about incentives for excessive risk-taking. Bank managers, on the other hand, tend to deny that such incentives exist. However, the incentives need not reveal themselves as deliberate risk-taking. Instead it is the competition among banks with the opportunity to finance their lending activities at a near risk-free interest rate that induces them to prefer debt financing to equity financing. Furthermore, competition for funding will not be based on banks' risk evaluation and risk management skills. Benink and Benston (2005) show how banks' equity capital relative to total assets has declined worldwide from a level of 20–30 percent in the 20s, close to that in non-financial firms, to a level around four percent in the late 80s when the Basel Committee began its work. During this period explicit and implicit guarantees of banks' liabilities were expanding. Risk-shifting and risk-taking incentives are likely to be influenced by bank managers' objectives relative to shareholders' as well.

How does bank capital affect risk? Previous studies focusing on the relationship between capital and risk have mixed results (Aggarwal and Jacques, 1998). Some studies find a positive relationship between capital and risk, meaning regulators encourage banks to increase their capital commensurably with the amount of risk taken, which refers to the 'regulatory hypothesis' (Pettway, 1976; Shrieves and Dahl, 1992; Berger, 1995; Demirgüç-Kunt and Huizinga, 2000; Iannotta et al., 2007; etc.). Nevertheless, opposite results are found in some studies. A negative relationship between capital and risk may refer to the 'moral hazard hypothesis' whereby banks have incentives to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002). For instance, Jahankhani and Lynge (1980), Brewer and Lee (1986), Karels et al. (1989), Jacques and Nigro (1997), and Agusman et al. (2008) show that equity-to-total assets is negatively related to risk. As also indicated by Kahane (1977), Koehn and Santomero (1980), and Kim and Santomero (1988), banks could respond to regulatory actions, forcing them to increase their capital by increasing asset risk (Altunbas et al., 2007).

Boyd et al. (1980) studied the portfolios of banking and non-bank subsidiaries during the seventies and found a potential for risk reduction at relatively low levels of non-bank activities. The results obtained by Kwast (1989) to determine an optimal risk-minimising combination of banking and nonbanking activities for the period 1976–1985 show only a slight potential for risk reduction. Gallo et al. (1996) examined the risk structure of bank holding companies in USA and the effect of mutual fund activities on bank risk and profitability over the period 1987-1994 and found that mutual fund activities moderated bank industry systematic risk and increased the profitability of banks. Similarly, Odesanmi et al.(2007) found that diversification across and within both interest and non-interest income generating activities decreases insolvency risk and diversification gains remain even though increased reliance on non-interest income lowers risk adjusted profits while investigating benefits of revenue diversification for banks in emerging economies. In contrast, another strand of the literature reports no diversification benefits or even an increase in risk with non-interest income activities. According to Boyd and Graham (1986), expansion by BHCs into nonbank activities during the seventies tended to increase the risk of failure of banks during the less stringent policy period. While studying the stock returns of BHCs between 1980 and 1993, Demsetz and Strahan (1997) found that although banks extended their product mixes, no risk reduction could be observed as banks tended to move to riskier activities and to lower their capital ratio.

Kwan (1998), investigated bank section 20 subsidiaries during the 1990–1997 period and found the increased volatility of accounting returns despite a non-increase in bank profitability. DeYoung and Roland (2001) examined the impact of fee-based activities on bank profitability and volatility for large US commercial banks from 1988 to 1995 and found that replacing traditional lending activities with fee-based activities is associated with both higher revenue volatility and higher total leverage. Stiroh (2004) studied potential diversification benefits in the U.S. banking industry both at aggregate level and at bank level.

In the aggregate, declining volatility of net operating revenue reflects reduced volatility of net interest income, not diversification benefits from noninterest income, which is quite volatile and increasingly correlated with net interest income. At the bank level, greater reliance on noninterest income, particularly trading revenue, is associated with lower risk-adjusted profits and higher risk. Stiroh and Rumble (2005), examined whether the observed shift toward activities that generate fees, trading revenue, and other non-interest income had improved the performance of US financial holding companies (FHCs) from 1997 to 2002 and found similar result that diversification gains are more than offset by the costs of increased exposure to volatile activities and has implications for supervisors, managers, investors, and borrowers.
In contrast, Baele and others (2004) showed that diversification of revenue streams from distinct financial activities increases the systematic risk of banks in Europe. Similarly, De Young and Roland (2001) studied the behaviour of 472 U.S. commercial banks between 1988 and 1995 and found that replacing traditional lending activities with fee-based activities is associated with both higher revenue volatility and higher total leverage, which implies higher earnings volatility. Mercieca and other (2006) investigated whether the observed shift into non-interest income activities improved performance of small European credit institutions, using a sample of 755 small banks for the period 1997–2003 and found no direct diversification benefits within and across business lines and an inverse association between non-interest income and bank performance.

Lepetit et al. (2008) investigated the relationship between bank risk and product diversification in the changing structure of the European banking industry for the period 1996–2002 and showed that banks expanding into non-interest income activities present higher risk and higher insolvency risk than banks which mainly supply loans. However, considering size effects and splitting non-interest activities into both trading activities and commission and fee activities they also showed that the positive link with risk is mostly accurate for small banks and essentially driven by commission and fee activities. A higher share of trading activities is never associated with higher risk and for small banks it implies, in some cases, lower asset and default risks.

Hidayat et al. (2012) examined the relationship between product diversification and bank risk over the period of 2002–2008 for Indonesian banks and showed that the effect of product diversification on bank risk depends highly on the bank's asset size. While the degree of product diversification is negatively associated with bank risk for small-sized banks, it is positively related to bank risk for large-sized banks. Pennathur et al. (2012) examined the impact of ownership on income diversification and risk for Indian banks over the period 2001–2009 and found that public sector banks with higher levels of governmental ownership are significantly less likely to pursue non-interest income sources. They also found that default risk is also reduced for these banks and fee-based income significantly reduces risk.

We specifically employ the recent two-step dynamic panel data approach to assess the relationships among banking capital, profitability, and risk. Capital, profitability, and risk should be considered simultaneously when examining the regulatory, SCP, and moral hazard hypotheses, because a change in capital gives rise to a change in banks' profitability and risk. Therefore, the level of capital should be treated as an endogenous variable when we investigate the regulatory and moral hazard hypotheses. The GMM model resolves the possible simultaneity between the degree of capital and profitability (risk) and takes into account the causal effect of the exogenous component. A pioneer research by Pettway (1976) explores the relationship between capital structure and risk for U.S. banks and bank holding companies over the period of 1971 and 1974, surprisingly finding a positive relationship between equity-to-total-assets and risk. Shrieves and Dahl (1992) also adopt U.S. data and reach the same positive result. Similar results are reached by applying Europe data, such as in Rime (2001) and Iannotta et al. (2007).

Some works find opposite results. In a utility maximizing and mean-variance framework, banks with relatively low risk aversion will choose relatively high leverage (low capital) and relatively high asset risk (Kim and Santomero, 1988). Equity-to-total-assets are found to be negatively related to risk (Jahankhani and Lynge, 1980; Brewer and Lee, 1986; Karels et al., 1989; Jacques and Nigro, 1997; and Agusman et al., 2008). The negative relationship between capital and risk may refer to the 'moral hazard hypothesis' that undercapitalized banks take on excessive risk to exploit existing flat deposit insurance schemes (Demirgüç-Kunt and Kane, 2002).

Kwan and Eisenbeis (1997) explore findings that show a positive effect of inefficiency on risk-taking, which supports the moral hazard hypothesis that poor performers are more vulnerable to risk-taking than high performance banks. As for a different country sample, the same result is still found, such as in Altunbas et al. (2007) and Agusman et al. (2008). As noted by Shrieves and Dahl (1992), a positive correlation between capital and risk may result from regulatory costs, the unintended impact of minimum capital requirements; bankruptcy cost avoidance, or risk aversion by bank managers, while a negative correlation may result from the mispricing of deposit insurance. Altunbas et al. (2007) further refer to a positive relationship between capital and risk as the 'regulatory hypothesis', meaning regulators encourage banks to increase their capital commensurably with the amount of risk taken, while a negative relationship may refer to the 'moral hazard hypothesis' that banks have incentives to exploit existing flat deposit insurance schemes.

We find that the implementation of the capital adequacy requirement reduced risk taking at commercial banks. The acceptance of retired government officials on banks boards has an insignificant effect on bank risk. The relationship between the stable shareholders ownership and bank risk is nonlinear; the risk decreases initially with the ownership by stable shareholders, and then increases as the asset substitution effect dominates the effect of managerial entrenchment on bank risk. The decline of franchise value increases bank risk.

3 . Description of the Data and Empirical Methodology

This subsection examines the relationship between product diversification and bank risk in the Indian commercial banking industry. To capture the degree of product diversification of each bank, the average ratio of net non-interest income to net operating income is used from each bank's income statements of annual accounting data from 2001 to 2014. Net operating income is the sum of net interest income and net non-interest income. Net non-interest income is computed as revenues from commissions and fees and from foreign exchange plus gains on investment in securities minus losses on investment in securities and foreign exchange transactions. Net interest income stems from traditional banking activities, while net non-interest income stems from non-traditional activities.

To capture insolvency risk for each bank, annual accounting data is used to calculate the Z-score (ADZ) which indicates the probability of bank failure (Boyd & Graham, 1986):

$$ADZ = \frac{\text{ROA} + \text{EA}}{\text{SDROA}} \qquad Eq(3.0)$$

Where, ROA is the average return on asset and SDROA is the standard deviation of the ROA over the sample period.

Stiroh (2004) and others regard non-interest income activities as a measure of the degree of non-banking activities or product diversification. Furthermore, as a product diversification measure for each bank, Stiroh (2004), De Young and Roland (2001), and Lepetit et al. (2008) divide net non-interest income into two components: the average ratio of net fee and commission income to net operating income (COM) and the average ratio of net trading income to net operating income (TRAD). This decomposition of non-interest income may be appropriate for the analysis of risk with implications for different types of financial products.

According to the literature, panel data analysis is used for analyzing commercial banks' risk taking behavior. This method is useful for identifying and measuring the effects that are simply not detectable in pure cross-section or pure time-series data. Panel data model is used to deal with the problem of heterogeneity. In addition, it can also be used to investigate the dynamic of change due to external factors which may affect dependent variables. Basically, panel data methodology comprises static and dynamic models. Static models again can be differentiated in terms of group effects, time effects, and both time and group effects. These effects are either fixed effect or random effect. A fixed effect model assumes differences in intercepts across groups or time periods, whereas a random effect model explores differences in error variances. Static panel data models are based on a key assumption, i.e., the absence of correlation between the error components with the explanatory variables. However, these models may cause the emergence of endogeneity problems so that when the model is estimated with the approach fixed-effect and random-effects estimator will produce biased and inconsistent (Verbeek, 2008). To solve the problem using static panel data, Arellano and Bond (1991) proposed an approach known as the Generalized Methods of Moments (GMM). This method helps to provide a more useful framework for comparison and assessment, and a simple alternative to other estimators, especially against the maximum likelihood. It is from this perspective that we have used the dynamic panel data methodology.

According to the literature, theoretical arguments in favour of using dynamic panel data model for analysing risk taking decisions of banks derive from asymmetric information and adverse selection perspective.

The main feature of a dynamic panel data specification is the inclusion of a lagged dependent variable in the set of explanatory variables i.e.

$$y_{i,t} = \alpha y_{i,t-1} + \beta(L)X_{i,t} + \eta_i + \varepsilon_{i,t}, |\alpha| < 1, i = 1, \dots, N, t = 1, \dots, T \qquad Eq(3.1)$$

where the subscripts i and t denote the cross sectional and time dimension of the panel sample respectively, $y_{i,t}$ is the ADZ, $\beta(L)$ is the lag polynomial vector, X_{it} *is* $(1 \times k)$ vector of explanatory and control (viz., Total assets, CRAR, LDR, Other income ratio, Fee income ratio , Forex income, Trading income ratio, banks market share and size, inflation, and GDP growth)) variables other than $y_{i,t-1}$, η_i is the unobserved individual (bank specific) effects and $\varepsilon_{i,t}$ are the error terms.

As the lagged dependent variable, $y_{i,t-1}$ is inherently correlated with the bank specific effects, η_i, OLS estimation methods will produce biased and inconsistent parameters estimates. Equation (3.1) is consistently estimated utilizing the Generalized Method of Moments (GMM) as proposed by Arellano and Bond (1991) and generalized by Arellano and Bover (1995) and Blundell and Bond (1998). The GMM estimation of Arellano and Bond (1991) is based on the first difference transformation of equation (3.1) and the subsequent elimination of bank-specific effects:

$$\Delta y_{i,t} = \alpha \Delta y_{i,t-1} + \beta(L)\Delta X_{i,t} + \Delta\varepsilon_{i,t}, \qquad i = 1, \dots, N, t = 1, \dots, T \qquad Eq(3.2)$$

where Δ is the first difference operator. In equation (3.2), the lagged dependent variable, Δy_{it-1} is, by construction, correlated with the error term, $\Delta\varepsilon_{it}$ imposing a bias in the estimation of the model. Nonetheless, y_{it-2}, which is expected to be correlated with Δy_{it-1} and not correlated with $\Delta\varepsilon_{it}$ for $t = 3,\dots,T$, can be used as an instrument in the estimation of (3.2), given that ε_{it} are not serially correlated. This suggests that lags of order two, and more, of the dependent variable satisfy the following moment conditions:

$$E[y_{i,t-s}\Delta\varepsilon_{i,t}] = 0 \; for \; t = 3, \dots, T \; and \; s \geq 2 \qquad Eq(3.3)$$

A second source of bias stems from the possible endogeneity of the explanatory variables and the resultant correlation with the error term. In the case of *strictly exogenous* variables, all past and future values of the explanatory variable are uncorrelated with the error term, implying the following moment conditions:

$$E[X_{i,t-s}\,\Delta\varepsilon_{i,t}] = 0, \qquad t = 3, \dots, T \; and \; for \; all \; s. \qquad Eq(3.4)$$

The assumption of strict exogeneity is restrictive and invalid in the presence of reverse causality i.e. when $E[X_{is}\varepsilon_{it}] \neq 0$ for $t < s$. For a set of *weakly exogenous* or *predetermined* explanatory variables, only current and lagged values of X_{it} are valid instruments and the following moment conditions can be used:

$$E[X_{i,t-s}\, \Delta\varepsilon_{i,t}\ ] = 0, \qquad t = 3,\ldots,T \text{ and for } s \geq 2. \qquad Eq(3.5)$$

The orthogonality restrictions described in (3.3) – (3.5) form the underpinnings of the one-step GMM estimation which produces, under the assumption of independent and homoscedastic residuals (both cross-sectionally and over time), consistent parameter estimates. Arellano and Bond (1991) propose another variant of the GMM estimator, namely the two-step estimator, which utilizes the estimated residuals in order to construct a consistent variance covariance matrix of the moment conditions. Although the two-step estimator is asymptotically more efficient than the one-step estimator and relaxes the assumption of homoscedasticity, the efficiency gains are not that important even in the case of heteroscedastic errors (e.g. see Arellano and Bond (1991), Blundel and Bond (1998) and Blundell et al. (2000)). This result is further supported by the empirical findings of Judson and Owen (1999), who performed Monte Carlo experiments for a variety of cross sectional and time series dimensions and showed that the one-step estimator outperforms the two-step estimator. Moreover, the two-step estimator imposes a downward (upward) bias in standard errors (t-statistics) due to its dependence to estimated values (as it uses the estimated residuals from the one-step estimator) (Windmeijer, 2005), which may lead to unreliable asymptotic statistical inference (Bond, 2002, Bond and Windmeijeir, 2002). This issue should be taken into account, especially in the case of data samples with relatively small cross section dimension (Arellano and Bond, 1991 and Blundell and Bond, 1998).

As noted above, the validity of the instruments used in the moment conditions as well as the assumption of serial independence of the residuals is crucial for the consistency of the GMM estimates. In line with the dynamic panel data literature, we test the overall validity of the instruments using the Sargan specification test proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundel and Bond (1998). The Sargan test for over-identifying restrictions is based on the sample analog of the moment conditions used in the estimation process so as to determine the suitability of the instruments. Under the null hypothesis of valid moment conditions, the Sargan test statistic is asymptotically distributed as chi-square. Furthermore, the fundamental assumption that the errors, ε_{it}, are serially uncorrelated can be assessed by testing for the hypothesis that the differenced errors, $\Delta\varepsilon_{it}$ are not second order autocorrelated. Rejection of the null hypothesis of no second order autocorrelation of the differenced errors implies serial correlation for the level of the error term and thus inconsistency of the GMM estimates. However, as noted by Roodman (2009), the system GMM can generate moment conditions prolifically. Too many instruments in the system GMM over fits endogenous variable even as it weakens the Hansen test of the instruments' joint validity. Therefore, in order to deal with the instruments proliferation, this study will use two main techniques in limiting the number of instruments – such as using only certain lags instead of all available lags for instruments and combining instruments through addition into smaller sets by collapsing the block of the instrument matrix.

This study has used one-step system GMM estimation. However, for robustness checking, the two-step estimation in the system GMM was also considered. The success of the GMM estimator in producing unbiased, consistent and efficient results is highly dependent on the adoption of the appropriate instruments. Therefore, there are three specifications tests as suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). First, the Hansen test of over-identifying restrictions, which tests the overall validity of the instruments by analysing the sample analogue of the moments conditions used in the estimation process. If the moment condition holds, then the instrument is valid and the model has been correctly specified. Second, it is important to test that there is no serial correlation among the transformed error term. Third, to test the validity of extra moment's conditions on the system GMM, the difference in Hansen test is used. This test measures the difference between the Hansen statistic generated from the system GMM and the difference GMM. Failure to reject the three null hypotheses gives support to the estimated model.

Table.1 Data definition

Variable Name	Definition
ADZ	Z-Score
lnTA	Log Total Asset
GTA	Growth in Total Asset
LDR	Loan-Deposit Ratio
feeinc	Fee Income
forexinc	Forex Income
Tradinc	Trading Income
oyr	Other Income Ratio
xsizeta	Bank Size in terms of asset market share
crar	Capital to Risk Weighted Ratio
zinf	Inflation
zgy	GDP growth

Table.2 Summary statistics of the variables

Variable	Mean	Std. Dev.	Min	Max
ADZ	1.38	0.42	0.60	4.18
lnTA	10.40	1.31	6.31	13.98
GTA	4.17	6.32	-30.17	135.16
LDR	65.09	12.16	26.06	165.81
feeinc	13.12	7.67	-15.54	55.88
forexinc	3.66	5.14	-24.28	135.30
tradinc	8.49	13.30	-181.74	67.44
oyr	14.38	6.15	-1.47	43.74
xsizeta	2.04	2.88	0.03	23.47
crar	9.38	4.35	-17.86	58.91
zinf	6.05	2.58	0.54	11.02
zgy	7.43	2.15	1.66	11.30

Table.3 Estimation results for the entire samples

Variable	Static Panel Data Model Estimates				Dynamic Panel Data Model Estimates			
ADZ	OYR	Fee	Forex	Trading	OYR	Fee	Forex	Trading
ADZ_{t-1}	-	-	-	-	0.578*** (19.56)	0.592*** (17.99)	0.556*** (17.87)	0.583*** (18.94)
	0.004*** (3.82)	-0.001 (-1.39)	0.005*** (5.02)	0.0009 (-1.01)	0.002*** (7.77)	0.000 (-0.23)	0.002*** (5.52)	0.000 (0.87)
lnTA	0.006 (0.51)	-0.003 (-0.23)	-0.007 (-0.63)	-0.003 (-0.27)	0.019* (1.65)	0.029** (2.3)	0.026** (2.42)	0.034*** (2.91)
GTA	0.001 (1.53)	0.001** (1.89)	0.001** (1.71)	0.001** (1.93)	0.000 (-0.49)	0.000 (0.28)	0.000 (-0.35)	0.000 (-0.32)
eqTA	0.073*** (17.19)	0.073*** (17.15)	0.072*** (17.00)	0.072*** (16.99)	0.031*** (18.65)	0.032*** (16.77)	0.032*** (14.00)	0.032*** (16.74)
Xcrar	-0.053*** (-17.69)	-0.054*** (-17.62)	-0.053*** (-17.54)	-0.053*** (-17.52)	-0.031*** (-14.76)	-0.032*** (-12.21)	-0.033*** (-10.08)	-0.034*** (-10.02)
LDR	-0.013*** (-24.20)	-0.013*** (-25.11)	-0.013*** (-24.40)	-0.013*** (-25.05)	-0.007*** (-27.52)	-0.008*** (-21.66)	-0.008*** (-29.85)	-0.008*** (-25.77)
Zinf	0.004** (2.22)	0.003** (1.96)	0.003* (1.85)	0.003* (1.74)	0.002*** (5.30)	0.002*** (5.65)	0.001*** (4.31)	0.001*** (4.05)
Zgy	-0.001 (-0.35)	0.001 (0.01)	0.0001 (-0.08)	-0.001 (-0.35)	-0.002*** (-4.46)	-0.002*** (-3.41)	-0.002*** (-3.25)	-0.001*** (-3.27)
Xsizeta	-0.004 (-0.5)	-0.001 (-0.11)	-0.002 (-0.29)	-0.002 (-0.20)	0.009 (1.07)	0.018 (0.86)	0.013* (1.71)	0.011 (1.21)
_cons	2.129*** (20.32)	2.296*** (23.20)	2.287*** (23.50)	2.295*** (22.99)	0.899*** (8.26)	0.817*** (9.17)	0.900 (7.81)	0.817*** (8.06)

Note: (i) ***, ** and * indicate the level significance at the 1%, 5% and 10% , respectively and (ii) values in parenthesis represents t-statistics and z-statistics for static and dynamic panel data models, respectively.

Table.4 Estimation results for the public sector banks

Variable	Static Panel Data Model Estimates				Dynamic Panel Data Model Estimates			
ADZ	OYR	Fee	Forex	Trading	OYR	Fee	Forex	Trading
ADZ_{t-1}					0.364** (2.35)	0.454*** (6.46)	0.475*** (3.89)	0.410*** (2.91)
	0.006*** (4.20)	-0.003** (-2.24)	-0.004 (-1.42)	0.001 (1.17)	0.003*** (2.81)	-0.001 (-0.93)	-0.001 (-0.85)	0.001** (2.42)
lnTA	0.018 (0.96)	0.0009 (0.02)	0.005 (0.25)	0.003 (0.17)	0.049 (0.74)	0.001 (0.02)	0.012 (0.15)	0.042 (0.58)
GTA	-0.002* (-1.69)	-0.001 (-0.8)	-0.001 (-0.92)	-0.001 (-1.07)	-0.002** (-2.08)	-0.002 (-1.47)	-0.001 (-1.23)	-0.001 (-1.39)
eqTA	0.039*** (3.11)	0.036*** (2.83)	0.034*** (2.72)	0.036*** (2.83)	0.035* (1.82)	0.058*** (2.65)	0.056** (2.32)	0.033* (1.79)
Xcrar	-0.039*** (-6.23)	-0.038*** (-5.96)	-0.037*** (-5.77)	-0.037*** (-5.83)	-0.048*** (-4.02)	-0.081*** (-3.88)	-0.062*** (-3.11)	-0.044*** (-3.58)
LDR	-0.009*** (-7.01)	-0.01*** (-7.29)	-0.010*** (-7.51)	-0.010*** (-7.25)	-0.007*** (-4.53)	-0.009*** (-4.33)	-0.009*** (-4.45)	-0.007*** (-4.81)
Zinf	-0.001 (-0.33)	-0.001* (-0.53)	-0.001 (-0.29)	0 (-0.02)	-0.002* (-1.66)	-0.001 (-1.1)	-0.001 (-0.93)	-0.001 (-0.68)
Zgy	0.004 (1.59)	0.006*** (2.49)	0.006** (2.39)	0.006*** (2.6)	0.001 (0.99)	0.001 (0.8)	0.002 (1.26)	0.003*** (2.91)
Xsizeta	0.021* (2.08)	0.014 (1.43)	0.015 (1.51)	0.016* (1.64)	0.028 (0.5)	0.05 (0.74)	0.032 (0.51)	0.014 (0.23)
_cons	1.619*** (9.11)	1.953*** (11.41)	1.890*** (11.24)	1.859*** (11.02)	0.796 (1.13)	1.513* (1.67)	1.2 (1.26)	0.841 (1.09)

Note: (i) ***, ** and * indicate the level significance at the 1%, 5% and 10% , respectively and (ii) values in parenthesis represents t-statistics and z-statistics for static and dynamic panel data models, respectively.

Table. 5 Estimation results for the private sector banks

Variable	Static Panel Data Model Estimates				Dynamic Panel Data Model Estimates			
ADZ	OYR	Fee	Forex	Trading	OYR	Fee	Forex	Trading
ADZ_{t-1}					0.333 (1.18)	0.417 (1.23)	0.337 (1.53)	0.406 (1.28)
	-0.001 (-1.25)	0.0009 (0.13)	0.000 (0.20)	-0.001*** (-2.65)	0 (-0.4)	0.001 (1.18)	0.002 (1.01)	0 (-1.26)
lnTA	-0.052*** (-3.98)	-0.047*** (-3.78)	-0.048*** (-3.79)	-0.052*** (-4.12)	0.011 (0.1)	0.048 (0.37)	0.082 (0.49)	0.039 (0.29)
GTA	0.0009 (0.81)	0.0009 (0.66)	0.0009 (0.65)	0.0009 (0.73)	-0.001 (-0.69)	-0.002* (-1.74)	-0.001** (-2.12)	-0.001* (-1.65)
eqTA	0.069*** (17.16)	0.069*** (17.01)	0.069*** (17.05)	0.069*** (17.11)	0.025*** (4.68)	0.026*** (5.05)	0.038*** (8.97)	0.026*** (4.92)
Xcrar	-0.051*** (-16.59)	-0.051*** (-16.42)	-0.051*** (-16.49)	-0.050*** (-16.55)	-0.033*** (-7.49)	-0.033*** (-6.86)	-0.029*** (-6.48)	-0.033*** (-7.18)
LDR	-0.009*** (-15.88)	-0.009*** (-15.8)	-0.009*** (-15.76)	-0.009*** (-16.21)	-0.002 (-0.55)	-0.005 (-1.38)	-0.005*** (-5.32)	-0.005 (-1.24)
Zinf	0.003 (1.35)	0.003 (1.47)	0.003 (1.48)	0.002 (0.87)	-0.001 (-0.41)	0 (-0.33)	0.001 (0.46)	0 (-0.29)
Zgy	-0.003 (-1.43)	-0.003 (-1.29)	-0.003 (-1.27)	-0.005** (-2.03)	0 (-0.18)	-0.001 (-0.59)	-0.002 (-1.12)	-0.001 (-0.47)
Xsizeta	-0.049*** (-4.44)	-0.053*** (-4.9)	-0.053*** (-5.01)	-0.05*** (-4.76)	-0.13 (-0.63)	-0.017 (-0.09)	-0.011 (-0.18)	-0.033 (-0.18)
_cons	2.567*** (21.56)	2.493*** (23.44)	2.496*** (23.82)	2.577*** (23.71)	1.267 (1.03)	0.844 (0.56)	0.509 (0.33)	0.953 (0.62)

Note: (i) ***, ** and * indicate the level significance at the 1%, 5% and 10% , respectively and (ii) values in parenthesis represents t-statistics and z-statistics for static and dynamic panel data models, respectively.

Table.6 Estimation results for the small sized banks

Variable	Static Panel Data Model Estimates				Dynamic Panel Data Model Estimates			
ADZ	OYR	Fee	Forex	Trading	OYR	Fee	Forex	Trading
ADZ_{t-1}	-	-	-	-	0.495*** (4.20)	0.304** (1.99)	0.540*** (5.44)	0.269* (1.82)
	0.001 (1.53)	-0.001 (-1.02)	0.003* (1.75)	0.000 (-1.42)	0.000 (-0.78)	-0.001 (-1.58)	0.002*** (3.12)	0.000** (-2.41)
lnTA	0.008 (0.66)	0.003 (0.26)	0.003 (0.23)	0.003 (0.29)	0.065 (0.87)	0.012 (0.18)	0.052 (0.99)	0.000 (0.14)
GTA	-0.001** (-2.03)	-0.001* (-1.8)	-0.001* (-1.72)	-0.001* (-1.74)	-0.001 (-1.59)	-0.001* (-1.69)	-0.001*** (-2.33)	-0.001** (-2.12)
eqTA	0.076*** (16.72)	0.076*** (16.92)	0.075*** (16.65)	0.076*** (16.97)	0.046*** (6.62)	0.031*** (4.52)	0.052*** (8.15)	0.044*** (6.59)
xcrar	-0.056*** (-17.27)	-0.056*** (-17.53)	-0.055*** (-17.24)	-0.056*** (-17.56)	-0.038*** (-14.14)	-0.036*** (-18.77)	-0.040*** (-15.62)	-0.036*** (-14.17)
LDR	-0.013*** (-14.64)	-0.013*** (-15.47)	-0.013*** (-15.22)	-0.014*** (-15.57)	-0.008*** (-15.44)	-0.008*** (-13.79)	-0.008*** (-12.13)	-0.008*** (-14.67)
zinf	0.002 (1.22)	0.002 (1.22)	0.002 (1.19)	0.002 (0.94)	0.000 (-0.74)	-0.001 (-1.21)	0.000 (-0.66)	-0.001 (-1.15)
zgy	0.007*** (3.43)	0.007*** (3.48)	0.007*** (3.5)	0.006*** (2.92)	-0.003*** (-3.55)	-0.003*** (-4.3)	-0.002** (-2.38)	-0.002** (-2.42)
_cons	2.023*** (18.81)	2.121*** (22.09)	2.095*** (22.24)	2.135*** (22.02)	0.646 (0.89)	1.490** (2.42)	0.636 (1.18)	1.53** (2.31)

Note: (i) ***, ** and * indicate the level significance at the 1%, 5% and 10% , respectively and (ii) values in parenthesis represents t-statistics and z-statistics for static and dynamic panel data models, respectively.

Table.7 Estimation results for the large sized banks

Variable	Static Panel Data Model Estimates				Dynamic Panel Data Model Estimates			
ADZ	OYR	Fee	Forex	Trading	OYR	Fee	Forex	Trading
ADZ_{t-1}	-	-	-	-	0.474*** (6.43)	0.471*** (4.16)	0.294*** (2.47)	0.419*** (4.36)
	0.008*** (4.47)	0.000 (-0.15)	0.004*** (3.37)	0.000 (0.32)	-0.001 (-0.74)	0.001 (1.03)	0.002*** (3.15)	0.000 (-0.19)
lnTA	-0.003 (-0.14)	-0.013 (-0.68)	-0.018 (-0.97)	-0.013 (-0.68)	0.130* (1.88)	-0.022 (-0.52)	0.020 (0.36)	0.06 (1.08)
GTA	0.002** (2.22)	0.002** (2.38)	0.002** (2.14)	0.002** (2.37)	0.000 (-0.2)	0.001 (1.24)	0.000 (-0.13)	0.000 (0.14)
eqTA	0.071*** (9.62)	0.069*** (9.17)	0.069*** (9.35)	0.069*** (9.23)	0.076*** (4.29)	0.057*** (3.32)	0.057*** (3.15)	0.046*** (3.31)
xcrar	-0.050*** (-10.18)	-0.048*** (-9.43)	-0.048*** (-9.78)	-0.048*** (-9.63)	-0.106*** (-4.16)	-0.086*** (-3.43)	-0.093*** (-3.74)	-0.071*** (-4.00)
LDR	-0.012*** (-15.16)	-0.012*** (-15.43)	-0.012*** (-15.04)	-0.012*** (-15.28)	-0.010*** (-8.62)	-0.008*** (-8.11)	-0.009*** (-9.8)	-0.008*** (-11.2)
zinf	0.005* (1.71)	0.004 (1.30)	0.003 (1.18)	0.004 (1.35)	0.001 (1.45)	0.002*** (2.57)	0.001 (1.21)	0.001 (1.18)
zgy	-0.010*** (-2.94)	-0.008** (-2.35)	-0.008** (-2.39)	-0.007** (-2.24)	-0.004*** (-2.87)	-0.001 (-1.24)	-0.002 (-1.55)	-0.003*** (-2.63)
_cons	2.196*** (11.81)	2.420*** (13.17)	2.442*** (13.54)	2.409*** (13.21)	0.430 (0.70)	1.948*** (3.61)	1.842*** (3.08)	1.046* (1.89)

Note: (i) ***, ** and * indicate the level significance at the 1%, 5% and 10% , respectively and (ii) values in parenthesis represents t-statistics and z-statistics for static and dynamic panel data models, respectively.

The Sargan and the serial-correlation tests do not reject the null hypothesis of correct specification, which means that we have valid instruments and no serial correlation. For the full sample the empirical results reveal that increasing Indian banking capital will decrease bank's risk. In terms of persistence, banks' risk is significantly increasing, showing that the previous period of risk will be enhanced in the next period.

The significant results associated with the risk measure based on the Z-score (ADZ) suggest that the effect of product diversification on bank is highly dependent on the banks' asset size and ownership. The degree of product diversification is negatively associated with bank and insolvency risk for small-sized banks, while the degree of product diversification is positively related to bank and insolvency risks for large-sized banks. The results of the size-dependent link between product diversification and bank risk in Table 6 and 7, illustrate the critical role of asset size and the differential directional effect of product diversification on bank risks.

Product diversification reduces bank risk for banks with a lower TA, while it increases bank risk for banks with a higher TA. Product diversification reduces bank risk for public sector banks, while it increases bank risk for private sector banks. Concerning the results of other control variables, the coefficients on the growth rate of total assets (DLOG(TA)), and the ratio of loans to deposits (LDR) are insignificant for all model specifications. This finding implies that bank risks appear not to be related to asset growth, the ratio of loans to deposits. Moreover, the coefficients on the capital ratio (EQUITY) in the ADZ equations are significantly positive. This finding implies that the capital ratio is positively related to bank risk.

For a further investigation of the relationship between product diversification and bank risk in relation to bank size, we divide non-interest income into trading activities and commission and fee activities. These activities are considered alternative measures of product diversification based on the work of Lepetit et al. (2008) on the European banking industry. Table 3-7 present the results for the case where the average ratio of net commission and fee income to net operating income (FEE_COM) and the average ratio of net trading income to net operating income (TRAD) represent product diversification, instead of NNII. On the other hand, the coefficient on the average ratio of net trading income to net operating income (TRAD) is significantly positive. Taken together, these results suggest that commission and fee activities could intensify bank risk while the impact of trading activities on bank risk is less clear. The intensified risk associated with commission and fee activities might support the finding that earnings volatility of these activities is relatively high.

The results are summarized as follows. First, banks with a high level of NNII are associated with low ratios of loans and deposits to assets (LOAN, DEPO) and a high capital ratio (CRAR). These banks are less dependent on traditional financial intermediation activities with less capital leverage. Second, banks with a high level of NNII are associated with large size total assets (TA). This implies that large banks tend to intensify product diversification. De Young and Roland (2001) posit that a possible reason may be that non-interest income activity requires significant fixed costs. Third, concerning the relationship between bank risks and non-interest income activities, the banks with a higher NNII display higher bank risks and higher insolvency risk (smaller ADZ). In sum, these findings seem to be consistent with previous results from univariate mean tests by Lepetit et al. (2008) in that non-interest income is positively associated with bank risk and insolvency risk for European banks.

Conclusions

This study has examined risk implications of the recent trends regarding diversified financial products that is provided by banks with additional sources of income in the Indian banking industry. Our study provides clear evidence that product diversification causes small-sized banks to reduce bank risk successfully but magnifies bank risk for large-sized banks. The results in the Indian banking industry are different from those of Lepetit et al. (2008) in the European banking industry. Furthermore, the results from our models demonstrate, to different extents, that greater reliance on commission and fee activities is associated with higher bank risk in terms of earnings volatility particularly for small-sized banks.

Our results have important policy implications related to bank supervision from the perspective of bank risk in the Indian banking industry. The argument that product diversification increases bank risk for large-sized banks suggests that deregulation practices that encourage banks to pursue non-traditional activities may adversely affect the banking system due to the sizeable market share of large-sized banks. Thus, the financial authorities, including Reserve Bank of India, must carefully monitor large banks' behavior related to various bank and insolvency risks, such as credit risk, market risk, liquidity risk, and operational risk, under the Basel II Accord framework. In particular, strict monitoring policies to reduce bank risk might be needed for large-sized banks.

It should be noted that our regression analysis has some limitations. For example, we have focused on the discussion about how product diversification affects risk measures in relation to banks' asset size. However, when we examine the role of product diversification, the analysis should take into account not only bank risk but also bank profitability or efficiency due to their close interactions. More careful and extensive examination about the relationship among product diversification, bank risk, and bank profitability should be conducted to understand the in-depth feature of the Indian banking industry. Next, our empirical analysis is based on averaged data over the small sample period from 2001 to 2014. The small sample may cause substantial sample biases in our estimation results. Moreover, the use of averaged data cannot enable us to capture the dynamic aspects, including structural changes, although the Indian banking industry has been developing rapidly with continuous changing environments.

Another direction to look into is to incorporate market-based risk measures. The market-based risk measures can supplement traditional analysis, which is based on financial accounting statements, with forward-looking information from security prices. Most large banks are now listed on the Indian Stock Exchanges, and thus face regulatory monitoring and the daily scrutiny of stock market participants. Finally, to date, there has been no empirical and theoretical work performed on these important issues in the Indian banking industry. Although we admit that it is challenging to verify empirically these important problems due to a lack of data, we hope that the results derived in this paper can be a good starting point and benchmark to test the relationship between product diversification and bank risk taking behavior in India.

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