The Relationship between Competition and Risk Taking Behavior of Indian Banks

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Abstract

Under the traditional franchise value paradigm, competition in banking markets is considered to be risk enhancing because of its tendency to raise interest rates on deposits. Taking a contrarian view, Boyd and De Nicolo (2005) have argued that competition in the loan market can lead to lower interest rates and hence, reduce bank risk taking. Following these theoretical results, the empirical evidence on the relationship between risk and competition in banking has also been mixed. This paper analyzes the competition-stability relationship for the Indian banking sector for the period 1999-2000 to 2012-2013. Banking competition is measured using structural measures of concentration viz. 5-bank concentration ratios and the Herfindahl-Hirschman Index as well as a non-structural measure of competition- the Panzar-Rosse H-Statistic. Our results show that while concentration leads to lower levels of default, market and asset risks, it exacerbates the levels of capital and liquidity risks. These results have interesting implications for banking sector policy in emerging economies.

JEL Classification: G21, G28

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1. Introduction

The health of the financial sector aids in good economic performance and therefore, it is important that the banking sector of a country operates on sound lines. In recent years, the debate regarding the effects of competition on risk taking behavior of banks has gained momentum and become an area of increased interest for both academicians and policy makers. Two hypotheses are predominant in the literature with respect to the above relationship (Schaeck et al, 2006; Berger et al, 2008). The "competition-fragility" view states that increased competition among banks lowers market power and profit margins, thereby increasing their risk taking. On the other hand, the "competition-stability" view suggests that more market power in the market for loans results in increased bank risk because higher interest rates on loans make repayment more difficult for the borrowers. However, the overall risk of banks may not increase if they protect themselves through higher capital or employ other risk-mitigating strategies (Berger et al, 2008).

These arguments indicate that so far no consensus has been reached in the literature on the competition- bank risk taking nexus. Further, most of the studies analyzing this relationship, whether single or cross-country, have focused mainly on advanced economies. Research on emerging market economies (EMEs) is extremely sparse. This is despite the fact that recent global events demonstrate a key challenge facing banking regulators in EMEs today is maintaining the stability of their domestic banking systems in the face of increased competition from domestic as well as foreign banks. In EMEs, a rapidly developing financial system can pose systemic risks if policymakers underestimate its wider ramifications.

In order to fill this gap in the literature this paper analyzes the competition-risk taking relationship by considering the Indian banking sector as a case study. India is one of the most important EMEs with a GDP growth rate that has recently surpassed China's. India's banking sector is quite well developed and is characterized by a vast spectrum of banks of different sizes and ownership categories. Since the liberalization of the economy in 1990s with new banks entering the market, increasing competition has often raised concerns about its implications for stability. There are similar concerns in policy circles across EMEs. Our study contributes both specifically to the existing literature on EMEs as well as in general to the existing knowledge on the competition and risk taking behavior of banks.

This is the first paper to examine the impact of competition on the various risks (i.e., default, market, asset, capital and liquidity risks) faced by Indian scheduled commercial banks (SCBs). Following Anzoategui et al (2010), we consider a non-structural measure of competition viz. Panzar-Rosse (1987) H-Statistic and following Liu et al (2010), several structural measures of market power viz. 5-bank concentration ratios (based on loans, deposits and assets) and the Hirfindahl-Hirschmann Index (HHI). We also take into account the effects of other bank specific and macroeconomic controls such as return on assets (ROA), size and the annual GDP growth rate. The risk and concentration/ competition measures along with control variables are explained in greater detail in Section 3. The study spans the period 1999-2000 to 2012-2013 and uses an unbalanced panel data set consisting of 756 observations. Our results show that increased competition leads to higher stability when related to default, market and asset risks. However, competition adversely affects capital and liquidity risks, thus lowering stability. This mixed evidence has interesting policy implications as discussed in the concluding section.

The remaining paper is organized as follows. Section 2 reviews the existing literature on the competition-stability nexus. Section 3 highlights the data sources and methodology applied in the paper. Section 4 provides the analysis of descriptive statistics and broad trends while section 5 highlights the estimation results from panel data regressions. Section 6 concludes and provides policy implications of our findings.

2. Literature Review

In the past couple of decades, an extant theoretical and empirical literature has come up, investigating the issue of competition and stability in banking. This has occurred due to questions regarding what type of market structure leads to a productive and sound environment for banks to function in (Liu et al, 2010).

The traditional competition-fragility view provides models which conclude that higher concentration and lower competition in banking systems lead to greater stability as higher profits act as a cushion against fragility. The need to protect their franchise value provides banks with incentives against excessive risk taking. In more competitive environments, there is greater pressure on maintaining profits, which makes banks take on more risks, resulting in higher

fragility. On the other hand, in systems where entry is restricted, there is limited competition. Thus, banks have better profit opportunities, capital cushions and therefore fewer incentives to take on excessive risks, thus affecting financial stability positively (Beck, 2008)

In contrast to the above, the competition-fragility argument asserts that greater concentration in banking structures results in more risk taking by banks (Beck, 2008). Boyd and De Nicoló (2005) argue that viewpoint of market power boosting profits and hence banking stability ignores the potential impact of banks' market power on firm behavior. Instead of banks choosing the riskiness of their assets, borrowers end up having to choose the riskiness of their investment, undertaken in the form of bank loans. The authors argue that concentrated banking systems enhance market power, which then allows banks to increase the interest rate they charge to firms. These higher interest rates may induce firms to assume greater risk, which results in a higher probability of loans turning bad/ non-performing.[1]

Arping (2014) presents a model in which competition makes banks more reluctant to take on excessive risks. The author shows that as competition intensifies and margins decline, banks face greater threats of failure. They respond to such contingencies by reducing their risk-taking. Yet, at the same time, banks become riskier. This is attributed to the fact that the direct, destabilizing effect of lower margins outweighs the disciplining effect of competition. Moreover, an increase in competition reduces banks' incentive to build precautionary capital buffers. The vital implication following this is that the effects of competition on risk-taking and on failure risk can move in opposite directions.

The empirical literature contains several cross-country studies on the competition-risk relationship. Beck et al (2005) empirically examined the relationship between concentration and banking system fragility using a cross-sectional sample of about 2,500 U.S. banks in 2003 and a panel data set of about 2,600 banks in 134 non-industrialized countries for 1993-2004. They found that a banking system that is highly concentrated also has larger and more diversified banks which help to generate stability. Their results also suggest that concentration is associated with lower probability of a country facing a systemic banking crisis.

[1] Saha and Sensarma (2013) showed that the results of Boyd and De Nicolo (2005) are conditional upon credit risk not exceeding a critical level.

Schaeck et al (2006) examined the relationship between competition and banking system fragility employing data from 38 countries during the period 1980 – 2003. Using the Panzar and Rosse H-Statistic as a measure for competition, their results suggest that banking systems that are more competitive are less vulnerable to systemic crises. They conclude that competition and concentration are significantly different from each other and describe different characteristics of banking systems. Whereas concentration is definitely a measure of market structure, they argue that competition can be said to measure competitive dynamics among financial institutions.

Berger et al (2008) focus on the impact of market power on measures of loan risk, bank risk, and bank equity. Based on data for 8,235 banks in 23 developed economies, their results show that banks with a greater degree of market power have less overall risk exposure. While this result appears consistent with the "competition-fragility" view, their work also finds that market power increases loan portfolio risk which is in line with the "competition-stability" view. Beck et al (2011) show that not only is the relationship between bank competition and stability ambiguous, but it can also differ across countries depending on market, regulatory and institutional features. They show that higher competition will have a larger impact on banks' risk taking incentives in those systems that have stricter activity restrictions, more homogenous market structures, more generous deposit insurance schemes and better credit information sharing. Liu et al (2013) studied the relationship between competition and bank stability in 11 European countries over the period 2000-2008. They find evidence for a U-shaped relationship between competition and stability. In other words there is an optimum level of bank competition that would keep bank risks at a minimum level.

While the above studies are based on data taken mostly from developed countries, there are a few studies pertaining specifically to EMEs. Crystal et al (2002) studied banks in select Latin American countries during the period 1995-2000 and found that foreign banks show more robust loan growth, a more aggressive response to asset quality deterioration and a greater ability to absorb losses than domestic banks. They conclude that such characteristics can help strengthen the financial systems of host countries. Yeyati and Micco (2003) study bank competition and foreign entry in eight Latin American countries and the implications for risk taking. Their results show that foreign bank entry leads to less competition in banking. They also find that banking sector fragility is positively

related to competition and therefore foreign bank entry can lead to banking stability despite foreign banks in the region having higher insolvency risk and more volatile returns.

Zhang et al (2013) study the relationship between bank performance measured by technical efficiency, risk and competition across BRIC economies, using 1001 bank-year observations covering major domestic commercial banks for the period 2003-10. They find that efficient banks take a lower level of risks and that the presence of state ownership and foreign banks reduces bank efficiency. Amidu and Wolfe (2013) study the effects of competition on diversification and stability using a sample of 978 banks in 55 developing economies from 2000–2007. Their main finding indicates that competition increases stability as diversification across and within both interest and non-interest income generating activities of banks increases. They identify revenue diversification as a channel through which competition reduces bank insolvency risk. Soedarmono and Tarazi (2014) study a sample of commercial banks in Asia Pacific from 1994-2009 and highlight the fact that banks in less competitive markets exhibit lower loan growth and higher instability. Such instability is further followed by a decline in deposit growth, suggesting that Asian banks are also subject to indirect market discipline mechanisms through bank market structure. The study advocates greater reliance on market discipline and strengthening of financial intermediation to promote bank stability.

Some studies have examined the relationship between competition and stability using different kinds of market segmentation within the banking sector of individual countries as the basis for their investigation. Ghosh (2009) explores the liaison between charter value and bank risk-taking for India for the period 1996-2006. He also studies the determinants of charter value, particularly focusing on competition. The results indicate that concentration in deposits or loans markets exerts a strong influence on charter value of banks. Thus, there is a strong link between competition and charter value. Further, banks' size, their operating efficiency and non-interest income are the main determinants of charter value. Zhao et al (2009) study the lending market of Indian banks through which they attempt to understand the effect of financial reforms on competition and risk taking incentives of banks during 1992-2004. They observe that there is an increase in competition due to reforms which also increased banks' risk taking.

Goetz (2012) examines the effect of a bank's diversification on its risk taking behavior as well as the risk taking behavior of competing, non- diversified banks in the US. The results reveal that greater geographic diversification of banks affects a bank's lending behavior and market interest rates. This has further ramifications for non-diversified competitors due to interactions in the banking market. By utilizing the state-specific timing of a removal of intrastate branching restrictions, the study indicates that a bank's diversification also impacts the risk taking of competitors, even if these banks are not diversifying their activities.

Liu and Wilson (2013) examine how the relationship between competition and risk varies across different ownership structures for the Japanese banking system over the period 2000—2009. They find that, on a national basis, City and Trust banks take on more risk on average than their regionally focused counterparts, i.e. Regional, Tier 2 Regional, Shinkin and Credit Cooperative banks. The relationship between competition and risk also differs across bank types on the basis of different initial levels of risk. Increasing competition seems to reduce the risk of City banks and increase the risk of the other types of banks.

Jimenez et al (2013) investigates the linearity of the relationship between bank competition and risk. The paper uses data for 107 commercial and savings banks in Spain for the period 1988-2003. Their empirical results suggest a nonlinear relationship between banking market competition and bank risk-taking using standard concentration measures for both loan and deposit markets. However when the Lerner index is used as a measure of bank competition, the result does not indicate a nonlinear relationship. Kick and Prieto (2013) analyze the competition-bank risk nexus by using bank-level data for German cooperative and savings banks for the period 1994-2010. Using bank specific, efficiency- adjusted Lerner Index as a proxy for bank-specific market power, they conclude that market power tends to reduce risks. In contrast, using the Boone Indicator (the elasticity of profits to marginal costs) and/or the regional branch share as a measure of competition, the results suggest that higher competition leads to lower risks.

Relating competition and concentration to some specific types of risks, Agoraki et al (2009) investigate whether the effects of regulation on banking risks are actually caused by the market powers of banks. Using data for the Central and European banking sectors from 1998-2005 they

find suggest that higher market power is associated with lower credit risk and lower probability of default of banks. Choudhury et al (2010) study the relationship between bank ownership concentration and risks measured by non-performing loans and capital adequacy ratio for around 500 commercial banks for more than 50 countries over the period 2005-2007. The results show that concentrated ownership significantly reduces a bank's bad loans ratio and increases capital ratio. At low levels of shareholder protection rights and supervisory control, ownership concentration can lead to reduction in banks' riskiness. Schaeck and Cihak (2012) study the effect of competition on capital buffers held by banks. Based on an analysis of data for more than 2,600 banks from 10 European countries during 1999–2004, the authors find that the Panzar-Rosse H-Statistic has a positive and significant effect on capital ratios indicating that banks hold more capital when faced with higher competition.

There is no existing empirical research that focuses on analyzing the link between competition and risk taking behavior of banks in India, although studies for developed economies such as Europe, Germany, Japan and the United States and some emerging market economies do exist. The two studies which come closest to our paper and that also study Indian banking are Ghosh (2009) and Zhao et al (2009). While Ghosh (2009) focuses on charter value and risk taking but not competition, Zhao et al (2009) investigate the impact of reforms on competition and risk taking in the lending market. However, our study stands out in that we focus specifically on the impact of competition, measured by both the structural and non-structural approaches, on a variety of risks faced by banks.

In the light of the above discussion, our paper makes several contributions. This is the first study that attempts to relate competition with risk in the case of Indian banks. Second, we measure concentration/ competition in a number of ways viz. structural measures like the 5-bank concentration ratios (based on loans, deposits and assets) and the Herfindahl-Hirschmann Index (HHI) along with the non-structural Panzar and Rosse H-Statistic. Third we study bank stability using a variety of risk indicators such as default, market, asset, capital and liquidity risks. Our empirical results provide a comprehensive understanding of the competition-stability link for Indian SCBs and thereby contribute to the relevant literature.

3. Data and Econometric Methodology

Bank-wise figures of the relevant variables employed in the study for Indian SCBs, i.e., public sector banks, Indian private banks and foreign banks, have been gathered from the various issues of Statistical Tables Relating to Banks in India. It is an annual publication of the Reserve Bank of India (RBI) which provides audited data on the balance sheet and income statements of individual banks. Our data-set covers the period 1999-2000 to 2012-2013. Macroeconomic data has been collected from the RBI's Handbook of Statistics for the Indian Economy.

To assess the impact of competition on banks' risk, we estimate equation (1) as follows:

$$Risk_{it} = \alpha_i + \beta_1 c_{it} + \beta_2 x_{it} + \varepsilon_{it} \quad \text{..... Eqn. (1)}$$

where Risk = a risk indicator; α_i represents bank specific effects; c = vector of concentration/ competition variables; x = vector of bank specific and macroeconomic controls. While the above specification has contemporaneous variables on the right hand side, we tried estimating with lagged independent variables. The results remain qualitatively unchanged indicating that our results do not suffer from endogeneity problems. Following Altunbas et al (2007) and Zhang et al (2013), we define five different measures of risk viz. default risk, asset risk, market risk, capital risk and liquidity risk. The last two are measured by capital and liquidity buffers of banks which imply protection against risks and hence are closer to soundness in their interpretation. For concentration/ competition variables we use three types of concentration ratios (5-bank concentration ratio or CR5 based on assets, deposits and loans), the Herfindahl-Hirschman Index (HHI) and the Panzar-Rosse H-Statistic. The control variables are bank size, profitability and GDP growth. Table 1 provides the definition and computation for each risk, concentration/ competition and control variable used in the study. While the risk and control variables are computed using simple formulas described in Table 1, the estimation procedures for the concentration/ competition variables require some explanation.

Following Liu et al (2010), we calculate the 5-bank concentration ratios (CR) and the Herfindahl-Hirschman Index (HHI) as follows:

$CR_n = \Sigma s_i$ ..... Eqn. (2)

where s_i is the share of the i'th largest banks in total loans, deposits or assets. In other words, $s_i = x_i/\Sigma x_i$, where x_i is the market share of bank i and n is the number of banks in the market. We calculate CR5 based on assets, deposits and loans. However we note that Indian banking is characterized by different types of banks across ownership and size categories. Banks compete with their counterparts within the same market segment and therefore it is more appropriate to infer competitive conditions within a peer group. To allow this, we take n in equation (2) as the number of banks in the relevant market segment where a bank operates. To define market segments we divide the banking market into the following groups: small domestic banks, large domestic banks and foreign banks. Foreign banks in India operate as branches of foreign headquartered banks and are not locally incorporated. They cater to multinational companies or those with forex requirements and high net worth individuals (e.g. business travelers). We divide domestic banks into small and large groups on the basis of the median value of their total assets. Banks above the medium value are classified as large while banks below it as classified as small. We assume that domestic banks compete with peers which are at par with them in terms of size. There is enough anecdotal evidence from Indian banking sector to support this approach. Large banks such as State Bank of India (a state owned bank) and ICICI Bank (a relatively new private sector bank) fiercely compete among each other at a pan-India level and with other large banks. At the other end of the size scale there are smaller banks such as Vijaya Bank (a state owned bank) and Federal Bank (an old private sector bank) who target similar customers and business.

The HHI is defined as follows:

$HHI = \Sigma s_i^2$ ……. Eqn. (3)

In case of a monopoly, HHI = 1. In case of an industry with n banks, the maximum possible value of the HHI would be 1 and the minimum possible value would be 1/n.

Following Anzoategui et al (2010), we estimate equation (2) to obtain the Panzar-Rosse H-Statistic:

$$\ln(TI_{it}) = \alpha + \beta_1 \ln(W_{1it}) + \beta_2 \ln(W_{2it}) + \beta_3 \ln(W_{3it}) + \gamma \ln(Z_{it}) + \varepsilon_{it} \text{ …….. Eqn. (4)}$$

where:

TI= total income /total assets (proxy for banks' output price)
W_1 = interest expenses /total deposits + total borrowings (proxy for input price of deposits)
W_2 = personnel expenses /total assets (proxy for input price of labor)
W_3 = other operating and administrative expenses /total assets (proxy for input price of equipment/fixed capital)

In equation (4), Z is a matrix of controls which includes equity /total assets, gross advances /total assets and size (logarithm of total assets). The equation is estimated using ordinary least squares (OLS) method. The error term ε is assumed to be normally distributed.

The H-Statistic (H-stat henceforth) is defined as $\beta1+\beta2+\beta3$, the sum of the input price elasticities of total revenues. The H-stat essentially measures the responsiveness of bank revenues to changes in input prices. An H-stat ≤ 0 is a sign of a monopoly; H-stat = 1 represents perfect competition, and an H-stat value that lies between 0 and 1 indicates monopolistic competition. The estimation of H-stat is done for the separate peer groups, viz. small domestic banks, large domestic banks and foreign banks.

4. Descriptive Statistics

Table 2 reports the mean values of the relevant variables while Figures 1 and 2 show the trend in risk and competition indicators over the sample period 2000-2013 for all scheduled commercial banks taken together. Mean values are calculated using weighted average where relative asset share is taken as weight. The results shows that mean weighted capital risk and mean weighted asset risk have remained fairly consistent for the entire sample period. Mean weighted market risk and mean weighted liquidity risk demonstrate a pattern of consistent increase and decrease respectively from the beginning till the end of the period. Mean weighted default risk declines drastically during 2008-2009, which is the peak financial crisis period, showing that the Indian banking sector was probably able to cushion the credit risk arising from bad loans in their overall

portfolio. However, from 2011-2013, there has been a sharp increase in default risk, suggesting that the proportion of bad loans has increased considerably. With respect to the competition variables, the mean CR5 (assets), mean CR5 (deposits), mean CR5 (loans) and mean HHI have remained considerably stable for the whole sample period. However, the mean H-stat, which is an indicator of banks' reaction to changes in input prices, has shown wide fluctuations. It displays a pattern of sharp rises and falls. The periods of sharp increase indicate a rise in banking market competition while lower values indicate a fall in the degree of competition.

Table 3 provides the broad descriptive statistics (means and standard deviations) of the variables mentioned in Table 1 across four categorizations- all banks, large domestic banks, small domestic banks and foreign banks. In terms of the risk indicators, foreign banks tend to exhibit higher values of mean and standard deviation as compared to the other categories. For the concentration variables, the statistics indicate that, foreign banks tend to have a higher mean except for H-Stat which measures competition. However, the standard deviation is higher for small domestic banks, indicating greater variation. With respect to control variables, foreign banks exhibit a higher mean value of ROA, while small and large domestic banks and all SCBs together, exhibit a higher mean value of size. The mean and standard deviation of annual GDP growth rate are the same for all categories as it is a bank-invariant variable.

Table 4 shows results from tests of differences in means of the relevant variables using the t test (two tailed, unequal variances). With respect to the first categorization for comparison, i.e. small domestic banks vs. large domestic banks, we find that for risk indicators, the difference between means is significant for market risk and asset risk. Differences between the two bank groups for all the competition variables are significant, while among the control variables, only size difference is significant, indicating greater variation. For the second categorization, i.e. foreign banks vs. small domestic banks, the table shows that all the competition, risk and control variables are significant with respect to differences in their means. For the third comparison category, i.e. foreign banks vs. large domestic banks, the results are the same as for category two.

Table 5 demonstrates the degree of correlation amongst the dependent and explanatory variables used in the multiple regression analysis. The main highlights of the table are as follows. Firstly, size is negatively correlated with all the risk variables. This means that as banks grow larger, they

are more prone to risks. Size is also negatively correlated with all the competition indicators, suggesting that the larger the bank, the lesser the chances of it facing intense competition from banks which are not at par. Similarly, negative correlation is observed between size and ROA, indicating that big banks can have lower profitability. However, size has a positive correlation with the annual GDP growth rate, meaning that a robust economic environment improves the performance of large banks. The second prominent variable affecting risk negatively is the annual GDP growth rate. It is negatively correlated with all risk indicators, showing that during a low economic cycle, banks are subject to higher risk. Amongst the competition indicators, excepting H-stat, GDP growth has a positive correlation with all the other variables. This indicates that a good business environment provides banks with the incentive to perform better, thus increasing competition. It displays a negative correlation with ROA, indicating that a not so stable economic cycle leads to lower returns for banks.

5. Estimation Results

We now report the results of our main regression as specified in equation (1). We employ panel regression methods and the choice between fixed effects and random effects models is driven by the outcome of Hausman tests. When the Hausman test favours the fixed effects (FE) model, we present the relevant estimates along with the F-test statistic to measure goodness of fit of the model. In case of random effects (RE), the F-test is not available and hence we present the Wald test statistic to assess the model fit. We begin the discussion with the effect of concentration (measured by the 5-bank concentration ratio based on loans and the HHI) on all five types of risk.

Table 6 reports the empirical estimation results for default risk, market risk and asset risk as the dependent variables. We find that in model (1), the CR5 for loans has a positive coefficient of 0.204 that is statistically significant at the 10% level. This shows that banks with larger market shares in the loan market could be more vulnerable to a bad loans problem. This evidence favours the insight of Boyd and De Nicolo (2005) who argued that competition in the loan market can actually help because the consequent fall in interest rates would lead to lower credit risks. The coefficient of HHI in model (2) is also positive but statistically significant. With respect to the control variables, we observe that both size and annual GDP growth have negative and statistically significant coefficients, indicating that a large scale of operations and upswings in the business cycle cause default risk to decline. Large banks have better risk management expertise which may

explain the lower proportion of NPAs in their overall portfolio. Robust GDP growth improves the financial health of borrowers and hence leads to less defaults.

Within table 6, models (3) and (4) present the results for market risk. We find that the concentration variable of CR5 (loans) has a positive coefficient of 0.522 which is statistically significant at the 1% level. Therefore, larger the market share of banks in the loan market, the greater is the market risk they are exposed to. This indicates that banks have to access short term debt from other banks to keep protecting their market share. However the other measure of concentration viz. HHI does not show a significant coefficient. Size is the only control variable with a significant coefficient. The negative sign of the coefficient suggests that as banks grow larger, dependence on borrowings and exposure to interest rate volatility make them more vulnerable to market risk. Moving to the regressions for asset risk in models (5) and (6), we observe that both the CR5 and the HHI variables have positive coefficients that are statistically significant at the 1% level. These results suggest that banks with a higher market share in lending have to hold more loan loss provisions against their total assets. As loan loss provisions in Indian banks is computed from a backward looking formula based on the quality of existing assets, this is an indication that banks with higher market power carry more stressed assets on their balance sheet. Size has a negative and significant coefficient, suggesting that big banks tend to keep a greater proportion of loan loss provisions. ROA enters the equation positively and significantly, indicating that the more profitable the bank, the higher is its asset risk. Overall the above findings provide support for the competition-stability view which suggests that concentration can exacerbate risk taking while competition helps to reduce risks.

Table 7 presents results for capital risk and liquidity risk, measured by the protection or buffer that banks have from these risks. In models (1) and (2) we observe that CR5 for loans has the coefficient 12.518 that is significant at the 1% level. The HHI also has a positive coefficient of 26.397 that is significant at the 1% level. These results mean that banks in highly concentrated market segments hold more capital. In other words, banks with higher market power are safer from an equity risk perspective as they hold more capital. While this may be due to higher regulatory capital requirements imposed by the banking regulator, it also supports the competition-fragility view that banks with higher market power protect themselves with higher capital or other risk management measures (Berger et al, 2008). Amongst the control variables, size has a negative and significant

relationship with capital risk while ROA displays a positive and significant relationship. This suggests that larger banks are more prone to capital risk and banks with higher profits are more stable. The annual GDP growth rate has a negative and significant coefficient, implying that during an upswing of the business cycle, banks can be more prone to capital risk. Models (3) and (4) in table 7 examines how competition variables affect liquidity risk. However neither CR5 nor HHI show statistically significant coefficients. With respect to bank specific controls, size enters the equation negatively and significantly, suggesting that larger banks can face difficulties in meeting their liabilities when they fall due, making them prone to liquidity risk. In the long run, inability to keep sufficient amount of liquid assets can lead to financial distress and insolvency. ROA enters the equation positively and significantly, suggesting that banks which generate high profits tend to have lower liquidity risk. The annual GDP growth rate has a positive and significant coefficient, thus indicating that a good business cycle promotes stability. In sum, while concentration does not seem to affect liquidity risk, our results for capital risk confirm the findings of Berger et al (2008) that concentration encourages banks to protect themselves through higher equity capital.

Table 8 illustrates the relationship between risk taking and competition where the latter is measured by the H Stat described earlier. In most of the risk categories, expect market risk, we do not find any role of completion. In case of market risk (model 2), we observe a positive coefficient for H Stat that is significant at the 10% level. This indicates that greater competition leads to increased reliance on inter-bank borrowings thereby increasing the vulnerability to interest rate fluctuations. This result contradicts our previous finding with CR5 in table 6 where we concluded that concentration leads to higher market risk. This is a puzzle for us but we prefer to go by the result for CR5 which had a lower probability of type-I error as the level of significance was 1%.

Finally we carry out some robustness checks for the above results. In tables 9 and 10, we re-estimate the risk-concentration relationship with two alternative measures of CR5 based on deposits and assets. In all cases our previous results get repeated. For instance, the coefficient of CR5 based on deposits is positive and significant for default risk, market risk, asset risk and capital risk. This confirms that higher concentration exacerbates default risk, market risk and asset risk

but also leads to higher equity held by banks. The coefficient of CR5 based on assets is positive and significant for market risk, asset risk and capital risk as before. Interestingly, for the first time the coefficient of CR5 turns out to be positive and significant for liquidity risk suggesting that as banks' market share grows larger, they are also able to hold more liquid assets to meet their liabilities as and when they fall due. This reduces their vulnerability to liquidity risk. This further confirms our previous results and the findings of Berger et al (2008) that banks with higher market power are able to protect themselves using various risk mitigation strategies.

6. Conclusions and Recommendations

We test the competition- stability liaison for the Indian scheduled commercial banking sector for the period 1999-2000 to 20122013. Five types of risk, i.e., default risk, asset risk, market risk, capital risk and liquidity risk are analyzed to see how competition affects them. We find that concentration affects default risk, asset risk and market risk positively, indicating that increased competition can help to reduce some types of risks faced by banks. On the other hand concentration has positive relationships with capital and liquidity ratios, suggesting that increase in competition may lead to financial instability.

Our results have important implications for banking sector policy. The evidence from this paper suggests that infusing more competition in the banking sector would engender greater financial stability which is in line with the competition-stability view in the literature or the theoretical work of Boyd and De Nicolo (2005). However while encouraging competition, the RBI should be cognizant about pressures on capital and liquidity buffers of banks. Therefore, any strategy on entry of new banks has to be carefully coordinated with supervisory efforts and macro-prudential policy in order to derive the benefits of greater competition in the banking industry. In recent years the RBI has been trying to open up the banking sector to new entrants. The regulator is currently reviewing applications for setting up new banks. As the RBI is India's banking regulator as well as monetary policy authority, it would do well to calibrate its bank licensing policy with macro-prudential efforts due to the close relationship between competition and risks evidenced above.

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Table 1: Definitions of Variables

Variable	Definition
Risk Variables	
Default Risk	*Default risk* is measured by gross NPAs to gross advances. A higher NPL ratio indicates a higher proportion of problematic loans in a bank's overall portfolio and increases its exposure to credit risk.
Asset Risk	*Asset risk* is measured by the ratio of loan loss provisions to total assets. While higher provisions helps to absorb losses in a better fashion, making such banks less prone to bankruptcy, but in case of India where provisioning is pro-cyclical, the ratio is a backward looking indicator of the quality of assets on a bank's books. Therefore a higher ratio would indicate inferior asset quality i.e. higher asset risk.
Market Risk	*Market risk* is measured by the ratio of interbank borrowings to total borrowings. A high value of this ratio for a bank indicates that it relies more on interbank borrowing and faces higher risk arising from movements in interest rates. Interbank markets are vital for banks' liquidity management when interbank markets function smoothly in normal time. However, in crisis periods, overreliance on interbank borrowing can lead to liquidity problems.
Capital Risk	*Capital risk* is measured by the capital buffer of banks given by the ratio of equity to total assets. It reflects to what extent a bank's total assets are funded by equity capital. A bank with a lower ratio indicates higher risk and vice versa.
Liquidity Risk	*Liquidity risk* is the risk that a bank faces of insufficient liquidity in order to meet its liabilities as and when they fall due. It is measured by the liquidity buffer or the ratio of liquid assets to total assets. The higher the ratio, the lower is the liquidity risk a bank faces.
Concentration Variables	
CR5	The n-bank concentration ratio, denoted by CR_n, measures the share of the industry's n largest banks with respect to a measure of total industry size. The most widely used size measures are based on loans, deposits and assets. $CR_n = \Sigma\, s_i$ where s_i is the share of the i'th largest banks in total loans, deposits or assets of a particular bank segment. Further, $s_i = x_i/\Sigma\, x_i$, where x_i is the market share of bank i in total assets of the banking segment. CR_n for n = 3, 4, 5 or 8 are among the

	most widely quoted n-firm concentration ratios. We use CR5 for assets, deposits and loans.
HHI	The Herfindahl–Hirschman Index (HHI) is calculated as HHI $= \Sigma s_i^2$ where s_i is the market share of bank i in the total assets of a banking segment. In an industry where there is a single monopoly producer, HHI = 1. In an industry with n banks, the maximum possible value of the HHI is 1 while its minimum possible value is 1/n.
Competition Variable	
H-Stat	The H-statistic is calculated from a reduced form revenue equation in which factor price inputs and bank outputs are related. Since this approach observes bank's reaction to changes in input prices, the H-statistic equals the sum of the coefficients of input price factors with respect to bank revenue. $0<H<1$ can be interpreted as a measure of the intensity of competition, with higher the value, higher intensity of competition. Under perfect competition, H=1.
Bank Specific Controls	
Return on Assets	ROA reflects the ability of a bank's management to generate profits from its assets. It is calculated as ROA= Profit during the year/Total Assets.
Size	An important part of bank policy making is trying to understand which size helps banks in managing risk better. It is measured by the log of total assets.
Macroeconomic Control	
GDP Growth Rate	High levels of GDP growth occurring during an upswing of business cycle might engender good business opportunities for banks. It is measured by annual growth rate of real GDP.

Table 2: Mean Weighted Risk and Mean Competition Variables

Year	Mean Wtd Capital Risk	Mean Wtd Default Risk	Mean Wtd Market Risk	Mean Wtd Liquidity Risk	Mean Wtd Asset Risk	Mean CR5a	Mean CR5d	Mean CR5l	Mean HHI	Mean H-Stat
2000	0.010	0.136	0.070	0.144	0.004	0.548	0.556	0.568	0.095	0.461
2001	0.007	0.119	0.101	0.142	0.004	0.544	0.547	0.557	0.094	0.386
2002	0.008	0.114	0.135	0.140	0.006	0.696	0.630	0.626	0.159	0.881
2003	0.006	0.088	0.153	0.098	0.009	0.655	0.620	0.630	0.155	0.759
2004	0.006	0.071	0.153	0.097	0.008	0.621	0.626	0.624	0.120	0.698
2005	0.007	0.037	0.138	0.068	0.005	0.708	0.698	0.705	0.150	0.359
2006	0.004	0.031	0.100	0.090	0.006	0.723	0.734	0.720	0.139	0.571
2007	0.002	0.022	0.106	0.096	0.006	0.683	0.692	0.687	0.127	0.627
2008	0.003	0.021	0.118	0.099	0.006	0.655	0.657	0.650	0.133	0.547
2009	0.003	0.023	0.049	0.095	0.009	0.710	0.718	0.716	0.153	0.663
2010	0.004	0.025	0.068	0.091	0.009	0.686	0.702	0.696	0.136	0.428
2011	0.004	0.019	0.064	0.091	0.009	0.671	0.681	0.649	0.159	0.555
2012	0.000	0.114	0.060	0.074	0.007	0.635	0.700	0.632	0.135	0.198
2013	0.000	0.129	0.047	0.061	0.007	0.644	0.698	0.623	0.138	0.510

CR5a= assets of the 5 largest banks; CR5d= deposits of the 5 largest banks; CR5l= loans/advances of the 5 largest banks

Figure 1: Trends in Mean Weighted Risk Variables

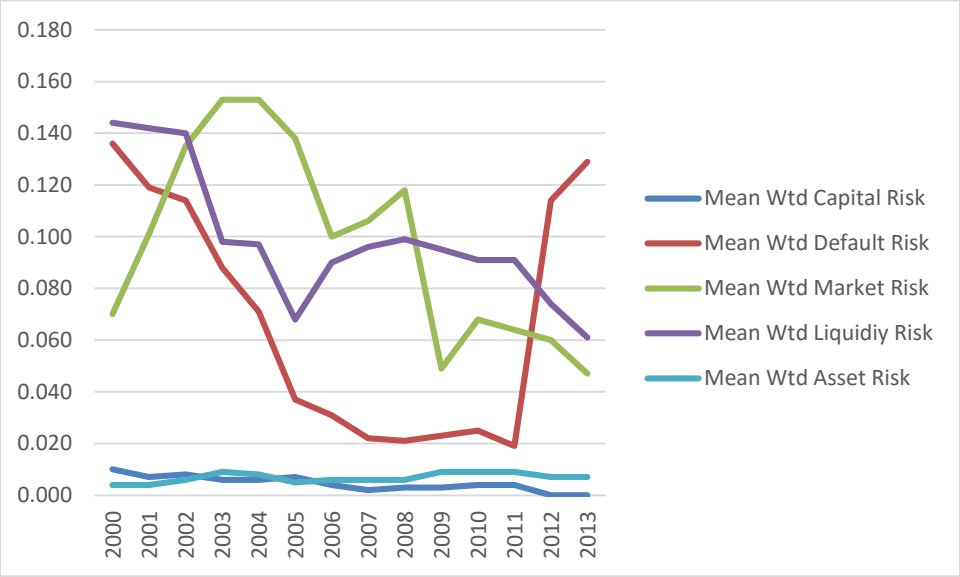

Figure 2: Trends in Competition Variables

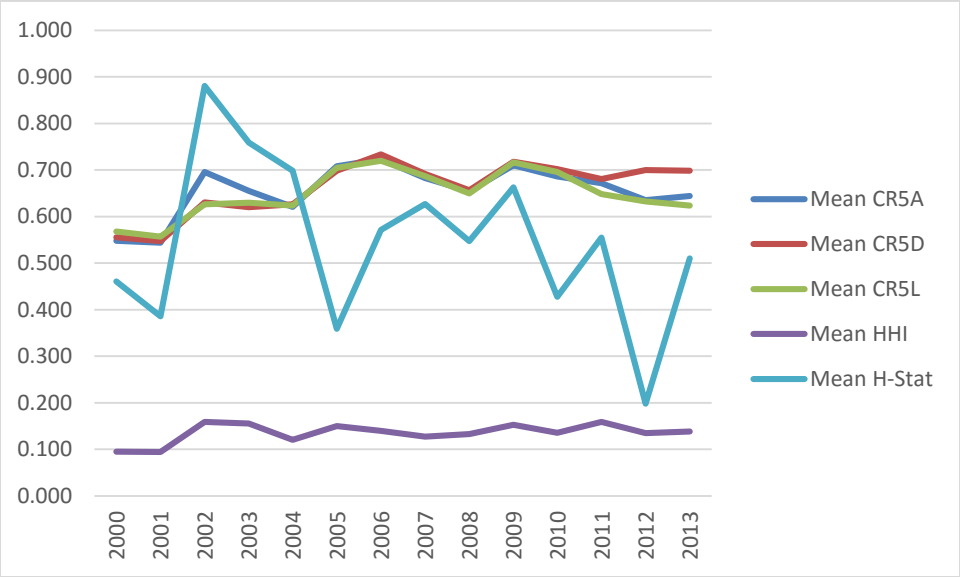

Table 3: Descriptive Statistics

	All Banks No. of Obs:751		Large Domestic Banks No. of Obs:253		Small Domestic Banks No. of Obs:244		Foreign Banks No. of Obs:254	
Variable	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Risk Variables								
Capital Risk	1.243	7.865	0.011	0.022	0.014	0.028	3.673	13.255
Default Risk	0.113	0.327	0.071	0.075	0.079	0.082	0.187	0.547
Market Risk	0.280	0.320	0.100	0.159	0.220	0.283	0.518	0.330
Liquidity Risk	1.168	8.116	0.105	0.059	0.111	0.070	3.264	13.782
Asset Risk	0.206	1.300	0.011	0.004	0.012	0.007	0.593	2.196
Competition Variables								
CR5 Assets	0.643	0.160	0.585	0.041	0.502	0.088	0.838	0.075
CR5 Deposits	0.646	0.156	0.572	0.040	0.526	0.106	0.834	0.070
CR5 Loans/Advances	0.637	0.143	0.589	0.040	0.507	0.083	0.809	0.063
HHI	0.131	0.057	0.119	0.012	0.079	0.018	0.194	0.049
H Stat	0.549	0.249	0.643	0.217	0.462	0.241	0.541	0.255
Control Variables								
ROA	0.135	1.222	0.008	0.004	0.008	0.008	0.384	2.082
Size	5.995	1.107	6.881	0.400	6.020	0.588	5.089	1.206
GDP Growth	6.937	2.022	6.993	2.021	6.994	2.023	6.828	2.027

Table 4: Test of Means (t statistics)

Comparison Categories	**Small Domestic Banks vs. Large Domestic Banks**	**Foreign Banks vs. Small Domestic Banks**	**Foreign Banks vs. Large Domestic Banks**
t statistics			
Risk Variables			
Capital Risk	1.115	4.400***	4.403***
Default Risk	1.075	3.115***	3.340***
Market Risk	5.761***	10.847***	18.177***
Liquidity Risk	1.154	3.645***	3.653***
Asset Risk	1.997**	4.218***	4.226***
Competition Variables			
CR5 Assets	-13.461***	45.688***	46.981***
CR5 Deposits	-6.312***	38.288***	52.134***
CR5 Loans/Advances	-13.860***	45.407***	46.891***
HHI	-28.639***	34.898***	23.519***
H Stat	-8.801***	3.562***	-4.845***
Control Variables			
Return on Assets (ROA)	-0.247	2.878***	2.877***
Size	-17.706***	-11.011***	-21.924***

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table 5: Correlation Statistics

Variables	Capr	Dr	Mr	Lr	Ar	Cr5a	Cr5d	Cr5l	HHI	H-Stat	ROA	Size	GDPG
Capr	1												
Dr	0.173	1											
Mr	0.246	0.175	1										
Lr	0.641	0.088	0.227	1									
Ar	0.873	0.140	0.218	0.591	1								
Cr5a	0.252	0.095	0.451	0.208	0.242	1							
Cr5d	0.156	0.068	0.403	0.113	0.145	0.954	1						
Cr5l	0.180	0.080	0.405	0.128	0.167	0.976	0.970	1					
HHI	0.315	0.095	0.400	0.248	0.301	0.938	0.858	0.874	1				
H-Stat	0.156	0.002	0.078	0.154	0.159	0.118	-0.059	0.035	0.238	1			
ROA	0.724	0.061	0.171	0.619	0.800	0.170	0.103	0.120	0.214	0.109	1		
Size	-0.512	-0.293	-0.574	-0.411	-0.485	-0.386	-0.299	-0.312	-0.368	-0.065	-0.350	1	
GDPG	-0.181	-0.172	-0.115	-0.128	-0.171	0.117	0.170	0.180	0.005	-0.052	-0.125	0.244	1

Note: Capr = Capital risk; Dr = Default risk; Mr= Market risk; Lr= Liquidity risk; Ar = Asset risk

Table 6: Concentration and Risk (Default Risk, Market Risk, Asset Risk)

	Default Risk (Gross NPAs/ Gross Advances)		Market Risk (Inter-bank borrowings/ Total borrowings)		Asset Risk (Loan loss provisions/ Total assets)	
Concentration Variables	(1)	(2)	(3)	(4)	(5)	(6)
CR5 (Loans & Advances)	0.204*		0.522***		1.440***	
	(0.123)		(0.103)		(0.465)	
HHI		0.147		0.072		3.578***
		(0.245)		(0.291)		(0.824)
Control Variables						
Size	-0.083***	-0.081***	-0.131***	-0.121***	-0.628***	-0.566***
	(0.014)	(0.014)	(0.012)	(0.017)	(0.051)	(0.050)
ROA	-0.006	-0.005	-0.005	-0.002	0.636***	0.633***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.025)	(0.025)
GDP Growth	-0.013***	-0.010***	-0.006	-0.001	-0.012	0.000
	(0.004)	(0.003)	(0.004)	(0.004)	(0.013)	(0.012)
Intercept	0.588	0.667	0.778	1.009	3.058	3.048
	(0.106)	(0.961)	(0.098)	(0.116)	(0.358)	(0.328)
FE/RE	RE	RE	RE	FE	FE	FE
R-square (within)	0.069	0.066	0.092	0.087	0.669	0.673
F-stat				15.29***	322.30***	329.19***
Wald Test	59.90***	57.32***	174.43***			

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table 7: Concentration and Risk (Capital Risk, Liquidity Risk)

	Capital Buffer (Equity/ Total assets)		Liquidity Buffer (Liquid assets/ Total assets)	
Concentration Variables	(1)	(2)	(3)	(4)
CR5 (Loans & Advances)	12.518*** (2.807)		-1.034 (4.141)	
HHI		26.397*** (4.976)		9.249 (7.379)
Control Variables				
Size	-3.977*** (0.311)	-3.485*** (0.306)	-4.205*** (0.458)	-4.147*** (0.454)
ROA	3.275*** (0.153)	3.266*** (0.152)	3.190*** (0.226)	3.148*** (0.226)
GDP Growth	-0.128 (0.080)	-0.012 (0.074)	0.190* (0.118)	0.174 (0.110)
Intercept	17.575 (2.162)	18.321 (1.981)	25.293 (3.190)	23.186 (2.938)
FE/RE	FE	FE	FE	FE
R-square (within)	0.627	0.632	0.429	0.431
F-stat	269.00***	274.38***	120.19***	120.85***

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table 8: Competition and Risk (All Five Types of Risk)

	Default Risk (Gross NPAs/ Gross Advances)	Market Risk (Inter-bank borrowings/ Total borrowings)	Asset Risk (Loan loss provisions/ Total assets)	Capital Buffer (Equity/ Total assets)	Liquidity Buffer (Liquid assets/ Total assets)
Competition Variable	(1)	(2)	(3)	(4)	(5)
H Stat	-0.023 (0.033)	0.060* (0.035)	0.008 (0.106)	-0.188 (0.650)	0.661 (0.944)
Control Variables					
Size	-0.085*** (0.014)	-0.133*** (0.013)	-0.596*** (0.053)	-3.744*** (0.327)	-4.121*** (0.475)
ROA	-0.005 (0.007)	-0.003 (0.008)	0.646*** (0.025)	3.363*** (0.154)	3.185*** (0.224)
GDP Growth	-0.010*** (0.003)	0.000 (0.004)	0.002 (0.012)	0.003 (0.076)	0.176 (0.110)
Intercept	0.721 (0.094)	1.033 (0.084)	3.675 (0.336)	23.323 (2.076)	23.866 (2.973)
FE/RE	RE	RE	FE	FE	FE
R-square (within)	0.066	0.091	0.664	0.616	0.430
F Stat			315.18***	256.11***	120.38***
Wald Test	57.50***	136.28***			

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table 9: Robustness check for Default Risk, Market Risk, Asset Risk

	Default Risk (Gross NPAs/ Gross Advances)		Market Risk (Inter-bank borrowings/ Total borrowings)		Asset Risk (Loan loss provisions/ Total assets)	
Concentration Variables	(1)	(2)	(3)	(4)	(5)	(6)
CR5 (Deposits)	0.193* (0.111)		0.483*** (0.091)		1.902*** (0.430)	
CR5 (Assets)		0.066 (0.109)		0.526*** (0.091)		1.651*** (0.397)
Control Variables						
Size	-0.087*** (0.014)	-0.081*** (0.014)	-0.138*** (0.012)	-0.122*** (0.012)	-0.689*** (0.054)	-0.591*** (0.050)
ROA	-0.006 (0.007)	-0.005 (0.007)	-0.005 (0.007)	-0.006 (0.007)	0.627*** (0.025)	0.633*** (0.025)
GDP Growth	-0.012*** (0.004)	-0.011*** (0.004)	-0.005 (0.004)	-0.006 (0.004)	-0.013 (0.012)	-0.012 (0.012)
Intercept	0.612 (0.097)	0.650 (0.111)	0.829 (0.091)	0.714 (0.101)	3.127 (0.319)	2.691 (0.379)
FE/RE	RE	RE	RE	RE	FE	FE
R-square (within)	0.070	0.066	0.094	0.096	0.674	0.672
F-stat		57.35***			329.73***	328.03***
Wald Test	60.20***		177.64***	185.95***		

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table 10: Robustness check for Capital Risk, Liquidity Risk

	Capital Buffer (Equity/ Total assets)		Liquidity Buffer (Liquid assets/ Total assets)	
Concentration Variables	(1)	(2)	(3)	(4)
CR5 (Deposits)	14.954*** (2.587)		4.574 (3.853)	
CR5 (Assets)		11.495*** (2.404)		6.658* (3.546)
Control Variables				
Size	-4.436*** (0.327)	-3.666*** (0.304)	-4.448*** (0.487)	-4.200*** (0.449)
ROA	3.212*** (0.153)	3.275*** (0.153)	3.136*** (0.227)	3.131*** (0.225)
GDP Growth	-0.126** (0.077)	-0.103 (0.077)	0.140 (0.115)	0.118 (0.115)
Intercept	18.635 (1.921)	16.108 (2.294)	23.492 (2.860)	20.823 (3.383)
FE/RE	FE	FE	FE	FE
R-square (within)	0.635	0.629	0.430	0.432
F-stat	277.80***	270.94***	120.78***	121.71***

Notes: *** p<0.01, ** p<0.05, * p<0.1