Revenue diversification and insolvency risk: Evidence from banks in emerging economies

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Abstract

Are there significant benefits of revenue diversification for banks in emerging economies? This paper investigates the impact of revenue diversification on insolvency risk in emerging economies as measured by the distance to default. Using a panel dataset of 322 listed banks across 22 countries and a new methodological approach (Systems' Generalized Method of Moments estimator), we provide the first empirical evidence of the impact of (i) the observed shift towards non-interest income and (ii) diversification within interest and non-interest generating activities on insolvency risk. Our core finding is that diversification *across* and *within* both interest and non-interest income generating activities decreases insolvency risk. Moreover, we find diversification gains remain even though increased reliance on non-interest income lowers risk adjusted profits. By extension, our results have significant strategic implications for bank managers and supervisors in emerging economies.

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1. Introduction

Motivated by the ongoing debate in the literature concerning the impact of revenue diversification upon bank profitability; and the fact that thus far research has primarily focused on developed countries; we assess the extent to which revenue diversification affects bank insolvency risk in emerging economies.[1] Empirical studies have focused on the impact of revenue diversification on bank profitability; however, a tension remains in the literature. Some researchers positively link revenue diversification with increased income volatility and a greater probability of bank insolvency: DeYoung and Roland (2001); Stiroh (2004, 2006); and Stiroh and Rumble (2006). Whereas, earlier studies such as Hughes et al. (1996); Demsetz and Strahan (1997); and Berger et al. (1999) suggests that diversification reduces the probability of bank insolvency.

Our paper makes several important contributions to the literature as a result of the following extensions in methodology and scope: firstly, on the methodological side, we control for the endogeneity of the diversification decision by introducing a new framework not previously used in this context. We use the System Generalised Method of Moments (SYS-GMM) estimators for dynamic panel data outlined in Arellano and Bover (1995) and more fully developed in Blundell and Bond (1998). This model is specifically designed to address the econometric problems induced by unobserved bank specific effects, joint endogeneity of the explanatory variables as well as autoregressive properties in the dependent variable.[2] We combine the distance to default, an established measure of fragility which builds on the Merton (1974) framework, with measures of diversification in our study of insolvency risk in emerging economies. We also control for the macro economic environment, a dimension which many studies in this area have ignored but is important because inadequate macroeconomic and institutional environments will undermine the role of a bank in efficient risk management (Hardy and Pazarbaşioğlu (1998), Nilsen and Rovelli (2001), Vives (2002), Demirgüç-Kunt and Detragiache (2005) and Hackbarth et al. (2006)).

Next regarding scope, to the best of our knowledge we are the first to perform a panel data analysis on revenue diversification using banks in emerging economies. In addition, instead of profitability ratios used in the current literature, we incorporate more elements of bank risks (equity capital, expected returns and the volatility of returns) to provide a measure of the likelihood that a bank will experience losses that exceeds its capital base.[3]

We use information obtained from banks' income statements to determine the sources of net-operating revenue. If a bank's source of net-operating revenue is solely derived from net-interest income we consider the bank to be concentrated and a bank whose net operating income is evenly split between non-interest and net-interest income is considered diversified. Our analysis begins with a panel framework of 322 listed banks across 22 countries over the period 1995-2006. We then investigate the benefits of diversifying *into* and *within* non-interest

[1] Revenue diversification is viewed as an avenue through which credit risk, which would normally be concentrated in a bank's loan portfolio, can spread to the other non-interest generating activities that a bank engages in. As in developed economies, revenue diversification in emerging economies means that banks are able to engage in diverse non-interest income activities such as securities underwriting, insurance and real estate investment. Importantly, we report for the first time evidence of a shift towards these activities in emerging economies.

[2] The concern here is that explanatory variables (i.e. profitability ratios) can be related to measures of diversification, for example the benefits of diversification for an ailing bank that has chosen to diversify in order to improve its performance may be understated.

[3] Profitability ratios fail to unravel separately changes in efficiency from changes in market power which represents separate regulatory concerns.

income generating activities. We incorporate into our analyses the fact that banks' diversification activities occur, either through *shifts* between non-interest income and interest income generating activities, through shifts *within* these two types of income generating activity or through both. Some interesting results emerge: we find diversification *between* interest and non-interest generating activities, as well as diversification *within* both types of activities reduces insolvency risk for banks in emerging economies. However, we report a negative "size effect": as marginal increases in exposure to non-interest income increases insolvency risk. This is attributed to the fact that the banks in our sample which are relatively large, are approaching optimal levels of diversification in which increases in the level of diversification does not increase risk adjusted performance *ceteris paribus*. We find that this phenomenon is reversed in growing economies as a result of increased scope and opportunities for profitable diversification. Our results are robust to controls for changes in market power as measured by bank concentration, the impact of the deposit insurance scheme on bank risk taking, possible sample bias and the influence of banks' structure and strategies.

In line with the literature, we also assess the contribution of different income sources to risk adjusted measures of profitability and find that an overall diversification of revenue as well as diversification within banks' lending activities in emerging economies is associated with increased risk adjusted performance. This evidence suggests that revenue diversification increases bank profitability per unit of risk. The remainder of the paper is organized as follows, section (2) reviews related literature, section (3) explains the methodology, the diversification measures and other variables used, section (4) and (5) present empirical results and robustness tests respectively and finally, section (6) concludes.

2. Literature Review

The issue surrounding the impact of diversification on financial institutions remains an active area of debate. Even though current studies have employed a variety of methodologies to analyze the impact of revenue diversification on bank performance; the evidence remains mixed as to how diversification affects performance. In general these studies identify a potential of revenue diversification to reduce risk but have empirically found that this positive returns to product-mix diversification tend to be short lived Demsetz and Strahan (1997), DeYoung and Roland (2001), Acharya et al. (2006) Stiroh and Rumble (2006). There are two main argument put forth in the literature to explain this paradox: First, banks offset the risk reduction benefits of revenue diversification by increasing risk taking in other areas. Second, diversification gains are offset by the increased exposure to non-interest activities which are more volatile while not as profitable as interest generating activities. Similarly, Berger and Ofek (1995) argue against the benefits of diversification because of the strong empirical evidence linking diversification discount to value losses of about 13-15% of all banks surveyed.

More closely aligned papers to our study are those that explicitly analyze the impact of revenue diversification on bank risk, DeYoung and Roland (2001), Morgan and Samolyk (2003), Campa and Kedia (2002) and Stiroh (2004). The dominating result in these studies is that the move toward non-interest income actually worsens the risk/return trade off for the typical bank as volatility increases while average returns do not. Hence, these studies contradict the theoretical argument that combining banking with non-banking activities should further reduce the risks of commercial banks.

In contrast, some other studies have found diversification to be risk reducing.,(Berger et. al 1999), Barth et al. (2004), Stiroh and Rumble (2006) find that diversification of income through non traditional activities is positively associated with bank stability.[4] Other benefits of revenue diversification such as the ability of revenue diversification to increase the volume of financial intermediation have been highlighted in the literature Neuberger (1995).

Whilst the literature is clear on the need to control for the endogeneity of the diversification decision; doing this poses an estimation difficulty as most variables that bear on the diversification decision also impact firm value. Therefore, our empirical methodology fundamentally differs from most used in the literature. The Arellano Bond (SYS-GMM) has a distinct advantage over other methods used to analyze micro panel data in most of the studies surveyed because it specifically addresses the issue of endogeneity(Bond 2002).

Finally, we assess the contribution of different income sources to the volatility of banks' profit; this has a distinct advantage of identifying a potential channel through which revenue diversification impacts on bank insolvency risk. Previous studies such as DeYoung and Roland (2001) have associated revenue diversification with decrease risk adjusted profits and by extension increases insolvency risk. In studying emerging economies, volatility of performance measures is an incomplete measure of bank risk; in some cases it may even signal efficiency. This may well be the case if volatility happens when price change incorporates the new information that is constantly arriving to the market (Blejer 2006).

3. Methodology

In this section, we introduce the Arellano Bond SYS-GMM and also give a brief rationale for its use. We then describe the construction of the distance to default, and the various diversification measures used in our analysis.

3.1 Empirical Methodology

The issue of endogeneity has been raised in prior studies such as Beale et al. (2006); they identify the need to control for the endogeneity of the diversification decision as banks with low franchise value may want to boost their performance by diversifying into either riskier or more volatile activities. The share of non-interest income in a bank's net-operating revenue is not an exogenous variable but reflects banks strategic choices and business opportunities. Controlling for endogeneity is appreciably difficult as researchers need to identify variables that affect the diversification decision without being correlated with bank value or in our case insolvency risk.[5]

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[4] There is also a separate strand in the literature that looks at issues of diversification impacting on systemic risk. Wagner (2006), De Vries (2005) and Lehar (2005) argue diversification of risk at financial institutions does not decrease the likelihood of systemic risk. Wagner (2006) argues that diversification results in a reallocation of risks within the financial system, whereas, De Vries (2005) and Lehar (2005) argue that diversification increases the probability of multiple defaults. It is important to note that even if a reallocation of risk does not reduce total risk, insolvency risk for individual banks can still be significantly reduced if banks only hold the amount of risk they can manage efficiently and not necessarily hold all the risk they originate.

[5] Researchers such as Stiroh and Rumble (2006); use standard estimators such as the fixed effects estimators to eliminate the potential bias caused by omitted heterogeneity. The fixed effect estimator which is a method of moment estimator based on the data after subtracting time averages is popular for three reasons: it is simple, easily understood and robust standard errors are readily available. In fixed effects estimators there are two common assumptions, first; an assumption of strict exogeneity for the covariates which is crucial for the consistency of the fixed effects estimator; and also an assumption about the constant variance and no serial

In this paper, we estimate an auto regressive-distributed lag model using a panel with large cross section units each observed for a small number of time periods; this data structure is typical of micro panel data, and calls for estimation methods that do not require the time dimension to be large in order to obtain consistent parameter estimates (Bond 2002). Prior research has also indicated that for dynamic panel data models ordinary least squares (OLS) estimators as well as within groups' estimation are likely to provide biased estimates. We thus use the System Generalized Method of Moments (SYS-GMM) estimators for dynamic panel data outlined in Arellano and Bover (1995) and more fully developed in Blundell and Bond (1998). A prominent way the GMM estimators have been used in prior research has been through first-differenced GMM estimators applied to dynamic panel data models. The estimator was originally developed by Holtz-Eakin et al. (1988) and Arellano and Bond (1991) and is commonly used in macroeconomic growth and development literature by Caselli et al. (1996); Easterly et al. (1997), Benhabib and Spiegel (2000), Levine et al. (2000) and more recently Maechler and McDill (2006). The following equation is a general reduced form of the model:

$$(Y_{it} - Y_{it-1}) = \alpha_0(Y_{it}) + \alpha_1(BS_{it} - BS_{it-1}) + \alpha_2(M_{it} - M_{it-1}) + \alpha_3(X_{it} - X_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \qquad (1)$$

Y_{it} is the distance to default or the risk adjusted return measures such as (RAR(assets) and RAR(equity), BS_{it} is a vector of bank-specific variables, a macroeconomic control M_{it} is also included, and finally, X_{it} represents measures of diversification. In equation (1), the regression is differenced to eliminate the possibility of omitted variable bias created by unobserved country-specific effects; internal instruments which are lagged values of the original regressors are used to address the issue of simultaneity bias. First differencing in the case of equation (1) introduces a correlation between the new error term and the differenced lagged-dependent variable. Therefore coefficient estimates would be biased. This problem is addressed by assuming that $\varepsilon_{i,t}$ are serially uncorrelated, that is $E(\varepsilon_{i,t}\varepsilon_{i,s}) = 0$ for $t \neq s$. The condition of validity of internal instruments used in this model is for the instrument to be correlated with the endogenous variable but not the error term.

There is a serious drawback to estimating Equation (1) in isolation as it is well known that large finite sample biases as well as imprecision can occur when instrumental variables are weak, and this difficulty carries over into the GMM estimation of dynamic panel data models. When the time series are persistent and the number of time series observations is small, the first-differenced GMM estimator is poorly behaved. The reason is that, under these conditions, lagged levels of the variables are only weak instruments for subsequent first-differences (Blundell and Bond 1998; Bond et al. 2001). However, Blundell and Bond (1998) suggest estimating a system combining two sets of equations. One set of equations are the differenced equations specified above in equation (1), for which we use suitable lagged levels of Y_{it} and other explanatory variable (X) as instruments, and the other set of equations in the system are the levels equation;

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correlation used primarily to simplify calculations of standard errors. However, if either heteroskedasticity or serial correlation is present a Generalized Method of Moments procedure can be more efficient than the fixed effects estimators (Wooldridge 2001).

$$(Y_{it}) = \alpha_0(Y_{it-1}) + \alpha_1(BS_{it}) + \alpha_2(M_{it}) + \alpha_3(X_{it}) + \eta_{it} + (\varepsilon_{it}) \quad (2)$$

Provided the x_{it} regressors satisfies $\mathrm{E}(\Delta x_{it}\eta_i) = 0$ (3)

And the initial conditions satisfy the restrictions $\mathrm{E}(\Delta y_{i2}\eta_i) = 0$ (4)

Blundell and Bond (1998) show that the system estimator has superior properties in terms of small sample bias.[6] In the context of GMM the over identifying restrictions may be tested via a Sargan test. This is a chi squared (χ^2) test for the validity of the instruments also known as a test for the exogeneity of instruments; since good instruments should be both relevant and valid; i.e. correlated with the endogenous regressors while at the same time orthogonal to the errors (Baum et al. 2003). A rejection of the null hypothesis implies the instruments do not satisfy the orthogonality conditions required for their employment. Across all model specifications in this paper, we find that we cannot reject the null hypothesis in any of our estimations and conclude that the internal instruments used are valid. All standard errors reported are adjusted for heteroskedasticity and within the model the two step estimation procedure is specified (Hoeffler 2002); and since coefficient estimates will only be consistent if there are no serial correlation in the shocks, v_{it}, we test for second order serial correlation in the first differenced residuals. The hypothesis of no second order serial correlation in the first differenced residuals is not rejected for any of our estimations. In line with Hoeffler (2002), we interpret the absence of higher order serial correlation in all of our estimations as the error term not containing unobserved country specific effects which may cause the level residuals to be serially correlated.

3.2 Calculating Distance to Default

In calculating distance to default we use a "spread sheet version" of the Merton (1974) model. Merton used Black and Scholes (1973) framework to solve for the underlying asset value implied by the option's price and volatility. These derived values are then combined into a risk measure called distance to default that is directly related to the credit worthiness of the bank. Equation (5) links the distance-to-default to the expected difference between the asset value of the firm relative to the default barrier, after correcting and normalizing for the volatility of assets. The smaller the value of the DD the larger will be the probability that the firm will default on its debt. The distance-to-default T periods ahead, is given by:

$$DD = \frac{\ln(V_A / D) + (\mu - \frac{1}{2}\sigma_A{}^2)(T)}{\sigma_A\sqrt{T}} \quad (5)$$

Where V_A is the value of the banks assets, D is the debt value, μ is the growth rate of the asset value of the firm and σ_A is the asset volatility.[7]

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[6] Where, η_i are unobserved country effects. The GMM instrument set in our model consists of lagged values of the dependent variable and relevant regressors lagged two and three periods.

[7] The distance to default is a variation of the probability of default and is widely used (see Clare and Preistley (2002), Vassalou and Xing (2004) and Duffie et al. (2007)).

3.3 Diversification Measures

To measure revenue diversification we construct Herfindahl Hirschmann Index (HHI) for all banks to account for diversification between major activities. The revenue HHI(rev) is computed from the revenue flows as follows:

$$\text{HHI(rev)} = \left(\frac{NON}{NETOP}\right)^2 + \left(\frac{NET}{NETOP}\right)^2 \tag{6}$$

Where $NETOP = NON + NET$

Non-interest income is captured by NON, NET is net-interest income and net-operating revenue is $NETOP$; A rise in this index shows an increases in revenue concentration and less diversification. The measure of diversification allows the breakdown of net operating income into its two broad categories. In line with Mercieca et al. (2007) we use these computations in constructing measures of diversification within non-interest activities and within interest generating activities.

$$HHI(non) = \left(\frac{COM}{NON}\right)^2 + \left(\frac{TRD}{NON}\right)^2 + \left(\frac{OTOP}{NON}\right)^2 \tag{7}$$

Where $NON = COM + TRD + OTOP$; and COM captures commission revenue, TRD captures trading income and $OTOP$ is other operating income, and higher values indicate greater concentration.

$$HHI(loan) = \left(\frac{MTG}{LOAN}\right)^2 + \left(\frac{HPL}{LOAN}\right)^2 + \left(\frac{CORP}{LOAN}\right)^2 + \left(\frac{OTHLN}{LOAN}\right)^2 \tag{8}$$

Where $LOAN = MTG + HPL + CORP + OTHLN$; and MTG is mortgages, HPL represents hire purchase and leases, $CORP$ is loans to group companies and associates, governments, municipalities and other corporates and $OTHLN$ is other loans.

3.4 Risk adjusted performance measures

Using annual data from banks' balance sheets, we construct two risk adjusted performance measures RAR(Assets) and RAR(Equity). Both measures are derived from the following profit ratios; return on assets (ROA) and the return on equity (ROE); defined as the annualized net income divided by assets and equity respectively. For each bank we also calculate the standard deviations of asset and equity returns over the lifetime of the bank in the sample to measure the volatility of profits. A combination of these measures define risk adjusted return on assets, RAR(Assets) and RAR(Equity) as follows:

$$\text{RAR(Assets)} = \frac{ROA}{\sigma_{ROA}} \tag{9}$$

$$\text{RAR(Equity)} = \frac{ROE}{\sigma_{ROE}} \tag{10}$$

Where, these ratios can be interpreted as accounting returns per unit of risk.

3.5 Discussion of Variables

Our priors are that we anticipate revenue diversification to have a positive effect on risk adjusted profits and bank insolvency risk. This is because revenue diversification improves diversification of risk, and promotes competition among financial service providers. We also anticipate the coefficient of HHI(loan) which measures diversification within interest generating activities to be negative. In other words, diversification within lending activities will lengthen the distance to default. It is important at this stage to note that the regression coefficients on the individual components share of the revenue diversification HHI(non) measures the effect of a shift from the omitted category of the component into an alternative one as one component has to be omitted to avoid perfect collinearity. For instance the coefficient of non-interest income share measures the shift out of net-interest income (the omitted component) into non-interest income. If the proportion of non-interest income increases the distance to default then its coefficient will be positive in the distance to default regressions. On the other hand, if increasing the proportion of non-interest income shortens the distance to default then we expect the coefficients of (non-interest income share) to be negative in our distance to default equations.

We also include some control variables used in studies of revenue diversification (Stiroh 2004) and systemic risk (Curry et al., 2001 and Lehar 2005) to reflect banks strategic choices that are likely to affect performance and stability. To control for economic development, we use the change in Gross Domestic Product per capita (Ec_development) obtained from the World Development Indicators World Bank (2006). In addition we incorporate the following variables to represent differences in the structure and strategy of banks: First, Loans to asset ratio (Loans/Assets) to capture differences in the banks asset portfolios as banks that have an asset based diversification strategy may make more loans, and grow more rapidly irrespective of the profitability of loans to other earning assets; Second, equity to assets ratio (Equity/Assets) controls for risk preferences of banks i.e. risk loving banks may hold less equity, Third, bank size Ln(Assets) which is the logarithm of total assets as well as growth of assets (Ass_growth) which controls for differences in performance across size classes of the banks i.e. larger banks may be active in more markets and face better possibilities of diversification (Lehar, 2005). Finally, we include the return on assets (ROA) to control for the profitability of banks.

3.6 Data

All data are taken from financial statements of listed banks obtained from the Bankscope database maintained by Fitch/Bureau van Dijk. Table 1 shows summary statistics for our key diversification variables in the panel dataset. For each bank in the panel dataset there is one observation per year and yielding an overall total of 4045 observations. The summary statistics for concentration indicate that the banking systems in the countries surveyed are dominated by a few large banks. The range of Assets show a wide variation in the size of banks surveyed even though large banks dominate the dataset as the mean (assets) greatly exceeds the median. On the performance side, our sample includes both low and high performing banks as indicated by the range of the ROA.

The mean for HHI(loan) is 9671.93 compared to non-interest income generating activities HHI(non) of 1.47. These figures indicate a high level of diversification within fee generating

activities compared to interest generating activities. A closer examination of the different sources of both non and net-interest income further confirm the evidence that banks in emerging economies appear to be more diversified within non-interest generating activities and more concentrated in the interest generating activities they are involved with.

4. Empirical Results

Table 2 provides a list of the number of banks surveyed in each country relative to the total number of banks in the banking system. We present empirical results of our canonical model in Table 3. We find the expected relationships between the three key diversification variables HHI(rev), HHI(non), and HHI(loan) with the dependent variable distance to default in columns (1), (2), (3), and (4).[8] The coefficient of revenue diversification HHI(rev) in column 1 is negative and highly significant indicating that revenue diversification lengthens the distance to default.[9] The coefficient of HHI(non) in column (2) and (3) is negative and significant indicating that diversification within non-interest generating activities has a positive effect on banks insolvency risk. Column (3) however, shows an increase in the proportion of non-interest income to net operating revenue (non-interest income share) to be negative and significant indicating that a marginal increase in non-interest income shortens the distance to default. This is possible since the banks in our sample have being exploiting non-interest income sources for a relatively longer period of time and may be optimally diversified given their current set of diversification opportunities. The coefficient of HHI(loan) in column (4) also indicates a significantly positive effect of diversifying within interest bearing activities on distance to default. We assign these results to the benefits of relationship lending in the relatively high risk environment that exist in emerging economies. This reduces information asymmetries between banks and their customers and enhances decision making on the part of the bank (Elsas 2005).

Although the primary aim of this paper is not to investigate the link between diversification of banks' revenue and risk adjusted performance, we view this extra analysis to be necessary because of the link between risk adjusted performance and insolvency risk i.e. if revenue diversification increases risk adjusted profits then by extension it should reduce insolvency risk. We find evidence that diversification increases risk adjusted performance. Even though the results show that the relationship is non linear, as increased exposure to non-interest income generating activities will decrease risk adjusted profits and increase insolvency risk. These results are similar to Demsetz and Strahan (1997), Beale et al. (2006), Stiroh (2006), Stiroh and Rumble (2006) and Merceica et al. (2007).[10]

Finally, we report on the control variables used; if we find significantly strong coefficients for bank size, growth and other characteristics of large banking strategies we could conclude that our results may be driven by the fact that a combination of experience, size, and expertise is

[8] Distance to default is the dependent variable in all regressions except in Table 4, where the dependent variables are the risk adjusted return on assets and risk adjusted return on equity.

[9] Increases in HHI(rev) represent increases in concentration.

[10] DeYoung and Roland (2001) suggests three reasons for the positive association between non-interest income and the volatility of bank earnings. First, bank loans are mostly relationship based and thus have high switching costs. Second, for an ongoing lending relationship; in order to increase total product (produce more loans) the main input needed is variable (interest expense) whilst in contrast the main input needed to produce more fee based products is typically fixed or less variable (labor expense). This implies fee based activities may require greater operating leverage than lending activities which makes bank earnings more vulnerable to declines in bank revenues. Third, most fee based activities require banks to hold little or no fixed assets so unlike interest based activities like portfolio lending fee based activities like cash management require little or no regulatory capital. Thus, fee based activities are likely to employ greater financial leverage than lending activities (DeYoung and Rice, 2004).

enabling large banks in emerging economies to better exploit the diversification potential of fee-based activities. We find the coefficient of bank size Ln(Assets), as well as the Equity/Assets ratio to be mainly insignificant. The significance and signs of Ec_development, ROA, and Ass_growth in Table 3 show a positive impact of the macro economy, bank profitability and growth on insolvency risk. The coefficient of loans to assets ratio (Loans/Assets) is consistently significant and negative indicating a detrimental effect of loan concentration on bank solvency.

5 Robustness Tests

Using the same methodology described in the previous section we next present robustness checks to control for other factors or omitted bank characteristics that may drive both the diversification decision and insolvency risk. Our goal is to eliminate alternative explanations for the strong observed relationship between revenue diversification and insolvency risk. We first present robustness checks for the distance to default regression that controls for changes in concentration in the banking system. The literature argues that concentration reduces aggressive risk taking behavior and increases bank profits which protect banks against adverse shocks (DeYoung and Rice (2004), Beck et al. (2006) Yeyati and Micco (2007)). If this is the case, the relationship between revenue diversification and insolvency risk may reflect the conditional correlation between banking system concentration and bank insolvency risk. We calculate the "change in concentration" by taking the first difference of the fraction of assets held by the three largest banks in each country per year. This is a variation of similar proxies for concentration recognized in the literature (Beck et al. (2006), Al-Muharrami et al. (2006)). Table 5 presents these results. Changes in concentration (D_concentration) appear to have a net positive impact on insolvency risk. The coefficient of (D_concentration) is positive and significant in columns (1), (2), and (3) indicating that banks from concentrated banking systems are more stable. However, controlling for concentration has eliminated the significance of HHI(rev), HHI(non) and Non interest income share. Our results therefore, support the concentration-stability view even though we do not find the observed relationship between diversification and insolvency risk to be robust to changes in concentration. The insignificant and smaller coefficient of non-interest income share in column (3) compared to Table 3 column (2) reflect a far less detrimental effect of reliance on non-interest income share on insolvency risk for banks in concentrated banking systems.

Another concern is that the results of our canonical model may reflect the benefits of diversification to underperforming banks when they diversify to recover profitability. We thus re-estimate the regressions presented in Table 3, excluding banks which are underperforming according to the following criteria: (1) negative average asset growth over the sample period or negative returns on assets for at least 4 reporting years (34 banks were excluded). (2) Short sample life i.e. banks with less than 6 years of observation (28 banks were excluded).[11] We do not find evidence that the benefits of revenue diversification for insolvency risk are as a result of any conditional correlation between underperformance and the diversification decision. We thus conclude that diversification benefits exist for both poor and well performing banks in emerging economies[12].

We next analyze whether the impact of revenue diversification changes with respect to banks strategic choices and the underlying macro economic condition. Of particular interest is how

[11] We wish to express a note of caution, as there are other reasons (such as mergers, acquisitions or regrouping) why banks may have a short sample life other than failure.

[12] A data appendix is available from the authors upon request

the impact of diversification may vary: first, with size (larger banks diversifying for a long time may have reduced marginal benefit of revenue diversification and a higher direct cost of increased exposure to non-interest income). Second, with capital ratio (high charter value firms tend to have high capital ratios to protect value) and finally with economic growth as the economic condition in a bank's host country may impact both its ability to gain from diversification as well as insolvency risk. Table 6a and 6b report regressions with the diversification and non-interest income share variables interacted with Ln(Assets), Equity/Assets and Gross domestic product growth (Gdpgro).[13] In Table 6a column (1) and (2) the asset interaction term HHIrev*(Ass) is significantly positive, this shows that large banks gain less from diversification. The capital and economic growth interaction terms (HHI(rev)*Eq/Ass and HHI(rev)*Gdpgro) in Column (3), (4), (5) and (6) show that the benefits of diversification increase with capital ratio and economic growth. Table 6b reports similar regressions with (Ln (Assets), Eq/Ass and Gdpgro) interacted with HHI(non) and non-interest income share. The results suggest the benefits of diversification within non-interest income as well as exposure to non-interest income is positively related to capital ratio, economic growth and unrelated to bank size.[14] In Table 6b column (3) and (4) we find that in growing economies the negative impact of increased exposure to non-interest income is reversed as there are more opportunities for efficient diversification. This is evidenced by the positive sign of the interaction between non-interest income and GDP growth (non-interest income share*Gdpgro).

Finally, we check whether the deposit insurance scheme impacts upon the relationship between diversification and insolvency risk in emerging economies. Even though the debate on the impact of deposit insurance on financial stability is ongoing: Diamond and Dybvig (1983): Allen and Gale (1998) find it an optimal policy when bank runs threaten bank solvency whereas Demirgüç-Kunt and Detragiache (2002) find it detrimental to bank stability. However, there is a consensus on the fact that deposit insurance can be a source of moral hazard as banks are encouraged to finance high-risk, high-returns projects (Demirgüç-Kunt et al. 2005).[15] If this is the case then diversification may not have an independent effect on insolvency risk but instead reflects the conditional correlation between the deposit insurance scheme and bank stability. The results show that the benefits of diversification *within* interest and non-interest generating activities on insolvency risk remain unchanged. However, we find suggestive evidence that gains from shifting into non-interest income by banks in emerging economies may be amplified as a result of the deposit insurance scheme. This can be attributed to banks diversifying beyond optimal levels due to the deposit insurance scheme (see data appendix).[16]

6. Conclusion

Using the systems Generalized Method of Moments estimator (SYS-GMM) to determine the impact of revenue diversification on the distance to default, we find direct evidence of positive

[13] Data is obtained from the World development Indicators, World Bank (2006).

[14] Including the interaction terms in regressions as well as the actual variables can cause multi-collinearity of the regressors, even though the SYS-GMM is designed to address correlations between regressors, if the correlation is large enough it can affect the coefficient estimates.

[15] The moral hazard index we use is a principal component indicator measuring the generosity of deposit insurance and it is based on co-insurance, coverage of foreign currency and inter-bank deposits, type and source of funding, management, membership and level of explicit coverage. We obtain the moral hazard index from the World Bank database on Bank concentration and crises (Beck et al., 2006).

[16] As a final check and to eliminate the possibility of a sample selection bias driving our results, we exclude Indian banks from our original sample (due to their dominance in the original sample) and re-estimate the regressions reported in Table 3. Our results remain unchanged.

benefits of diversification across and within business lines on insolvency risk during the period 1995-2006. We also find marginal increases in exposure to non-interest income increases insolvency risk in the absence of efficient diversification opportunities. Intuitively this is because large banks in emerging economies have being better able to exploit the diversification potential of fee-based activities and hence gain less from marginal increases in exposure to non-interest income ceteris paribus. We find that this phenomenon is reversed in growing economies as a result of increased scope and opportunities for profitable diversification. Our results are robust to controls for varying macroeconomic conditions, coverage of the deposit insurance scheme, bank strategic focus and bank size. Furthermore, our results are substantiated when bank profitability, the initial size and growth of banks, and other measures of bank strategy that could possibly obscure the impact of diversification on insolvency risk are controlled for.

Our results highlight the value creating process of efficient risk management through revenue diversification within banks in emerging economies. Because we find significant positive effects of diversification within lending activities on the distance to default; we conclude that revenue diversification should not undermine the need to expand within lending activities. Finally, our results constitute building blocks for a new body of empirical research into the impact of revenue diversification on insolvency risks for banks in both developed and emerging economies.

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TABLE 1: Summary Statistics

	Mean	Median	Standard deviation	Minimum	Maximum
Assets (US$ '000)	667451.70	1220.85	3665921	0.003	47300000
Equity/Assets	17.79	9.61	2319341	-61.35	100.00
Loans/Assets	47.34	48.15	18.70	-18.62	96.86
ROA	1.90	1.22	12.56	-158.46	510.01
HHI(loan)	9671.93	6.99	234434.50	0.00	7785695
HHI(non)	1.47	0.57	13.49	0.00	439.86
HHI(rev)	117.98	0.59	4834.99	0.50	228067.80
Commission	0.44	0.23	2.50	0.00	84.48
Trading	1.00	0.11	11.04	0.00	238.87
OTOP	0.69	0.15	6.99	0.00	281.12
Mortgages	1556.74	4.38	13732.22	0.00	158955.6
HP/Leases	3.00	0.24	8.77	0.00	79.01
Other Loans	9612.26	5.24	236744.6	0.00	7785695
Concentration	39.42	35.52	15.09	17.76	83.90
Non interest income share	0.37	0.34	0.55	-10.00	9.25
Net interest income share	0.81	0.67	7.19	-8.35	338.19
Distance to default	2.29	1.51	5.75	-4.44	133.82

Notes: Results are for 322 listed banks across 22 countries over the period 1995-2006. ROA is the return on assets, HHI(loan); is a measure of the diversification within interest generating activities, HHI(non) is a measure of diversification within non-interest generating activities and HHI(rev) is a measure of the shift between income sources. Commission, Trading and OTOP (other operating income) is calculated as the squared share of commission, Trading and other operating income in total non-interest income respectively. The same intuition applies to Mortgages, HP/Leases and other Loans which measures their respective shares (all squared) in net interest income of the banks (see section 3.3 on the calculation of diversification measures).

Table 2: Overview of Countries Surveyed

Country	Average total number of Banks over the sample period (1)	Number of listed banks surveyed in the sample (2)
Argentina	79	6
Brazil	200	18
Chile	42	7
China	80	10
Columbia	38	9
Egypt	38	24
Hungary	45	3
India	99	44*
Indonesia	62	22
Jordan	18	15
Malaysia	109	21
Mexico	63	15
Morocco	18	8
Pakistan	45	28
Peru	30	9
Philippines	53	9
Poland	54	4
Russia	488	7
South Africa	73	8
Thailand	55	23
Turkey	85	13
Venezuela	58	19
Total	1832	322

Notes: Source of data is Bankscope. * India has the most number of banks in the sample. Sample is for the period 1995-2006.

Table 3: The relationship between Distance to default and selected variables

	(1)	(2)	(3)	(4)
DD_lag	0.436***	0.638***	0.569***	0.511***
	(0.059)	(0.084)	(0.078)	(0.059)
Loans/Assets	-0.019***	-0.035***	-0.036***	-0.014**
	(0.006)	(0.011)	(0.010)	(0.007)
Ec_development	0.000***	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Assets)	0.049	0.026	0.013	0.047*
	(0.033)	(0.030)	(0.030)	(0.025)
Equity/Assets	0.021*	0.015	0.034	0.007
	(0.012)	(0.022)	(0.022)	(0.017)
ROA	0.049**	0.102***	0.065***	0.034*
	(0.021)	(0.022)	(0.020)	(0.020)
Ass_growth	0.000	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
HHI(rev)	-0.00004***			
	(0.000)			
HHI(non)		-0.013**	-0.011***	
		(0.006)	(0.003)	
Non interest Income share			-1.012***	
			(0.310)	
HHI(loan)				-0.000***
				(0.000)
AB test of no AR(2)p>Z	0.481	0.235	0.105	0.180
Sargan test for Overid P>chi	0.130	0.187	0.156	0.197

Systems GMM regressions include all listed banks. Robust standard errors are reported in parentheses. ***, **,* indicates statistical significance at the 1%, 5% and 10% Level respectively. Sargan Test for over identifying restrictions is based on two step regressions.

Table 4: Risk adjusted performance regressions

	(1)	(2)	(3)	(4)
	RAR(Assets)	RAR(Assets)	RAR(Equity)	RAR(Equity)
ROAvol1/ROEvol1	0.086	0.163*	0.256***	0.242***
	(0.128)	(0.090)	(0.057)	(0.057)
Loans/assets	0.225*	0.205	0.945**	0.853***
	(0.137)	(0.178)	(0.436)	(0.330)
Ec_development	0.000	-0.000	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Assets)	0.829**	0.886**	3.922**	4.544***
	(0.354)	(0.423)	(1.770)	(1.417)
Equity/Assets	0.589**	0.817**	0.720*	1.187**
	(0.289)	(0.382)	(0.403)	(0.491)
HHI(rev)	-0.001***		-0.019***	
	(0.000)		(0.005)	
HHI(non)		-0.056		-0.060
		(0.054)		(0.540)
Non interest income share		-10.516*		-36.566**
		(6.086)		(17.602)

Systems GMM regressions include all listed banks. Robustness standard errors are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5% and 10% Level respectively. RAR(Assets), RAR(Equity), are the risk adjusted returns on assets and equity respectively.

Table 5: Controlling for changes in market power. Concentration as measured by the asset share of the top 3 largest banks)

	(1)	(2)	(3)	(4)
DD_lag	0.475***	0.468***	0.493***	0.342***
	(0.067)	(0.068)	(0.079)	(0.066)
Loans/Assets	-0.014**	-0.015**	-0.019***	0.007
	(0.007)	(0.007)	(0.007)	(0.008)
Ec_development	0.000	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Assets)	0.040	0.029	0.009	-0.047*
	(0.035)	(0.037)	(0.043)	(0.025)
Equity/Assets	0.025*	0.024**	0.020**	0.027*
	(0.013)	(0.011)	(0.010)	(0.016)
ROA	0.173***	0.183***	0.136***	0.116**
	(0.067)	(0.069)	(0.052)	(0.051)
Asset_gro	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
HHI(rev)	-0.001			
	(0.001)			
D_concentration	0.064***	0.068**	0.059**	0.007
	(0.024)	(0.030)	(0.027)	(0.021)
HHI(non)		-0.127	-0.123	
		(0.091)	(0.111)	
Non interest Income share			-0.168	
			(0.459)	
HHI(loan)				-0.000***
				(0.000)
AB test of no AR(2)p>Z	0.360	0.574	0.593	0.176
Sargan test for Overid P>chi	0.610	0.553	0.516	0.497

Systems GMM regressions include all listed banks. Robust standard errors are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5% and 10% Level respectively. Sargan Test for over identifying restrictions is based on two step regressions.

Table 6a: Controlling for possible strategic bias and economic shock

	(1)	(2)	(3)	(4)	(5)	(6)
DD_lag	0.563***	0.562***	0.562***	0.562***	0.554***	0.555***
	(0.044)	(0.044)	(0.044)	(0.046)	(0.044)	(0.044)
Loans/assets	-0.008**	-0.008**	-0.007**	-0.008**	-0.008**	-0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
EC_development	0.000**	0.000**	0.000**	0.000	0.000***	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Assets)	0.008	0.008	0.009	0.008	0.016	0.016
	(0.018)	(0.018)	(0.018)	(0.016)	(0.018)	(0.018)
Equity/Assets	0.004	0.004	0.004	0.004	0.007	0.007
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
ROA	0.056***	0.055***	0.055***	0.055**	0.056***	0.057***
	(0.021)	(0.021)	(0.021)	(0.025)	(0.020)	(0.020)
Ass_growth	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
HHI(rev)*Ass	0.000***	0.000***				
	(0.000)	(0.000)				
HHI(rev)		-0.00003***		0.0003***		0.001*
		(0.000)		(0.000)		(0.000)
HHI(rev)*Gdpgro					-0.000**	-0.00007*
					(0.000)	(0.000)
HHI(rev)*Eq/Ass			-0.000***	-0.00004***		
			(0.000)	(0.000)		
AB test of no AR(2)p>Z	0.295	0.290	0.294	0.301	0.305	0.305
Sargan test for Overid P>chi	0.127	0.119	0.123	0.116	0.139	0.138

Systems GMM regressions include all listed banks. Robust standard errors are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5% and 10% Level respectively. Sargan Test for over identifying restrictions is based on two step regressions. NB: HHI(rev)*Ass = HHI(rev)*Ln(Assets), HHI(rev)*Gdpgro = HHI(rev)*Gross domestic product growth, HHI(rev)*Eq/Ass = HHI(rev)* Equity/Assets.

Table 6b: Controlling for possible strategic bias and economic shock

	(1)	(2)	(3)	(4)	(5)	(6)
DD_lag	0.619***	0.580***	0.538***	0.617***	0.536***	0.736***
	(0.090)	(0.084)	(0.082)	(0.062)	(0.077)	(0.063)
Loans/Assets	-0.039***	-0.039***	-0.009	-0.014**	-0.013	-0.017***
	(0.010)	(0.011)	(0.012)	(0.006)	(0.009)	(0.005)
Ec_development	0.000	0.000	0.000	0.000	0.000	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Assets)	0.007	0.008	-0.049	-0.017	0.052	-0.012
	(0.031)	(0.032)	(0.047)	(0.018)	(0.059)	(0.026)
Equity/Assets	0.045*	0.015	0.021	0.012	0.029*	0.003
	(0.024)	(0.030)	(0.020)	(0.014)	(0.016)	(0.010)
ROA	0.091***	0.059**	0.070***	0.051***	0.086***	0.061***
	(0.021)	(0.023)	(0.020)	(0.018)	(0.023)	(0.019)
Ass_growth	0.000***	0.000***	0.000	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
HHI(non)*Eq/Ass	-0.002***	0.001				
	(0.001)	(0.003)				
Non interest Income share* Eq/Ass	-0.043**	0.031				
	(0.021)	(0.041)				
HHI(non)		-0.020		-0.003		-0.009
		(0.017)		(0.004)		(0.009)
Non interest Income share		-1.261**		-1.084***		-0.932***
		(0.546)		(0.259)		(0.322)
HHI(non)*Gdpgro			-0.001	-0.001*		
			(0.003)	(0.001)		
Non interest Income share*Gdpgro			0.117*	0.115***		
			(0.063)	(0.035)		
HHI(non)*Ass					-0.003	-0.000
					(0.004)	(0.002)
Non interest Income share*Ass					0.022	0.020
					(0.052)	(0.036)
AB test of no AR(2)p>Z	0.166	0.096	0.794	0.259	0.325	0.125
Sargan test for Overid P>chi	0.361	0.294	0.120	0.241	0.247	0.230

Systems GMM regressions include all listed banks. Robust standard errors are reported in parentheses. ***, **, * indicates statistical significance at the 1%, 5% and 10% Level respectively. Sargan Test for over identifying restrictions is based on two step regressions. NB: HHI(non)*Ass= HHI(non)*Ln(Assets), Non interest income share* Ass= Non interest income share* Ln(Assets), HHI(non)*Gdpgro= HHI(non)*Gross domestic product growth, Non interest income share *Gdpgro= Non interest income share* Gross domestic product growth and HHI(non)*Eq/Ass= HHI(non)* Equity/Assets, Non interest income share* Eq/Ass= Non interest income share *Equity/Assets.