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**Business Strategy and Systemic Risk - Evidence from  
Indian Banks**

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## **Business Strategy and Systemic Risk - Evidence from Indian Banks**

### **Abstract**

This study examines the impact of business strategic choices on systemic risk using unique panel data from banks in India, for a 29-quarter period. Based on the publicly available quarterly revenue information on business segments, the study will associate the revenue segment information with choices related to business strategies of banks and allow equity prices to predict systemic risk associated with strategic choices related to focus, diversification and differentiation.

The results of panel data analysis show that systemic risk is reduced if state-owned banks focus less on corporate segments, consistent with prior empirical evidence. The study also find that diversifying across business segments by a private sector bank, reduces systemic risk, which is in contrast to the international evidence. Further, this study do not find any impact of differentiation strategy on systemic risk, which is also in contrast to international evidence.

**Keywords:** Business Strategy, differentiation, wholesale banking, Systemic Risk

## 1 Introduction

When trying to understand a major crisis in which substantial fraction of the banking system is endangered, the focus on the characteristics of institutions that may fail is potentially important as all banks need not contribute equally to the risk parole of stability of the banking system (De Jonghe, 2008); the differences in risk may stem from their strategic choices.

The strategic choices of banks are important from a systemic perspective. A failing bank may trigger spill-over effects that the bank does not take into account when choosing its business strategy (Jaeger-Ambrozewicz, 2012). During the recent crisis, regulators enhanced their level of monitoring subjecting the main banks to stress tests and prompted managers to implement strategies that would decrease their risk (Calluzzo & Dong, 2015). It is important to know how banks have changed their business strategies and how such changes have shown up in the changes of their contribution to systemic risk (Calluzzo & Dong, 2015).

The fundamental strategic decision of a commercial bank includes the selection of assets or investments in various sectors of the economy (Deepphouse, 1999). It is important to understand such asset/revenue allocation decisions from the view of systemic risk. This dissertation associate the bank's asset/revenue allocation information with their choices related to business strategies each from the perspectives of Corporate focus, Diversification, and Differentiation. Banks at times being aggressive may seek to take advantage of the large scale of credit demand from corporates during the preceding credit boom to expand their market share. Such a strategic choice of Corporate focus creates a high level of credit risk (lending to relatively risky borrowers) with further increase in systemic risk (Besar, Booth, Chan, Milne, & Pickles, 2011). There is literature (Wagner, 2010) which examines the impact of Diversification Strategy on systemic risk. This strategic choice reduces diversity and thereby increases systemic risk by increasing the similarity of banks' asset portfolios and further increasing the system's sensitivity to aggregate fluctuations (Alessandri & Haldane, 2009).

The more differentiation in asset allocation across banks, the less likely it is that the banking system will lack resilience, and, consequently, the less financial stability will be at risk (Calmès & Théoret, 2014).

There are number of reasons because of which this study believes that systemic risk is an important issue to be examined in the Indian context. Firstly, systemic risk could generate

losses due to contagion, beyond the immediate losses on record of the bankruptcy of large corporate groups (RBI, December 2013). Secondly, rise in proportion of risky assets in the total assets of Scheduled commercial banks (SCBs) is becoming more broad-based involving more banks (RBI, December 2013). Thirdly, deteriorating asset quality and soundness of Indian banks is contributing to the decline in stability of the banking system (RBI, December 2012). Fourthly, to assess systemic risk in India, RBI has established *Financial Stability Unit* in 17 July 2009 (Raghuraj, 13 August 2009) and created central repository (of large credits) on 11 September 2013 to be shared with the banks for enabling them to be aware of common exposures (RBI-Circular, 11 September 2013).

There are number of motives in examining if strategic choices of banks will have an impact on systemic risk in India. Firstly, banks are having significantly higher exposure (of the net worth) on single large corporate group (RBI, March 2010). This could generate losses due to contagion, beyond the immediate losses on record of the bankruptcy of large corporate groups (RBI, December 2013).

Secondly, the impact of business strategy on systemic risk gets affected by the regulatory interferences under different ownership structures. For example, PSBs paid attention to the government's post-crisis call and took part on a much larger scale than private banks in infrastructure financing. Subsequently, the stoppage of many large infrastructure projects and interest rate hikes affected PSBs<sup>1</sup>.

Thirdly, Strategic Diversification strengthens the medium term stability (RBI, June 2011) and makes the financial sector mature when it serves different segments, varying from retail to wholesale (Gandhi, May 2015). Fourthly, lack of strategic differentiation indicates that the rise in proportion of risky assets in the total assets of all banks is becoming more broad-based involving more banks (RBI, December 2013).

Fifthly, a wider range of markets and financial tools offers banks an opportunity to differentiate themselves by implementing their own specific business strategy which reduces common exposure of two banks to shocks (Allenspach & Monnin, 2009). It is imperative to know how changes in business strategy of banks under different ownerships will show up in the changes of systemic risk.

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<sup>1</sup> Goyal, A. (2014, October 06, 2014). Banking on diversity, *Indian Express*.

RBI guidelines on AS-17 Segment Reporting, applicable from 30 September 2007 stipulate that banks are required to report quarterly segment information on revenue with enhanced disclosures (RBI-Circular, 19 December 2006). The third study contributes to the existing literature by hand-collecting unique dataset that allows us simple distinction between wholesale, retail and treasury business of banks and associate them with strategic choices to understanding their impact on bank's contribution to systemic risk.

The rest of the study is organized as follows: Section 2 reviews the related literature on systemic risk and business strategies. Research question and hypothesis formulation are presented in Section 3. Section 4 discusses the Methodology, data & Summary Statistics. The relationship between business strategies and systemic risk is investigated in Section 5. Section 6 concludes this study.

## **2 Literature Review**

Single institution's risk measure does not necessarily reflect systemic risk – the risk that the stability of the financial system as a whole is threatened (Adrian & Brunnermeier, 2011).

Contagion is rare but can nonetheless wipe out a major part of the banking system (Elsinger, Lehar, & Summer, 2006) and has significant effect on the real economy (V. V. Acharya & Skeie, 2011; Calluzzo & Dong, 2015; Demirguc-Kunt, Detragiache, & Merrouche, 2013; Giannone, Lenza, Pill, & Reichlin, 2012; Reichlin, 2014).

Loretan (1996) argued that from a functional viewpoint, the financial system of an economy helps to serve three main tasks: (a) credit allocation, for example, through bank loans, but also through commercial paper, bonds, and stock; (b) the payments system; and (c) the pricing of financial assets. Shocks that can seriously affect any of these three functions of the financial system may regarded as “systemic” events.

Financial markets undergo regular bouts of systemic path dependence that influence their functioning and stability as well as investment returns and volatility (El-Erian & Spence, 2012). It is important to know how systemic risk is created in the economy. Losses to creditors are considered as graver than losses to shareholders, who are supposed to be less risk averse. This is especially true for depositors, who consider these funds as the safest and most liquid component of their wealth portfolios. Thus, the "harm" is greater and their reaction in altering their portfolios to avoid further losses is more serious (Kaufman, 1996).

Owing to their constant lending to and borrowing from each other and the necessity to pay other banks for third-party transfers, banks are more tightly financially interconnected with each other than are the other types of firms. Thus, banks are widely considered to be especially vulnerable to systemic risk, and shocks at any one bank are considered to be to be swiftly relayed to other banks, which in turn can relay the shock to the rest of the banks in the chain (Kaufman, 1996).

The unfavourable cumulative effects of the initial shock increase because bank deposits constituted the larger part of money supply of most countries. As a result, depositors experiencing losses are likely to cut back on their spending by more than they would for an equal dollar reduction in other, less liquid forms of wealth. Such cutbacks will decrease the income of other agents and hence their spending. Any impact of the reduced money supply, however, may be offset through deposit expansion by solvent banks that now have excess reserves or by the central bank through the injection of additional reserves (Kaufman, 1996). Several elements of investment strategy – including bank lending (Calluzzo & Dong, 2015), asset allocation (El-Erian & Spence, 2012), asset diversification (Calluzzo & Dong, 2015)— can be affected by systemic risk (El-Erian & Spence, 2012). It is thus essential for the development of good strategy to capture and process the content of systemic thinking and the related elements of risk and opportunity on an efficient and effective basis (Mark Haynes, 2000).

The fundamental strategic decision of a commercial bank includes the selection of assets or investments in various sectors of the economy (Deephouse, 1999). Many of the banking failures during the crisis, and their systemic ramifications, could have presumably been avoided if the high-risk nature of the assets at some banks had become apparent at an earlier stage (Knaup & Wagner, 2012). The quality of the selected assets by banks has an impact on systemic risk. The asset quality problems could be contagious from the fact that their downside impact can quickly transmit to earnings, capital, and liquidity. NPAs produce a chain reaction of effects on the sustainability and growth of the banking system, and if not dealt with properly could result in bank failures (Lokare, 2014). An analysis of the components contributing to Indian banking stability since 2010, shows that deteriorating asset quality and reducing soundness of a bank are major contributors to the decline in stability of the banking system (RBI, December 2012).

There is sufficient literature available in which systemic risk is estimated using market based data. While analysing the effect of the crisis on the Indian banking system, using a stock market-based measure, V. Acharya, Pedersen, Philippon, and Richardson (2010) estimate the systemic risk contributed by each Indian bank in the period preceding the crisis (January–December 2007) and compare it to realized returns during the crisis (January 2008 to February 2009). They find that the performance of public banks surpassed private banks during the crisis and ascribe this outcome to implicit and explicit government support for public-sector banks. To measure the *ex-ante* systemic risk of Indian public and private financial firms, Eichengreen and Gupta (2013) used the marginal expected shortfall (MES) measure that captures the tail dependence of the stock return of a financial firm on the market as a whole. The effectiveness of the measure is present in its ability to forecast which firms could be the worst hit when a financial crisis occurs. The analysis was carried out for large financial institutions in India depending on data availability for the period under consideration. They have used 70 firms in all, 19 public sector banks and 51 private sector banks. The time period used in their analysis was January 2007 to December 2007. They use the normal tail events as the worst 5 percent market outcomes at daily frequency over the pre-crisis period. In their analysis, they consider the 5 percent worst days for the market returns as measured by the S&P CNX NIFTY index in any given measurement period, and then determine the negative of the average return for any given bank for these 5 percent worst days. The MES measure can also be explained as the contribution of each firm to the systemic risk when a crisis occurs.

Systemic risk can also be measured using extreme value analysis, as the probability of a sharp decline in bank's stock price conditional on a crash in a banking index (De Jonghe, 2010) or by using the CoVaR methodology of Adrian and Brunnermeier (2011), as marginal contribution of a particular institution to the overall systemic risk.

The lack of linkages between Indian banks and the global financial system means that they are comparatively immune to volatility in global markets. In one part of literature it is argued that, for India simpler regulation based on broad patterns was used partly, as the skills for complex risk-based regulation were absent, but ended up having good stability-improving incentives.

Firstly, owing to different capabilities, banks were granted learning time to switch over to internal risk rating-based capital buffers. Secondly, the absence of historical data for wholesale and retail, coupled with the unavailability of industry benchmarks for the calculation of internal parameters, could misreport the risk-based pricing. Thirdly, Indian capital adequacy norms

were fixed higher than the Basel norms to ensure that risky exposures were not undercapitalized, despite the difference in approach.

Further prudential (safety) norms included risk weights and provisioning requirements that essentially moderated sectoral booms. A risk assessment methodology not based wholly on self-assessment was protective<sup>2</sup>.

The Indian banking system was earlier expected to be protected from the global financial crisis due to heavy public ownership and conservative management. However, to the surprise of many observers, private banks in particular experienced a sharp increase in interbank borrowing rates and deposit flight from mid-2008. Public banks meanwhile posted faster deposit growth than the system as a whole (Eichengreen & Gupta, 2013).

The strategic focus on corporate, retail, and treasury segments has been discussed widely for its impact on systemic risk.

The total loss to the banking system from the failure of the corporate/group will generally be distributed across banks in proportion to their individual exposures to the corporate /group. If, in the case of one or more banks, the loss is large enough to cause distress to the bank, then there will be additional losses to the banking system owing to the contagion caused by the distressed bank/banks. Depending on the importance of the distressed bank/banks in the network of interbank exposures, the contagion losses may be considerable (RBI, December 2013).

Industries in India recorded the highest share in restructured standard advances and with relatively high GNPA's contributed the highest share of stressed advances in the banks' loans portfolio (RBI, December 2013). Five sectors, namely, Infrastructure, Iron & Steel, Textiles, Aviation and Mining together contribute 24 percent of total advances of SCBs, and account for around 53 percent of their total stressed advances (RBI, December 2013). Stressed financial condition of some State Electricity Boards and airline companies also added to the decline in the asset quality of banks (RBI, June 2012). Concentration in commercial real estate lending has also been a strong predictor of bank failure in both the recent financial crisis and in the U.S. bank failure wave of the late 1980s and early 1990s (Cole & White, 2012).

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<sup>2</sup> Goyal, A. (2014, October 06, 2014). Banking on diversity, *Indian Express*.

Retail focus, with a relatively high proportion of core deposits and loans in total assets, consistently lower extreme systematic risk (De Jonghe, 2008). However, while expanding aggressively in retail market, the risk of loaning to people with dubious credit profile may be high. Many of the customers will borrow for the first time from banks and therefore no credit data will be available making it difficult to find how leveraged they are and that may pose a potential risk to the system<sup>3</sup>. Treasury focus increase banks' sensitivity to the market index during times of extreme equity market movements (De Jonghe, 2008).

There exists literature which examines the impact of diversification strategy on systemic risk. For banks individually, this made sense. Although it helped reduce the idiosyncratic risk from individual business lines, it simultaneously reduces diversity and thereby increases systemic risk. By increasing the similarity of banks' asset portfolios, it increases the system's sensitivity to aggregate fluctuations (Alessandri & Haldane, 2009; Wagner, 2010).

Interdependence among banks that arises from active trading and financial network relationships that were developed for the sake of risk diversification might also have made financial institutions contribute more systemic risk to the financial system and at the same time, become more vulnerable to contagion (Battiston, Delli Gatti, Gallegati, Greenwald, & Stiglitz, 2012; Calluzzo & Dong, 2015). Securitization increased the dimensionality, and thus complexity, of the financial network. Nodes grew in size and interconnections between them multiplied. The financial cat's-cradle became dense and opaque. As a result, the precise source and location of underlying claims became anyone's guess. Follow-the-leader became blind-man's buff (Haldane, 2009). In short, diversification strategies by individual firms generated heightened uncertainty across the system as a whole (Haldane, 2009).

The impact of differentiation strategy on systemic risk has been studied well in literature. All banks react simultaneously to a common regime change and rationally allocate assets in the same way. *Ceteris paribus*, the more that this behaviour occurs, the more likely it is that the banking system will lack resilience, and, consequently, the more financial stability will be at risk (Calmès & Théoret, 2014). Strategic differentiation is important because it is possible that banks are interconnected in ways that could enhance the chance of simultaneous credit losses; which could be because of their similar sized balance sheets, largely comparable shares of lending and deposits, comparatively large shares of housing loans; similar capital positions and

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<sup>3</sup> Ray, A. (16 April 2014). Retail Loans: PSU banks have an edge, *The Economic Times* p. 18.

the same credit ratings (RBA, March 2014). The 2007 credit crisis has been severely increased by banking strategic complementarities in the face of regulatory constraints (Adrian & Brunnermeier, 2011; Farhi & Tirole, 2012; Gauthier, Lehar, & Souissi, 2010; Loutskina, 2011; Schoenmaker, 2013; Wagner, 2007).

The literature has also found strategic complementarities in the decisions of individual banks that, with other banks, force the central bank to bail them out collectively. Farhi and Tirole (2012) show how the private leverage choices of financial intermediaries display strategic complementarities through the response of monetary policy, which makes it optimal for banks to adopt a risky balance sheet. V. V. Acharya and Yorulmazer (2007) identify the regulators' *ex post* incentives to bail out failed banks when many are failing. Hence, banks, especially small ones, are induced to "herd" their investment policies and thereby increase the risk of collective failure (Vives, 2014).

Financial institutions rebalancing their portfolio in order to comply with the capital requirements end up with more similar portfolios (Zhou 2013). In turn, this enhances systemic linkage within the system. Although the individual risk of each institution in the regulated system is lower, the systemic linkage within the system is higher (Zhou, 2013). Zhou (2013) shows higher dependence in the regulated system to be an endogenous consequence of banks' individual risk management rather than a strategic choice toward systemic risk-shifting. The higher dependence under regulation in their model is a consequence of individual risk management. Even if "systemic moral hazard" is absent, imposing a capital requirements may nevertheless increase systemic risk in the cross-sectional dimension (Zhou, 2013).

In one part of the literature it is argued that strategic differentiation may not have any impact on systemic risk. Even though banks can follow various strategies to handle their loan portfolios, they consistently tend to respond in the same way to macroeconomic shocks (Calluzzo & Dong, 2015). A higher common exposure to shocks does not necessarily imply higher systemic risk. An increase in common exposure can, for example, be compensated by a decrease in banks' total exposure, causing the overall systemic risk to decrease. This situation occurs, for example, when two banks switch from independent risky strategies (no common exposure, very high individual risk) to a common safe strategy (complete common exposure, but very low risk) (Allenspach & Monnin, 2009).

The discussion on review of existing literature reveals that while the systemic risk has been extensively researched in developed markets like USA, the research on Indian markets is limited in terms of number of studies as well as scope. In due course of time, the banking sector has changed much owing to the regulatory changes after the Basel Capital Accord and the impact of the global financial crisis (GFC). However, the review of available literature reveals that there are many gaps in the research on impact of business strategies on contribution to systemic risk in Indian context. These research gaps provide scope for a comprehensive study on business strategy and systemic risk in Indian context. A detailed discussion on the research gaps is presented in Section 3.

### **3 Research Questions and Hypothesis Development**

Stability and strength of the banks is determined by their investment and funding decisions (Gavin & Hausmann, 1996) . Risk contribution made by banks is specific to a particular portfolio, particular proportions in which the assets are held (Kealhofer, 1998).

Thus, the fundamental strategic decisions of bank are the selection of assets (Santomero, 1984) or investments in various sectors of the economy (Deephouse, 1999). Banks earn revenues from different business operations, the distinction on bank revenue flows is relevant and offer different policy implications; if these activities are fundamentally risky, this might lead to regulatory limits and supervisory oversight or increased capital charges for particular activities (Stiroh, 2006).

Based on the publicly available quarterly revenue information on business segments (Corporate, Retail, and Treasury), the study will associate the revenue segment information with choices related to business strategies of any banks and allow equity prices and macro-economic information to predict systemic risk associated with different strategic choices. The strategic choices related to Corporate focus, Diversification and Differentiation.

The strategy of Corporate Focus should be positively impacting systemic risk. Firstly, Interconnections between banks having correlated exposures in corporate business segments (RBA, March 2014) increases the systemic risk. Banks at times being aggressive may seek to take advantage of the large-scale of credit demand from corporates during the preceding credit boom to expand their market share. Such a strategy creates a high level of credit risk (lending to relatively risky borrowers) with further increase in systemic risk (Besar et al., 2011).

Secondly, if, in the case of one or more banks, the loss from corporate failure is large enough to cause distress to the bank, then there will be further losses to the banking system due to the contagion caused by the distressed banks. Depending on the importance of the distressed banks in the network of interbank exposures, the contagion losses may be substantial (RBI, December 2013).

Thirdly, there has been a rise in the RWA to total assets post-2009 due to the downgrading of some borrowers and rising NPAs in India. It was observed that the share of 'BBB and below' rated corporate exposures of SCBs, attracting risk weights in the range of 100 to 150 percent, increased from around 55 percent to around 78 percent in post-recession period (RBI, December 2013).

The strategy of Diversification should be positively impacting systemic risk. Diversification reduces diversity and thereby increases systemic risk by increasing the similarity of banks' asset portfolios and further increasing the system's sensitivity to aggregate fluctuations (Alessandri & Haldane, 2009). Intuitively, this is because the impact of diversification on the variance of a portfolio (which is the source of the diversification benefits) is declining to the extent of diversification and becomes zero at full diversification. Therefore, the costs of diversification in terms of more systemic crises always start to outweigh its benefits for a sufficiently large degree of diversification (Wagner, 2010).

The strategy of Differentiation should help banks in reducing systemic risk. Firstly, the 2007 financial crisis has been severely increased by banking strategic complementarities in the face of regulatory constraints (Adrian & Brunnermeier, 2011; Farhi & Tirole, 2012; Gauthier et al., 2010; Loutskina, 2011; Schoenmaker, 2013; Wagner, 2007, 2010).

Secondly, the regulators have *ex post* incentives to bail out failed banks when many are failing (V. V. Acharya & Yorulmazer, 2007). Hence, banks, especially small ones, are induced to "herd" their investment policies and thereby increase the risk of collective failure (Vives, 2014). Thirdly, all banks react simultaneously to a common regime change and rationally allocate assets in the same way. *Ceteris paribus*, the more that this behaviour occurs, the more likely it is that the banking system will lack resilience, and, consequently, the more financial stability will be at risk (Calmès & Théoret, 2014).

From the literature review presented in Section 2, it can be found that that research limited relating to business strategy in Indian markets is very much limited. Based on the detailed review of literature, the following research gaps have been identified. Most of the existing literature is based on estimating the systemic risk. As far as systemic risk is concerned, there is no robust empirical work which examines the impact of business strategy. Unlike developed markets, the emerging market economy like India include many state-owned banks, such that, in this context, the consequence of ownership for the strategy impact on systemic risk is a major, yet unexamined proposition.

In light of the above discussion, we form our next hypothesis:

**H4: Strategic choices made by banks reduce systemic risk** - if at least one of the following three conditions is met.

- Strategic differentiation is negatively associated with systemic risk
- Strategic diversification is positively associated with systemic risk
- Corporate business (Focus strategy) is positively associated with systemic risk

Systemic risk =  $f(\text{Strategy})$  ... (3)

## 4 Data and Methodology

### 4.1 Model Specification

There are many factors that contribute to the build-up of systemic risk (Smaga, 2014). As discussed in Section 3, this study study associate strategy with the revenue information on business segments i.e. Corporate/Wholesale, Retail and Treasury to test whether strategic choices impact systemic risk. Adrian and Brunnermeier (2011) have proposed CoVaR as a measure of systemic risk and examined the firm characteristics which predict the contribution to systemic risk.

Since this study deals with the impact of business strategic choices on systemic risk, it is natural to use CoVaR (termed systemic risk) over a quarter for each bank as a measure of its contribution to systemic risk. Please refer to the appendix for more details on CoVaR estimation. While associating the revenue segment information with choices related to business strategies of any banks, t allow CoVaR to predict prospective systemic risks associated with different strategic choices.

Focus strategy, diversification strategy and differentiation strategy are used to represent strategic choices of banks. Focus strategy is associated with the proportion of revenue a bank generates by focusing on corporate, retail and treasury business segments (termed  $R_{CB, RB, TB}$ ). Diversification strategy (termed DIV and estimated as  $1 - \sum_{R=1}^3 (P_R)^2$ ) is obtained as sum of the squares of revenue as a fraction of total revenue under a given business segment (i.e. corporate, retail or treasury); the index so obtained is subtracted from 1 to obtain this diversification index. Differentiation strategy (termed strategic deviation and estimated as  $\sum_{R=1}^3 \left[ \text{Abs} \left( \frac{P_{Rit} - \overline{P_{Rt}}}{\sigma(P_{Rt})} \right) \right]$ ) is obtained by comparing each (revenue) strategy of each bank with the banking sector mean for that (revenue) strategy, expressing it as a standard deviation and then aggregating the absolute values of the standard deviations of all three (revenue) strategy variables for each bank.

In line with earlier studies (Adrian & Brunnermeier, 2011; De Jonghe, 2008), value at risk, capital to asset, market  $\beta$ , volatility and size are control variables. A discussion on the estimation of controls can be found in the appendix.

Value at risk (termed VaR) controls for risk of bank in isolation. Capital–Asset ratio (termed capital to asset) calculated at market level controls for banks' capacity to bear losses and avoid crises. Market beta (termed Market  $\beta$ ) calculated from daily equity return data within each quarter controls for systematic risk. Shareholder return volatility (termed volatility) is obtained by estimating standard deviation of the market returns over a quarter. Log of market value of equity (termed SIZE) controls for a bank's tail betas.

The resulting equation is as follows.

$$\begin{aligned} \text{Systemic Risk}_{it} = & \alpha_0 + \alpha_1 \text{WB}_{it} + \alpha_2 \text{RB}_{it} + \alpha_3 \text{TB}_{it} + \alpha_4 \text{DIV}_{it} + \alpha_5 \text{Strategic Deviation}_{it} + \\ & \alpha_6 \text{VaR}_{it} + \alpha_7 \text{capital to asset}_{i,t} + \alpha_8 \text{market beta}_{i,t} + \alpha_9 \text{Volatility}_{i,t} + \\ & \alpha_{10} \text{Cost to Income ratio}_{i,t} + \alpha_{11} \text{Size}_{i,t} + \varepsilon_{i,t} \dots \quad (1) \end{aligned}$$

As discussed in Section 3, existing literature predicts that if systemic risk contains information on business strategic choices related to corporate focus, diversification and differentiation, we should see a negative coefficient of  $\text{WB}_t$  in model 1. If banks which are diversifying fully (and thus hold identical portfolios) fail together, we should see a negative coefficient of DIV in model 1. If a bank differentiates its business strategies in context of other banks, we should see a positive coefficient of strategic deviation in model 1.

If higher risk in individual banks later leads to increase in the risk of system, we should see a positive coefficient of VaR in model 1. If capital–asset ratio at higher levels improves banks’ capacity to bear losses and avoid crises, then we should see a positive coefficient of capital–asset ratio in model 1. If increase in systematic risk also increases systemic risk, then we should see a negative coefficient of Market beta in model 1. If bank equity values are sensitive to all the factors that affect the overall stock market, we should see a negative coefficient of volatility in model 1. If large sized banks are exposed to many sectors, we should see a negative coefficient of SIZE in model 1. If the difference in the contributions to systemic risk by banks is because of their differences in efficiency, we should control for the same using cost-to-income ratio.

## 4.2 Data

The bank-level quarterly data has been developed from CMIE. The data on business segments (corporate, retail and treasury revenue) has been hand collected from DION INSIGHT. This data pertains to the period 2008 to 2015 for 39 listed banks. The sample is divided into public and private sector groups. Thus, we covered 25 public sector banks and 15 private sector banks resulting in 1131 bank-quarter observations.

Summary statistics of the variables used in the regression model are reported in Table 1, and the following can be observed: First, interestingly, public banks are much smaller, on average, than the private sector banks even though they have operated in India much longer than their new competitors. Second, private banks are much better capitalized than other state-owned banks. This could imply either that new private banks are in a better position to take risk, or that they are more risk averse.

Third, the proportion of corporate banking revenue is highest across public sector banks. Fourth, the income diversification index of public sector banks is higher, on average, than the private sector banks. This could imply that public sector banks are potentially capable of generating revenue in a variety of ways. Fifth, the differentiation index is much higher across new private banks, on average, than the public sector banks.

Sixth, the VaR, returns volatility, cost-to-income ratio and the ratio of loan loss provisions to gross non-performing loans is higher across private banks, on average, than the public sector banks. This differs from the studies of Altunbas, Evans, and Molyneux (2001), where public sector banks have slight cost and profit advantages over their private commercial banking counterparts. However, the market beta and the ratio of gross non-performing loans to advances of state-owned banks, is higher than that of private banks. Finally, the price-to-book ratio of private banks (1.78) is much higher than that of state-owned banks (0.78).

**Table 1**  
**Summary statistics by bank ownership, 2008 Q4-2015 Q4.**

<b>Bank characteristics</b>	<b>All banks</b>	<b>Public</b>	<b>Private</b>
<b>% of revenue in corporate banking</b>			
MEAN	40.277	44.809	32.439
STD	0.11676	0.08841	0.11841
<b>Diversification</b>			
MEAN	0.62904	0.6344	0.61978
STD	0.05064	0.04953	0.05126
<b>Differentiation</b>			
MEAN	2.89353	2.48951	3.59232
STD	1.56799	1.36124	1.65556
<b>Non-performing assets ratio (Gross NPA/Total Advances) %</b>			
MEAN	2.77	2.97	2.40
STD	0.01647	0.0156	0.01735
<b>Loan loss provisions ratio (LLP/Gross NPA)</b>			
MEAN	0.13443	0.12302	0.1553
STD	0.13301	0.09561	0.18091
<b>VAR</b>			
MEAN	-0.1504	-0.1065	-0.2288
STD	0.10689	0.04135	0.13861
<b>Market Beta</b>			
MEAN	1.1125	1.12474	1.09121
STD	0.47606	0.48856	0.45331
<b>Returns Volatility</b>			
MEAN	0.02451	0.02449	0.02455
STD	0.00913	0.00829	0.01044
<b>Price-to-Book value</b>			
MEAN	1.14263	0.77805	1.77663
STD	0.80137	0.322	0.97289
<b>Cost-to-Income</b>			
MEAN	0.183	0.16827	0.20914
STD	0.04728	0.03267	0.05695
<b>Market value of equity (Million Rs.)</b>			
MEAN	183683	134809	268670
STD	361213	286592	451153
<b>Number of banks</b>	39	25	14

Source: Compiled from CMIE PROWESS

## 5 Analysis of Results

Regression results for model we are presented in table 2. Public sector banks with large corporate business are likely to be related with higher systemic risk contributions in the current quarter and one quarter later, at the 10 percent significance levels.

Private sector banks with larger income diversification tend to be associated with smaller systemic risk contributions current quarter and one quarter later, at the 10% significance levels. A plausible explanation for this is that *diversification strategy* reduces the likelihood of institutional failure and should thus benefit financial stability overall. The coefficient of  $DIFF_t$  is insignificant at all levels of significance under all ownership types. This provides strong evidence that *differentiation strategy* by a bank does not benefit shareholders.

## 6 Conclusions

This study examines strategic choices in the context of scheduled commercial banks within India. While associating the revenue segment information with choices related to business strategies of any banks, this study find that focus strategy seems to reduce systemic risk, given that a state-owned bank reduces its corporate exposure. This is consistent with RBI (December 2013), which argues that rise in proportion of risky assets in the total assets of Indian SCBs, which has become more broad-based, leads to interconnectedness in the Indian banking sector could cause losses due to contagion, over and above the direct losses on account of the failure of large corporate groups.

Private sector banks with larger income diversification tend to be associated with smaller systemic risk contributions in the current quarter and one quarter later. A plausible explanation for this is that *diversification strategy* reduces the likelihood of institutional failure and should thus benefit financial stability overall.

The study find that differentiation strategy does not impact systemic risk under any bank ownership type, which is in contrast to the international evidence. The plausible explanation for this is even though banks can adopt different strategies in the way they manage their loan portfolios, they consistently tend to respond in the same way to macroeconomic shocks (Calluzzo & Dong, 2015).

**Table 1**  
**Bank-level regressions using panel**  
**data**

Lag (in quarters)	Dependent Variable: Systemic Risk (CoVaR)					
	All banks		Public		Private	
	(0)	(1)	(0)	(1)	(0)	(1)
<b>Constant</b>	-0.0686*** (0.0239)	-0.0847*** (0.0274)	-0.0396 (0.0288)	-0.0750** (0.0337)	-0.1055*** (0.0294)	-0.1038*** (0.0294)
<b>Corporate banking</b>	-0.0181*** (0.0069)	-0.0203*** (0.0075)	-0.0135* (0.0076)	-0.0157* (0.0097)	-0.0085 (0.0111)	-0.0080 (0.0120)
<b>Diversification</b>	0.0002 (0.0188)	0.0167 (0.0189)	-0.0081 (0.0210)	0.0047 (0.0255)	0.0370* (0.0201)	0.0534*** (0.0192)
<b>Differentiation</b>	-0.0001 (0.0006)	0.0006 (0.0007)	-0.0002 (0.0006)	0.0004 (0.0008)	0.0002 (0.0007)	0.0012 (0.0008)
<b>Non-performing assets</b>	0.1333 (0.1022)	0.2820** (0.1170)	-0.0101 (0.1144)	0.2682 (0.1802)	0.0685 (0.1024)	0.1839 (0.1143)
<b>Loan loss provisions</b>	0.0022 (0.0028)	0.0055** (0.0029)	-0.0023 (0.0033)	0.0029 (0.0044)	-0.0030 (0.0033)	0.0013 (0.0038)
<b>VaR</b>	0.2130*** (0.0415)	0.1619*** (0.0357)	0.5922*** (0.0370)	0.4402*** (0.0384)	0.1562*** (0.0326)	0.1195*** (0.0317)
<b>Market Beta</b>	0.0031** (0.0014)	0.0011 (0.0014)	0.0037** (0.0017)	0.0017 (0.0021)	-0.0035 (0.0022)	-0.0045** (0.0022)
<b>Returns volatility</b>	0.1596 (0.1157)	0.1244 (0.0952)	-0.0547 (0.1259)	0.0858 (0.1494)	0.2492 (0.1597)	-0.0110 (0.1437)
<b>Price-to-book ratio</b>	0.0016 (0.0024)	-0.0006 (0.0024)	0.0072 (0.0053)	0.0001 (0.0056)	-0.0024 (0.0026)	-0.0040 (0.0029)

<b>Cost-to-income</b>	-0.0112 (0.0235)	-0.0117 (0.0209)	-0.0190 (0.0234)	-0.0256 (0.0236)	0.0225 (0.0296)	0.0344 (0.0333)
<b>Size</b>	-0.0042** (0.0020)	-0.0039* (0.0020)	-0.0032 (0.0026)	-0.0018 (0.0028)	-0.0028 (0.0021)	-0.0043* (0.0026)
<b>R-Square</b>	0.34	0.22	0.56	0.34	0.48	0.36
<b>Number of Banks</b>	39	39	25	25	14	14
<b>Time Series Length (Quarters)</b>	29	28	29	28	29	28

Note: \*  $p < .10$ , \*\*  $p < .05$ , \*\*\*  $p < .01$ , Standard errors (Newey-West) in parentheses are corrected for heteroscedasticity and autocorrelation

## Appendix

### Estimation of Systemic Risk

Adrian and Brunnermeier (2011) used CoVaR, i.e. VaR of the whole financial sector conditional on institution  $i$  being in distress to capture the marginal contribution of a particular institution to the overall systemic risk and also the marginal contribution of the system risk to the distress of a particular institution. Using the methodology of Adrian and Brunnermeier (2011), we will estimate the marginal contribution of a particular institution to the overall systemic risk and also the marginal contribution of the system risk to the distress of a particular institution. The analysis will focus on the growth rate of market value of total financial assets. We will focus on assets as they are most closely related to the supply of credit to the real economy. We will use quantile regression approach for this estimation.

We will follow the Black–Scholes–Merton option pricing methodology (Akhigbe, Madura, & Martin, 2007; Hillegeist, Keating, Cram, & Lundstedt, 2004) to estimate the market value of assets<sup>4</sup>, using the structural model of Merton (1974) that treats the equity value as a European call option written on the underlying assets of a firm. The market value of a firm's total assets is assumed to follow a geometric Brownian motion. We will use the observables ( $V_{E,t}$  market value of equity and  $\sigma_{E,t}$  annualized standard deviation of market equity) to compute the initial value for the unobservables:

$$V_{A,t} = V_{E,t} + F_t,$$

$$\sigma_{A,t} = \frac{\sigma_{E,t} * V_{E,t}}{(V_{E,t} + F_t)},$$

where

$V_{A,t}$  is market value of assets,

$\sigma_{A,t}$  is annualized standard deviation of market value of assets and

$F_t$  is book value of total liabilities gathered for each year.

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<sup>4</sup> Due to data limitation, we could not calculate market value of assets as in Adrian and Brunnermeier (2011). Market value of assets = Book value of assets\* Market book ratio; where Market to book ratio = Market value of equity/Book value of equity

We have eq. (1) (BSM model) and (2) (Hedge ratio) to be simultaneously solved for  $V_{A,t}$  and  $\sigma_{A,t}$  for each  $t$  (=week) We will adopt a one-year horizon  $T$  (a common procedure, used by Moody's KMV),  $r_t$  is the risk-free interest rate and is represented by the weekly nominal one-year  $T$ -bill rate

$$V_{E,t} = V_{A,t}N(d_{1,t}) - F_t e^{-r_t T} N(d_{2,t}) \quad \dots (1)$$

$$\sigma_{E,t} = [V_{A,t} N(d_{1,t}) \sigma_{A,t}] / V_{E,t} \quad \dots (2)$$

where

$$d_{1,t} = \frac{\ln(V_{A,t}/F_t) + \left(r_t + \frac{\sigma_{A,t}^2}{2}\right)T}{\sigma_{A,t}\sqrt{T}} \quad \dots (3)$$

$$d_{2,t} = d_{1,t} - \sigma_{A,t}\sqrt{T} \quad \dots (4)$$

$\sigma_{E,t}$  is the annualized estimate as  $\frac{\text{Standard Deviation } (R_{t-252}, R_{t-261}, \dots, R_t)}{\sqrt{\# \text{ trading days [non-missing data in the period } (t-261, t)]}}$ , where  $R$  is the firm's

market return and assuming there are maximum 261 trading days in a year.

The market value of assets is estimated using the above option pricing framework. The return on market value of asset is defined by  $X_t = \frac{V_{A,t} - V_{A,t-1}}{V_{A,t-1}}$ , where  $V_{A,t}$  is the market value of asset. We also estimate

$X_t^{\text{System}}$  as an average market valued asset returns weighted by lagged market valued total assets, i.e.

$$\frac{X_t^1 \times V_{A,t-1}^1 + \dots + X_t^N \times V_{A,t-1}^N}{V_{A,t-1}^1 + \dots + V_{A,t-1}^N}, \text{ where } N \text{ is the total number of banks.}$$

We will estimate the VaR (firm & system) and CoVaR (system) conditional on state variables  $M_t$  ( $\Delta$ 3MTH T-bill, Liquidity spread = 3MTH repo – 3MTH T-bill, Slope (yield curve) = 10Y T-bill – 3MTH T-bill, equity market return, real estate sector excess return over market) is well-known to capture time variation in conditional moments of asset returns, and is liquid and easily tradable. We restrict ourselves to a small set of risk factors to avoid overfitting the data. 3MTH T-bill is most significant in explaining the tails of financial sector market-valued asset returns. Liquidity spread measures short-term liquidity risk. Slope (yield curve) indicates the fixed-income factors that capture the time variation in the tails of asset returns. Control factors are equity market return, real estate sector and excess return over market.

We will estimate the quantile regression ( $q^{\text{th}}$  quantile)  $X_{q,t}^i = \alpha_q^i + \gamma_q^i M_{t-1} + \epsilon_t^i$  (over a period  $t$ , for each firm  $i$  to obtain risk of bank in isolation, i.e.  $\text{VaR}_{q,t}^{i|M_{t-1}} = \hat{X}_{q,t}^i = \hat{\alpha}_q^i + \hat{\gamma}_q^i M_{t-1}$  .

We will estimate the quantile regression  $X_{q,t}^{\text{System}|i} = \alpha_q^{\text{System}|i} + \beta_q^{\text{System}|i} X_t^i + \gamma_q^{\text{System}|i} M_{t-1} + \epsilon_t^{\text{System}|i}$  .

We had performed an analysis for 1, 5 and 50 percent quantiles. We have reported our results at 1%. We obtain the risk of financial system conditional on the returns of bank ‘i’ by obtaining the predicted value  $\hat{X}_{q,t}^{\text{System}|i}$  (over a period of time, for each firm i), which is also equal to  $\mathbf{VaR}_{q,t}^{\text{System}|X_t^i, M_{t-1}}$ . Using the estimates obtained from the previous regression and taking  $X_t^i = \text{VaR}_{q,t}^{i|M_{t-1}}$ , We will look for the contribution of bank ‘i’ to systemic risk by estimating  $\text{CoVaR}_{q,t}^{\text{System}|X_t^i = \text{VaR}_t^i(q), M_{t-1}} = \hat{\alpha}_q^{\text{System}|i} + \hat{\beta}_q^{\text{System}|i} \text{VaR}_{q,t}^{i|M_{t-1}} + \hat{\gamma}_q^{\text{System}|i} M_{t-1}$ .

We also estimate increase in the risk of system when bank ‘i’ fails by determining  $\Delta \text{CoVaR}_{q,t}^{\text{System}|i} = \text{CoVaR}_{q,t}^{\text{System}|X_t^i = \text{VaR}_t^i(q), M_{t-1}} - \text{CoVaR}_{q,t}^{\text{System}|X_t^i = \text{VaR}_t^i(50\%), M_{t-1}}$ , which will be used as a measure of systemic risk in our analysis, where  $\text{VaR}_t^i(50\%)$  implies that bank ‘i’ is in median state.,

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