The Effect of Financial Derivatives Usages on Commercial Banks Risk and Value: Evidence from European Markets

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Abstract

We use a new set of data containing European banks operating in 25 countries to analyze the effect of derivative use on measure of risk and value. We find that using derivatives does seem to increase banks' risk. Further investigation reveals that the positive (negative) risk exposures are driven by banks that use of derivatives for trading (hedging), supporting the argument that derivatives can increase (reduce) banks' risk if they are effectively used for trading (hedging) purpose. We also find significant evidence that the use of financial derivatives is positively associated with bank market value. Specially, we find trading purpose for banks mainly causes an increase in bank value, this differ from theories that suggest the decision to hedge is value increasing by non-financial firms.

Keywords: Commercial Banks; European Markets; Financial Derivatives.

JEL Classification: G15; G20; G21.

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1. Introduction

The traditional role for banks has been perceived to be the reduction of transactions costs and the provision of information. However, given the technological, information, and financial innovations of the last decade, risk sharing and risk management are increasingly being viewed as a major source of value creation in banking. Allen and Santomero (1997) argue that these changes have increasingly shifted banks away from their traditional activities. Instead, they suggest that banks are making increasing use of financial markets to transfer, transform, and redistribute risk. Thus the financial markets' perception of bank activities has taken on increasing importance. Especially, after global financial crisis in 2008, banks' derivative activities have become increasingly controversial[1]. In fact, the effect of derivative use on risk measure and value is especially important in banking since banks dominate most derivative markets.

However, the use of derivatives contracts by banks has increased in the past two decades, the effect of derivatives on the risks and market value of banks is still unknown. Despite more widely available data on derivatives usage, the evidence obtained from empirical research on its effects is mixed[2]. One possible answer to such contradictory results is whether banks use derivatives for trading or hedging purpose. Previous studies have used data disclosed by all kinds of firms, including non-financial firms and banks industries, been trying to improve our understanding of

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[1] For example, the US Federal Reserve Board Chairman Alan Greenspan argues that derivatives had contributed to the development of a "far more flexible, efficient and resilient financial system that existed just a quarter-century ago", whereas in contrast, the noted US investor Warren Buffet, views derivatives as "time bombs for both the parties that deal in them and the economic system."

[2] For example, Peek and Rosengren (1997) provide evidence that the group of large banks in the derivative market includes a relatively high percentage of troubled institutions. In contrast, Hassan Karels and Peterson (1994) find that most of the off-balance-sheet banking activities including derivatives use are associated to decrease the risk exposure. Venkatachalam (1996) documents that notional amount of derivatives are negatively related to bank equity value. However, Riffe (1997) finds that the notional amounts of derivatives are positively related to bank equity.

how firms use derivatives.[3] The identifying assumption in nearly all of this literature has been that firms, including financial firms[4], use derivatives for hedging. However, Chernenko and Faulkender (2011) have demonstrated non-financial firms use derivatives not only for hedging but also for speculation. In the practice, not to mention for financial firms, banks' involvement in the derivatives market has been considerably asymmetric with respect to trading and hedging activities and banks more likely to speculate with derivatives[5]. Therefore, the primary objective of this is to empirically investigate whether bank's purpose (trading or hedging) of using derivatives is significantly related to their bank risk and value.

Although there are many empirical studies investigating the association between derivatives activities and banks' risk and value in the U.S. (for example, Hassan, Karels and Peterson, 1994) and Venkatachalam, 1996)), to the best of our knowledge, Not only there is no empirical study providing European market evidence[6], which is

[3] Examples include broad cross-sectional analyses such as Nance, Smith, and Smithson (1993), Mian (1996), Geczy, Minton, and Schrand (1997), Graham and Smith (1999), Barton (2001), Hentschel and Kothari (2001), Graham and Rogers (2002), DaDalt, Gay,and Nam (2002), Guay and Kothari (2003), Bartram, Bown and Fehle (2009), Bartram, Bown and Conrad (2011), and Chernenko and Faulkender (2011), as well as analyses in specific industries such as gold mining in Tufano (1996, 1998), Petersen and Thiagarajan (2000), the oil and gas industry in Haushalter (2000), Jin and Jorion (2006), MacKay and Moeller (2007), the air line industry in Carter, Rogers, and Simkins (2006), the mutual fund industry in Koski and Pontiff (1999), the hedge fund industry in Chen (2011), and banks in Hassan, Karels and Peterson (1994), and Venkatachalam (1996).

[4] Due to deposit guarantees, security and regulations for the public, financial firms are more likely to focus on hedge. Whidbee and Wohar (1999) assumes that banks use derivatives do so primarily for the purpose of hedging the risk exposures that arise as a result of the asset-transformation functions they perform. Purnanadam (2007) analyze the determinants of interest rate hegdging in commercial banks.

[5] U.S. banks with the top 5 largest derivatives portfolios hold 99.6 percent of their contracts for trading purposes, primarily customer service transactions, while the remaining 0.4 percent is held for their own risk management needs (OCC (2009)). Minton et al. (2009) find that in 2005 the gross national amount of credit derivatives held by banks exceeds the amount of loans on their books. Only 23 large banks out of 395 use credit derivatives and the most of their derivatives positions are held for dealer activities rather than for hedging of loans. The net notional amount of credit derivatives used for hedging of loans in 2005 represents less than 2% of the total national amount of credit derivatives held by banks and less than 2% of their loans.

[6] Not only is Europe by far the most important region for derivatives, which have become a major part of the European financial services sector and a major direct and indirect contributor to economic growth, but it is also the most important region in the global derivatives market. The global OTC derivatives segment is mainly based in London. Many European banks are currently global leaders in derivatives. Furthermore, Goddard, Molyneux, Wilson and Tavakoli (2007) highlight a number of key recent developments in the academic literature on European banking

the most important region in the global derivative market[7], but also our unique bank data have exactly information on derivative usage across different underlying assets for trading or hedging purposes, that is never used from previous related research. Besides, further to the impact as a whole of derivatives use on risk exposure, the separate effect of each type of derivatives has been recently researched.[8] Thus we also separately consider the impact of the using foreign exchange and interest rate derivatives on the bank's risk and bank value,

This paper fills the gap by empirically examine the effect of derivative usage on bank's risk and value. We use a new, unique raw dataset that includes 355 listed commercial bank's observations in 25 Europe countries. We are able to examine the extent to which banks, either through their use of derivative with different underlying assets for trading or hedging purpose defined by IFRS accounting rule, can mitigate a market wide decline. The one important finding that emerges from the analyses is that we find the level of derivatives activities is positively associated with bank risk. Further investigation reveals that the positive (negative) risk exposures are driven by banks that use of derivatives for trading (hedging), supporting the argument that derivatives can increase (reduce) banks' risk if they are effectively used for trading (hedging) purpose.

The other key fining reports that banks increase in the use of derivatives corresponds to greater bank market value, supporting the argument that banks are more likely to speculate with derivatives. Nevertheless, we find significant evidence

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[7] With 44 per cent of the total global outstanding volume, the European derivatives market has a significantly higher share than its total share of equities or bonds; see Bank for International Settlements (2008) and World Federation of Exchanges (WFE) statistics (www.world-exchanges.org).

[8] For example, Allaynnis and Weston (2001) find that firm value (as measured by Tobin's *q*) is higher for U.S. firms with foreign exchange exposure that use foreign currency derivatives to hedge. Purnanandam (2007) suggests that a potential benefit of interest rate derivative usage comes from its ability to allow a commercial bank to maintain smooth operating policies in the event of external shocks. Unlike derivative non-user banks, the user banks may fewer (or no) adjustments to their on-balance sheet maturity GAPs and do not significantly cut their lending volume when the Fed tighten the money supply.

that the use of foreign exchange derivatives for trading (hedging) purpose is significantly (insignificantly) and positively associated with bank value. Specially, for interest rate derivative, banks use it not only for trading but also for hedging purpose are significantly and positively associated with bank value. In other words, we find trading purpose for banks mainly causes an increase in bank value, this differ from theories that suggest the decision to hedge is value increasing by non-financial firms but maintain the argument that banks are more likely to speculate with derivatives.

The remainder of this paper is organized as follows. Section 2 identifies the data sources, defines the variables, and establishes the empirical methods used in this paper. Section 3 presents our empirical results. Section 4 summarizes and concludes the paper.

2 Data and Variable Definitions

2.1 Data

Until recently, data on derivative usage by banks outside of the world were disclosed largely on a voluntary basis. A move toward common international Financial Reporting Standards Resources (IFRS) means that it is now practical to study international derivative use at the bank level. Because reporting standards can vary within and across countries, we also conduct robust checks that restrict our sample to those banks that comply with IFRS.

We obtain data on banks' balance sheet and income statements from a comprehensive database from the Bankscope database maintained by Fitch/IBCA/ Bureau Van Dijk, which provides a global database containing information on over 23,000 public and private banks. This panel data only includes commercial banks and bank holding companies (BHCs). We use data from consolidated accounts if available and otherwise from unconsolidated accounts to avoid double counting. The yearly observations are matched with country-level factors in the corresponding year, and the country profiles are specifically taken from the International Financial Statistics database of the International Monetary Fund. The initial sample consists of 218 listed European banks. We exclude banks that are foreign subsidiaries or branches, which reduces our sample to 1,112 banks. We drop additional banks for assorted reasons, an unreadable annual report or annual reports not containing “notes to the Firm-level Statements; stock price data are not available in Datastream and have no information on derivatives usage for trading or hedging purpose, resulting in a sample of 355 observations in 25 countries in the European market[9].

Base on our unique database, the derivatives that banks use for trading or hedging can be mainly composed of six types of derivatives: (i) foreign exchange, (ii) interest rate (iii) equity (iv) credit (v) commodity and (vi) other derivatives. We show the number of banks derivatives separately for six types of derivatives from Table 1 reveals that foreign exchange derivatives are the most common and followed by interest rate derivatives. Financial exposure of banks that engage in both domestic banking activity and foreign exchange operations can be separated into two primary categories: foreign exchange exposure and interest rate exposure. Such exposure can have a significant impact on a bank’s financial performance (Mun and Morgan, 2003). Therefore, in this paper, we only separately consider that the effect of using foreign exchange and interest rate derivatives on the bank’s risk and value. Besides, we can find that banks’ involvement in the derivatives market has been considerably asymmetric with respect to trading and hedging activities. Simultaneously, compared with the value of derivatives used for trading, the value of derivatives held by banks for hedging is much smaller in our sample.

[9] The dataset comprised of the following 25 countries: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.

<Table 1 is inserted about here>

3.2 Variable Definitions

The following sub-sections define the dependent and independent variables used in the empirical analyses in the present study.[10]

3.2.1 Dependent Variable: Bank Risk

While the risk of assets and liabilities contain different components and their interactions are difficult to decompose, the assumption of efficient capital markets suggests that net exposures can be estimated empirically using a bank's stock price as an aggregate measure of relevant information. Consequently, we follow Bartram, Brown and Conrad (2011) to use the standard deviation of daily stock returns (σ_{return}) for each bank to measure the bank risk[11].

3.2.2 Dependent Variable: Bank Value

The franchise value of a bank equals the present value of the current and future profits that a bank is expected to earn. This can be proxied by Tobin's Q ratio, the ratio of the market value of the assets to the book value (Luc and Ross (2007)). However, Tobin's Q ratio has two potential shortcomings (De Jonghe, and Vennet (2008))[12]. Therefore, we follow De Jonghe, and Vennet (2008) to use noise-adjusted Tobin's Q ratio (Q^{NA}) as a measure of bank's franchise valuation[13].

3.2.3 Independent Variable

We employ the notional outstanding amounts of derivatives to capture the extent

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[10] In order to facilitate a quick overview on our explanatory variables, we provide for the variables that we used in other studies and ours in Appendix.

[11] In addition, as further checks for robustness, we also carry out empirical analyses using market beta which is estimated by Sharp market model to measure the bank risk. The tenor of the results remains largely unchanged.

[12] First shortcoming is that although economic theory assumes the maximization of shareholder value, bank managers may not maximize the value of the firm when there is separation between ownership and control. Second, measurement error and (bad) luck may have an effect on bank's market valuation (Poterba (1988)).

[13] For robustness, we also reassess and confirm the results using the Tobin's Q to measure the bank's value. For protectional purpose, we do not report these results in a table and the tenor of the results remains unchanged.

of derivative activities by banks in Europe. Following Bartram, Brown and Conrad (2011), the usage of derivatives (*DER*) is measured by a binary variable[14] as follows:

$$DER_{it} = 1 \qquad \textit{if Commercial bank i uses derivative at year t}$$
$$DER_{it} = 0 \qquad \textit{if Commercial bank i does not use derivative at year t}$$

3.2.4 Control Variables

In order to rule out the possible effects on bank value and risk from balance sheet control variables. We follow the extent literatures to add a number of control variables. Below, we describe the various controls that we use in our multivariate tests and the theoretical reasons that led us to use them.

(a) Diversification

Diversification of activities within a single financial conglomerate could yield economics of scope that boost valuations. Or, diversification of activities could intensify agency problems and induce a discount in the valuation of financial conglomerate. Thus, we follow Luc and Ross (2007) to construct two measures that focus on diversification. Asset diversity (*MAD)* is a measure of diversification across different types of assets and is calculated as

$$1-\left|\frac{(\text{Net loans} - \text{Other earning assets})}{\text{Total earning assets}}\right|$$

where other earning assets include securities and investments. Total earning assets is the sum of net loans and other earning assets. *MAD* takes values between zero and one with higher values indicating greater diversification.

Income diversity *(MID)* is a measure of diversification across different sources of income and is calculated as

$$1-\left|\frac{(\text{Net interst income} - \text{Other operating income})}{\text{Total operating income}}\right|$$

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[14] In our robust empirical models, we use the bank's notional outstanding amounts of total derivatives, foreign exchange derivatives and interest rate derivatives respectively, scaled by the bank's total assets, as continuous measures of the bank's involvement in derivatives markets. Total derivatives include interest rate, foreign exchange, equity, commodity, credit and other derivatives. For protectional purpose, we do not report these results in a table and the tenor of the results remains unchanged.

Net interest income is interest income minus interest expense and other operating income includes net fee income, net commission income, and net trading income. Income diversity takes value between zero and one with higher values indicating greater diversification. The *MAD* and *MID* measures are "complementary" in that asset diversity is based on stock variables and income diversity is based on flow variables.

(b) *Bank Size*

There is ambiguous evidence for banks as to whether size leads to higher accounting profitability[15]. However, large banks are more likely to use derivatives than are smaller banks (Sinkey and Carter (2000)). We use the natural logarithm of a bank's total asset (*SIZE*) to control for the effect of size.

(c) *Profitability*

A Profitable bank is likely to trade at a premium relative to a less profitable one. Thus, if hedgers are more profitable, they will have higher bank value. To control for profitability, we use return on equity (*ROE*), defined as the ratio of net income to total equity, which is particularly important to shareholders and is related to the charter value of a bank. Besides, Net interest margin (*NIM)* is a measure of intermediation profitability before credit losses. It is calculated as net interest income (the difference between total interest income and total interest expense) dividend by total assets. We also included it as control variable.

(d) *Financial Distress*

Since higher capital (*EQRAT*) defined as the ratio of equity capital to total assets and liquidity (*LIQ*) defined as the liquidity assets divided by total assets reduces banks probability to distress, and thus, a lower value of risk; therefore, we included them as

[15] See Mukherjee, Ray and Miller (2001) and Steve, Schaecj and Wolfe (2007) for arguments that large bank size leads a higher bank value and, inverse, see Bonaccorsi, Patti and Gobbi (2001) for arguments that large bank size leads a lower bank value.

control variables.

(e) *Risk Exposure*

In this study, given data availability, we employ total corporate and commercial loans divided by total assets (*CCLOAN*) and non-interest income divided by total income (*NOMINT*) as additional variables to proxy for on-balance sheet interest rate risk. High interest rate reduces economic growth, hence, the volume of IPOs and acquisitions decline, thereby reducing banks' non-interest income. Thus, banks that are more reliant on non-interest income should have more exposure to interest rate risk. On the other hand, if banks have a high concentration of loans, which is commonly repriced more often than once a year, they will have less exposure to interest rate risk. We also control for credit risk proxied by *RES* which defined by loan loss reserve divided by total assets. We also consider the natural logarithm of GDP (*LNGDP*) to control different countries face different level of macroeconomic or country risk (Bartram, Brown and Fehle (2009)).

4. Empirical Results

4.1 Summary Statistics

Table 2 presents summary statistics of the main variables that we use in our article. The average *ROE* and *NIM* for the sample is 12.46% and 2.39%, which are slightly smaller than US banks[16], respectively.

<Table 2 is inserted about here>

4.2 Univariate Results

To begin, we compare the simple average of bank risk and value in our sample categorized by derivatives use.[17] These results are presented in Table 3. We measure

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[16] The average *ROE* and *NIM* for the bank samples in US is 13.36% and 3.44% (see Minton, Stulz and Williamson (2009)).

[17] In order to avoid selection bias problem in our study, we also follow Bartram, Brwon and Conrad (2011) to use propensity score matching method. For protectional purpose, we do not report these results in a table and the tenor of the results remains unchanged.

the significance of difference between the two types of banks using non-parametric Wilcoxon tests. Table 3 reports the *p*-value of these tests together with the means, medians and difference in means of bank characteristic for derivative users and nonusers. The results in Table 3 only refer to general derivatives use and shows that banks using derivatives have higher bank risk and value.

<Table 3 is inserted about here>

4.3 Panel Regression Analysis for the Whole Sample

To answer the question as to how effect of derivatives on bank risk and value, we implement the panel regression with fixed effect and follow Peterson (2009) to estimate standard error cluster by firm[18]. These relationships can be expressed as follows:

$$\sigma_{return} = \alpha_{0i} + \alpha_1 DER_{it} + \alpha_2 MAD_{it} + \alpha_3 MID_{it} + \alpha_4 LNTASS_{it} + \alpha_5 ROE_{it} + \alpha_6 NIM_{it} + \alpha_7 EQRAT_{it} + \alpha_8 LIQ_{it} + \alpha_9 CCLOAN_{it} + \alpha_{10} NOMINT_{it} + \alpha_{11} RES_{it} + \alpha_{12} LNGDP_{it} + \varepsilon_{\mathrm{it}} \quad (1)$$

$$Q_{it}^{NA} = \alpha_{0i} + \alpha_1 DER_{it} + \alpha_2 MAD_{it} + \alpha_3 MID_{it} + \alpha_4 LNTASS_{it} + \alpha_5 ROE_{it} + \alpha_6 NIM_{it} + \alpha_7 EQRAT_{it} + \alpha_8 LIQ_{it} + \alpha_9 CCLOAN_{it} + \alpha_{10} NOMINT_{it} + \alpha_{11} RES_{it} + \alpha_{12} LNGDP_{it} + \varepsilon_{\mathrm{it}} \quad (2)$$

When we consider the derivatives with the specific underlying asset in Equation (1)-(2), *DER* will be replaced by related derivative variables, for example, if we want to consider the effect of bank's foreign exchange derivatives on their bank risk and value, *DER* will be replaced by *FEDER*.

4.3.1 Bank Risk

In this section, we given one of primary focus of this study which is the impact of financial derivatives usage on bank risk and the control variables serve to compensate for any on- and off-balance sheet variable interactions. The results of the panel regression model with fixed effect are shown in Table 4. We further

[18] The Hausman test is the standard procedure used in empirical panel data analysis in order to discriminate between the fixed effects and random effects model. Based on our Hausman test result, p-value of 0.000, the panel regression model with the estimation of fixed effects is more suitable than a model with the estimation of random effects.

disaggregate *DER* (model (1)) into *FEDER* (model (2)) and *IRDER* (model (3)) to examine if bank use different underlying asset of derivatives reduce or increase bank risk exposure.

The results in model (1)-(3) indicate that there is a significantly positive relationship, between *DER* and bank risk, suggesting that the level of derivatives activities in banks is associated with an increase in bank risk exposure.

<Table 4 is inserted about here>

We also note that *DER* may be endogenous variable in Equation (1). To correct for such endogeniety issue, we estimate our regression model using the two-stage least squares (2SLS) methodology. Specifically, in the first-stage regression, we estimate *DER* using financial openness (*OPENNESS*)[19] as instrumental variables. Then in the second-stage regressions, we replace *DER* by its fitted values obtained from the first-stage regression.[20] However, the results in model (4)-(6), there is a less significantly positive relationship between *DER* and bank risk exposure.[21]

Furthermore, in order to examine whether the effect of using derivatives for the trading or hedging purpose with different underlying assets on bank's risk, we separately run panel regression by bank's purpose and disaggregate *DER* into *FEDER* and *IRDER* related. Table 5 presents four separate panel regression models. For *FXDER*, the results, show that using equity or foreign exchange derivatives for trading (model (1) in Table 5) (hedging (model (2) in Table 5)) purpose can increase (decrease) bank risk, remain weak consistently. This finding is consistent with Rogers and Sinkey (1999) and The Economist (2002)'s arguments[22]. The results, model (3) in

[19] The OPENNESS variable used in this study is taken from Chinn and Ito (2008), which is available at http://web.pdx.edu/~ito/.

[20] We do not report the full details of the first-stage regression. However, they are available upon request.

[21] Due to brevity, we report only main results for the analyses in later subsections. The 2SLS regression results, being qualitatively similar, are available upon request.

[22] Derivatives can reduce banks' risk if they are effectively used for hedging purposes or meeting

Table 5, indicate that there is positive relationship between TIRDER and bank risk. However, there is a significantly negative relationship between HIRDER and bank risk exposure (model (4) in Table 5), suggesting that using IR derivatives for trading (hedging) purpose can increase (decrease) bank risk.[23]

<Table 5 is inserted about here>

4.3.2 Bank Value

In this section, we given the other of primary focus of this study which is the impact of financial derivatives usage on bank value and the control variables serve to compensate for any on- and off-balance sheet variable interactions. The results of the panel regression model with fixed effect are shown in Table 6. Similar to the sub-section of bank risk considered, we still disaggregate *DER* (Model (1)) into *FEDER* and *IRDER* to examine if the use of, *FEDER* (Model (2)) and *IRDER* (Model (3)) reduces or increase bank's value.

Model (1)-(3) in Table 6 shows the results of the fixed-effect panel regression model. We find a positive and significant (p-value <0.1) relationship between derivative uses and bank value for banks with exposure. This result supporting the argument banks are more likely to speculate with derivatives. To correct for such endogeniety issue in equation (2), we also estimate our regression model using the two-stage least squares (2SLS) methodology. However, the results in model (4)-(6), , remain weak consistently.

<Table 6 is inserted about here>

In order to perform further tests to examine whether hedging or trading purpose for banks mainly causes an increase in bank value, Table 7 reports the effect of using

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customers' needs (Rogers and Sinkey (1999)). If banks use derivatives for trading purpose, derivative activities can increase banks' risk (The Economist (2002)).

[23] For robustness test, we also exclude 172 bank-year observations that simultaneously use derivatives for hedging purpose and trading purpose as defined by the IFRS accounting rule. For protectional purpose, we do not report these results in a table and the tenor of the results remains unchanged.

derivatives with different underlying assets for trading or hedging purpose on bank value. We find significant evidence that the use of foreign exchange (model (1) in Table 7) derivatives for trading purpose is significantly and positively associated with bank value. Specially, for interest rate derivative (model (3) and (4) in Table 7), banks use it not only for trading but also for hedging purpose are significantly and positively associated with bank value. In other words, we find trading purpose for banks mainly causes an increase in bank value, this differ from theories that suggest the decision to hedge is value increasing by non-financial firms.[24]

According to modern finance theory, the link between derivative usage and firm value depends on the extent to which their use effectively addresses market imperfections such taxes, distress costs and agency costs, resulting in a potential effect on firm value.[25] If the manager's wealth is a concave function of firm value, the manager will tend to hedge as much as possible because his wealth will be higher when firm value is hedged relative to his expected wealth for the unhedged firm value (for example, Smith and Stulz (1985) and Nance, Smith and Smithson (1993)). However, if the manager's wealth is a convex function of firm value, like bank industry, the manager faces a trade-off between expected wealth and the risk of that wealth. The other way can increase firm value is by reducing the likelihood of financial distress. As noted by Sinkey and Carter (2000), however, the notion that risk management reduces the costs of financial distress may not apply to banking institutions. Because of federal deposit guarantees, bank are not apply to the same market discipline as other firms, and as such, they not benefit from hedging to the same extent as nonfinancial firms.[26]

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[24] For robustness test, we also exclude 172 bank-year observations that simultaneously use derivatives for hedging purpose and trading purpose as defined by the IFRS accounting rule. For protectional purpose, we do not report these results in a table and the tenor of the results remains unchanged.

[25] For example, Smith and Stulz (1985); Stulz (1990) and Nance, Smith and Smithson (1993).

[26] In other words, deposit insurance mat mitigate some of the costs of financial distress because the

In conclusion, in the banking industry, the payoff to equity holders is more convex then in other industries. Because of the very high leverage of banks and the risk-shifting opportunities provided by deposit insurance, equity holders in banks face a convex payoff. This is especially true when banks are poorly capitalized. Equity in any firm can be viewed as a call option on the assets of the firm (Black and Scholes (1973)) and deposit insurance provides a subsidy to bank owners in the form of the put option (Merton (1977); Ronn and Verma (1986)). Risk taking by the bank increases the value of both options.

<Table 7 is inserted about here>

4.4 Seemingly Unrelated Regressions Analysis for the Whole Sample

In order to examine the extent to which banks, either through their use of derivative with different underlying assets for trading or hedging purpose, can mitigate a market wide decline. We follow Reichert and Shyu (2003); Au Yong, Faff and Chalmers(2009) and Pathan (2009) methodology, the market, foreign exchange and interest rate exposure betas are estimated for each sample bank as follows:

$$R_{it} = \alpha_{it} + \beta_{mt} R_{mt} + \beta_{xt} R_{xjt} + \beta_{rt} S_{rjt} + u_{it} \tag{3}$$

where R_{it} is the monthly return on bank stock i during time period t; β_{mt}, R_{mt} are the market beta and the monthly return on the local market index at time t; β_{xt}, R_{xjt} are the foreign exchange beta and the monthly return on a foreign exchange, measures in US dollars per unit of foreign currencies, for country j at time t; β_{rt}, S_{rjt} are the interest rate beta and the monthly difference between lending and deposit rate in country j at time t; α_{it}, u_{it} are constant and random error terms, respectively.[27]

FDIC bears most of these costs.

[27] In the section, local market index and exchange rate are collected from the Datastream database and monthly lending and deposit rate are taken from International Financial Statistics (IFS) database by IMF. However, we can’t get the monthly lending and deposit rate in four countries, including Austria, Bulgaria, Slovakia and Turkey, from IFS.

The stage two cross-sectional regressions hypothesizes that foreign exchange and interest rate betas, estimated from equation (3), are a function of both off-balance sheet derivatives and traditional on-balance sheet banking activities as follows:

$$\beta_x = \alpha_0 + \alpha_1 DER_i + \alpha_2 MAD_i + \alpha_3 MID_i + \alpha_4 LNTASS_i + \alpha_5 ROE_i + \alpha_6 NIM_i + \alpha_7 EQRAT_i + \alpha_8 LIQ_i + \alpha_9 CCLOAN_i + \alpha_{10} NOMINT_i + \alpha_{11} RES_i + \alpha_{12} LNGDP_i + \alpha_{13} YEARDUM_i + \varepsilon_{\mathrm{i}}$$

$$\beta_r = \alpha_0 + \alpha_1 DER_i + \alpha_2 MAD_i + \alpha_3 MID_i + \alpha_4 LNTASS_i + \alpha_5 ROE_i + \alpha_6 NIM_i + \alpha_7 EQRAT_i + \alpha_8 LIQ_i + \alpha_9 CCLOAN_i + \alpha_{10} NOMINT_i + \alpha_{11} RES_i + \alpha_{12} LNGDP_i + \alpha_{13} YEARDUM_i + \varepsilon_{\mathrm{i}} \quad (4)$$

where Year dummy i (YEARDUM) is a binary variable that take the value of one if data belongs to year i and zero otherwise. Equation (4) is estimated as a system of seemingly unrelated regressions (SUR). There are two main types of derivatives include foreign exchange, and interest rate that we concerned. When we consider the derivatives with the specific underlying asset in Equation (4), *DER* will be replaced by related derivative variables, for example if we want to consider the effect of bank's foreign exchange derivatives on their foreign exchange betas, *DER* will be replaced by *FEDER*. By linking the bank's beta β_x and β_r, we are also able to distinguish between trading and hedging derivatives positions. Using this approach we are able to conclude that banks that have exposed betas do appear to trade or hedge with derivatives.

<Table 8 is inserted about here>

Table 8 reports the results for two models of SUR regressions. The results shows that there is a significantly positive ($p < 0.001$) relationship between *FEDER* (*IRDER*) and bank's foreign exchange (interest rate) exposure, suggesting that the level of foreign exchange (interest rate) derivatives activities in banks is associated with an increase in foreign exchange (interest rate) exposure.

<Table 9 is inserted about here>

Furthermore, in order to examine whether the effect of using derivatives for the trading (model (1) and (2) in Table 9) or hedging (model (3) and (4) in Table 9) purpose with different underlying assets on bank's risk, we separately run SUR regression by bank's purpose and disaggregate *DER* into *FEDER* and *IRDER* related. The results for model (1) and (2) in Table 9, indicate that there is significantly positive (negative) relationship between *TFEDER (TIRDER*) and bank's foreign exchange (interest rate) beta. Nevertheless, there is also a negative (positive) (model (3) and (4) in Table 9), although not significantly, relationship between *HFEDER* (*HIRDER*) and bank's foreign exchange (interest rate) beta. These findings are also consistent with previous findings in this paper.

5. Conclusion

In this paper, we use a new set of data containing European banks operating in 25 countries to analyze the effect of derivative use on measure of risk and value. For the univariate test, we find that derivative usage is more prevalent in banks with higher exposures to bank risk and bank value. In multivariate regression for bank risk, the use of derivatives does seem to increase European banks risk. A possible explanation for this finding is that banks may use derivatives to speculate risk changes or bank's derivative trading activities may have exposed them to risk changes that are not effectively hedged. Further investigation revealed that the use of derivatives for hedging does seem to decrease European banks' risk, supporting the argument that derivatives can increase (reduce) banks' risk if they are effectively used for trading (hedging) purposes.

Using adjusted-noise Tobin's Q as an approximation for bank market value, we find significant evidence that the use of derivatives is positively associated with bank market value. Specially, we find trading purpose for banks mainly causes an increase in bank value. This finding supporting the argument banks are more likely to speculate with derivatives and this differ from theories that suggest the decision to hedge is value increasing by non-financial firms. Equity in any firm can be viewed as a call option on the assets of the firm (Black and Scholes (1973)) and deposit insurance provides a subsidy to bank owners in the form of the put option (Merton (1977); Ronn and Verma (1986)). Risk taking by the bank increases the value of both options. The higher bank value is also accompanied by greater risk.

Our findings will be particularly useful in addressing regulatory concerns regarding the risk effect of derivative usage. That is, regulator should continues to encourage better management of banks' internal control system and /or greater derivative disclosure to impose market discipline on banks to ensure that there is no unwarranted risk taking. Such actions would help reduce the likelihood and magnitude of banking losses and probability of banking system collapse, like global final crisis in 2008.

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Table 1 Summary of the use of derivatives for trading and hedging separately for different types of derivatives

This table shows the number of banks using derivatives for trading and hedging purpose separately for foreign exchange derivatives, interest rate derivatives, equity derivatives, credit derivatives, commodity derivatives and other derivatives during 2004 to 2008. However, banks can simultaneously use derivatives with different underlying assets for trading or hedging purposes.

	Foreign exchange Derivatives		Interest Rate Derivatives		Equity Derivatives		Credit derivatives		Commodity derivatives		Other Derivatives	
	Trading	Hedging	Trading	Hedging	Trading	Hedging	Trading	Hedging	Trading	Hedging	Trading	Hedging
2004	19	5	18	10	8	1	4	0	1	0	17	7
2005	42	37	43	13	24	20	6	0	6	0	10	4
2006	53	42	52	12	33	24	6	0	6	0	18	4
2007	46	35	48	11	30	20	9	0	9	0	23	5
2008	7	9	7	1	3	1	0	0	0	0	1	0
2004~2008	167	128	168	47	98	66	25	0	22	0	69	20

Table 2 summary statistics

Table A of this table presents the summary statistics of the variables used in this study, reporting the mean, median and standard deviation (S.D.) of the time-series variables for 355 observations over the sample period which runs from 2004 to 2008. Please refer to Appendix 1 for the definition and construction of the variables.

Variables	Mean	Median	S.D.	Max.	Min.
Dependent Variables-Bank Risk					
σ_{return}	0.0203	0.0176	0.0112	0.0639	0.0010
Dependent Variables-Bank Value					
$Q_{i,t}^{NA}$	1.0569	1.0678	0.0440	1.1115	0.9399
Independent Variables					
DER	0.04851	1.0000	0.1029	1.0000	0.0000
Control Variables					
MAD	0.6128	0.6254	0.2121	0.9994	0.0926
MID	0.6685	0.7163	0.3502	0.9982	0.0707
SIZE	24.0452	23.785	2.2515	28.968	19.145
ROE	0.1246	0.1400	0.1299	0.4617	-0.6667
NIM	0.0239	0.0218	0.0129	0.0975	0.0027
EQRAT	0.0783	0.0682	0.0487	0.4728	0.0139
LIQ	0.2520	0.2276	0.1399	0.7711	0.0206
CCLOAN	0.1904	0.1580	0.2050	0.7070	0.0000
NOMINT	0.0163	0.0128	0.0172	0.2569	0.0011
RES	0.0170	0.0144	0.0173	0.1308	0.0000
LNGDP	24.288	23.841	2.2386	30.357	20.398

Table 3 Univariate tests of bank risk, value and derivatives use

This table reports the mean and standard deviation (SD) for users (N=236) and Non-Users (N=119). The last column present p-values of Wilcoxon rank sum tests for differences between users and Non-users. The p-values in bold type are significant at the 5% level or higher for two-tailed test. Please refer to Appendix 1 for the definition and construction of the variables.

Variables	User		Non User		User－Nonuser		Wilcoxon P-value
	mean	SD	mean	SD	mean	p-value	
(i) Bank risk							
σ_{return}	0.0261	0.0013	0.0174	0.0005	0.0087	**0.0000**	**0.0000**
(ii) Bank value							
$Q_{i,t}^{NA}$	1.0688	0.0022	1.0359	0.0049	0.0329	**0.0000**	**0.0000**

Table 4 The association between derivative activities and bank Risk

The table reports the estimation output of the panel with fixed effect model with the σ_{return} as the dependent variable. Due to the endogeneity issue for derivatives, we apply two-stage least squares (2SLS) methodology in Model (4)-(6). In the first-stage, we estimated derivatives dummy using financial openness as instrumental variables. Then in the second-stage, we replace derivative dummy by its fitted values obtained from the first-stage regression. The models are estimated based on Peterson (2009) and cluster-adjusted standard errors are reported in the brackets. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.052	-0.086	-0.090	-0.092	-0.092	-0.090
	(0.040)	(0.042)**	(0.042)**	(0.043)**	(0.043)**	(0.043)**
DER	0.007			0.002		
	(0.001)***			(0.001)*		
FEDER		0.004			0.003	
		(0.001)***			(0.001)**	
IRDER			0.003			0.002
			(0.001)**			(0.001)*
MAD	-0.008	-0.009	-0.009	-0.011	-0.011	-0.011
	(0.004)*	(0.004)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**
MID	-0.003	-0.004	-0.003	-0.003	-0.003	-0.003
	(0.002)*	(0.002)***	(0.002)**	(0.002)	(0.002)*	(0.002)*
SIZE	0.001	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ROE	-0.017	-0.021	-0.023	-0.025	-0.025	-0.025
	(0.007)**	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
NIM	-0.091	-0.066	-0.060	-0.052	-0.051	-0.053
	(0.127)	(0.132)	(0.134)	(0.135)	(0.135)	(0.135)
EQRAT	-0.030	-0.025	-0.024	-0.031	-0.031	-0.032
	(0.037)	(0.038)	(0.039)	(0.039)	(0.039)	(0.039)
LIQ	0.010	0.007	0.005	0.003	0.003	0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
CCLOAN	0.007	0.006	0.007	0.006	0.006	0.006
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
NOMINT	0.039	0.050	0.040	0.055	0.055	0.054
	(0.048)	(0.051)	(0.051)	(0.052)	(0.052)	(0.052)
RES	-0.005	-0.015	-0.023	-0.039	-0.039	-0.039
	(0.043)	(0.045)	(0.046)	(0.046)	(0.046)	(0.046)
LNGDP	0.003	0.003	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Within-R^2	60.1%	56.6%	55.8%	54.93%	54.93%	54.95%
Between-R^2	14.2%	11.4%	9.91%	8.64%	8.64%	8.68%
Overall-R^2	30.3%	22.87%	21.33%	19.55%	19.53%	19.75%

Table 5 *The association between derivative activities for trading or hedging purpose and bank Risk*

The table reports the estimation output of the panel with fixed effect model with the σ_{return} as the dependent variable. The models are estimated based on Peterson (2009) and cluster-adjusted standard errors are reported in the brackets. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

Model	(1)	(2)	(3)	(4)
Intercept	-0.087	-0.088	-0.089	-0.079
	(0.041)**	(0.042)**	(0.042)**	(0.042)*
TFEDER	0.004			
	(0.001)***			
HFEDER		-0.003		
		(0.002)		
TIRDER			0.003	
			(0.001)***	
HIRDER				-0.005
				(0.002)***
MAD	-0.009	-0.011	-0.009	-0.011
	(0.004)**	(0.004)**	(0.004)**	(0.004)**
MID	-0.004	-0.003	-0.003	-0.004
	(0.002)**	(0.002)*	(0.002)*	(0.002)**
SIZE	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
ROE	-0.022	-0.023	-0.024	-0.020
	(0.007)***	(0.007)***	(0.007)***	(0.007)***
NIM	-0.076	-0.042	-0.071	-0.059
	(0.132)	(0.134)	(0.133)	(0.133)
EQRAT	-0.027	-0.031	-0.024	-0.025
	(0.038)	(0.039)	(0.038)	(0.038)
LIQ	0.007	0.003	0.005	0.005
	(0.009)	(0.009)	(0.009)	(0.009)
CCLOAN	0.006	0.006	0.007	0.006
	(0.005)	(0.005)	(0.005)	(0.005)
NOMINT	0.055	0.049	0.041	0.033
	(0.050)	(0.051)	(0.051)	(0.051)
RES	-0.013	-0.037	-0.019	-0.035
	(0.045)	(0.045)	(0.046)	(0.045)
LNGDP	0.003	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Within-R^2	56.8%	55.4%	56.2%	56.5%
Between-R^2	9.93%	10.4%	9.29%	11.2%
Overall-R^2	21.3%	21.5%	21.1%	23.1%

Table 6 The association between derivative activities and bank Value

The table reports the estimation output of the panel with fixed effect model with the Adjusted-noise Tobin's Q as the dependent variable. Due to the endogeneity issue for derivatives, we apply two-stage least squares (2SLS) methodology in Model (4)-(6). In the first-stage, we estimated derivatives dummy using financial openness as instrumental variables. Then in the second-stage, we replace derivative dummy by its fitted values obtained from the first-stage regression. The models are estimated based on Peterson (2009) and cluster-adjusted standard errors are reported in the brackets. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	2.091	2.268	2.286	2.313	2.311	2.301
	(0.132)***	(0.141)***	(0.139)***	(0.154)***	(0.153)***	(0.153)***
DER	0.404			0.004		
	(0.004)***			(0.002)*		
FEDER		0.260			0.006	
		(0.004)***			(0.002)**	
IRDER			0.028			0.010
			(0.004)***			(0.002)***
MAD	0.021	0.024	0.020	0.035	0.035	0.035
	(0.138)	(0.015)	(0.015)	(0.016)**	(0.016)**	(0.016)**
MID	-0.012	-0.009	-0.010	-0.014	-0.014	-0.014
	(0.005)**	(0.006)	(0.006)*	(0.006)**	(0.006)**	(0.006)**
SIZE	-0.031	-0.376	-0.039	-0.038	-0.037	-0.037
	(0.006)***	(0.006)***	(0.006)***	(0.006)***	(0.007)***	(0.006)***
ROE	0095	0.113	0.119	0.143	0.142	0.142
	(0.022)***	(0.024)***	(0.023)***	(0.025)***	(0.026)***	(0.026)***
NIM	-1.341	-1.452	-1.464	-1.556	-1.553	-1.542
	(0.416)***	(0.451)***	(0.444)***	(0.486)***	(0.486)***	(0.4863***
EQRAT	-0.102	-0.140	-0.166	-0.101	-0.099	-0.095
	(0.120)	(0.130)	(0.128)	(0.140)	(0.141)	(0.140)
LIQ	-0.016	-0.007	0.002	0.023	0.023	0.024
	(0.028)	(0.030)	(0.030)	(0.032)	(0.032)	(0.032)
CCLOAN	-0.005	-0.000	-0.008	0.003	0.002	0.002
	(0.014)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
NOMINT	-0.167	-0.218	-0.099	-0.250	-0.248	-0.244
	(0.159)	(0.172)	(0.171)	(0.186)	(0.186)	(0.186)
RES	-0.078	-0.061	-0.055	0.107	0.107	0.110
	(0.142)	(0.155)	(0.152)	(0.164)	(0.164)	(0.164)
LNGDP	-0.011	-0.012	-0.011	-0.014	-0.014	-0.141
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Within-R^2	77.4%	73.5%	74.3%	69.25%	69.25%	69.29%
Between-R^2	45.7%	45.0%	43.3%	40.44%	40.42%	40.37%
Overall-R^2	53.3%	46.5%	45.9%	41.18%	41.21%	41.34%

Table 7 The association between derivative activities for trading or hedging purpose and bank value

The table reports the estimation output of the panel with fixed effect model with the adjusted-Tobin's Q as the dependent variable. The models are estimated based on Peterson (2009) and cluster-adjusted standard errors are reported in the brackets. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

Model	(1)	(2)	(3)	(4)
Intercept	2.280	2.313	2.279	2.277
	(0.141)***	(0.152)***	(0.139)***	(0.151)***
TFEDER	0.027			
	(0.004)***			
HFEDER		0.001		
		(0.007)		
TIRDER			0.029	
			(0.004)***	
HIRDER				0.014
				(0.006)**
MAD	0.023	0.034	0.021	0.034
	(0.015)	(0.016)**	(0.015)	(0.016)**
MID	-0.010	-0.014	-0.011	-0.011
	(0.006)	(0.006)**	(0.006)*	(0.006)**
SIZE	-0.038	-0.038	-0.039	-0.037
	(0.006)***	(0.006)***	(0.006)***	(0.007)***
ROE	0.121	0.142	0.129	0.128
	(0.024)***	(0.026)***	(0.023)***	(0.026)***
NIM	-1.389	-1.561	-1.382	-1.536
	(0.450)***	(0.486)***	(0.443)***	(0.481)***
EQRAT	-0.124	-0.101	-0.159	-0.116
	(0.130)	(0.140)	(0.128)	(0.139)
LIQ	-0.006	0.023	0.003	0.017
	(0.030)	(0.032)	(0.030)	(0.032)
CCLOAN	-0.000	0.003	-0.008	0.003
	(0.016)	(0.017)	(0.016)	(0.017)
NOMINT	-0.251	-0.249	-0.132	-0.191
	(0.172)	(0.186)	(0.170)	(0.186)
RES	-0.064	0.106	-0.066	0.095
	(0.154)	(0.164)	(0.152)	(0.163)
LNGDP	-0.012	-0.014	-0.011	-0.013
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Within-R^2	73.6%	69.3%	74.5%	69.9%
Between-R^2	44.4%	40.5%	43.1%	41.4%
Overall-R^2	45.8%	41.2%	45.8%	42.8%

Table 8 The association between derivative activities and banks' foreign exchange risk and interest rate exposures

This table reports the coefficient estimates and corresponding standard error (in parentheses) of the following system of seemingly unrelated regressions:

$$\beta_X=\alpha_0+\alpha_1 DER_i+\alpha_2 MAD_i+\alpha_3 MID_i+\alpha_4 SIZE_i+\alpha_5 ROE_i+\alpha_6 NIM_i+\alpha_7 EQRAT_i+\alpha_8 LIQ_i+\alpha_9 CCLOAN_i+\alpha_{10} NOMINT_i+\alpha_{11} RES_i++\alpha_{12} LNGDP_i+\alpha_{13} YEARDUM_i+\varepsilon_i.$$

$$\beta_r=\alpha_0+\alpha_1 DER_i+\alpha_2 MAD_i+\alpha_3 MID_i+\alpha_4 SIZE_i+\alpha_5 ROE_i+\alpha_6 NIM_i+\alpha_7 EQRAT_i+\alpha_8 LIQ_i+\alpha_9 CCLOAN_i+\alpha_{10} NOMINT_i+\alpha_{11} RES_i+\alpha_{12} LNGDP_i+\alpha_{13} YEARDUM_i+\varepsilon_i,$$

The results reported are for the two sets of regression (FEDER and IRDER) using the risk coefficient as dependent variables. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

Model	(1)		(2)	
Dependent Variable	β_X	β_r	β_X	β_r
Intercept	-0.281	-0.069	-0.715	-0.043
	(0.887)	(0.108)	(0.897)	(0.110)
FEDER	0.354	-0.003		
	(0.122) ***	(0.015)		
IRDER			0.473	-0.032
			(0.126) ***	(0.015) **
MAD	0.743	-0.058	0.693	-0.059
	(0.184) ***	(0.022) **	(0.179) ***	(0.022) ***
MID	-0.021	-0.012	-0.102	-0.009
	(0.248)	(0.030)	(0.248)	(0.030)
SIZE	-0.041	0.002	-0.021	0.001
	(0.025) *	(0.003)	(0.026)	(0.003)
ROE	0.622	0.074	0.546	0.078
	(0.453)	(0.055)	(0.450)	(0.055)
EQRAT	0.837	0.031	1.007	0.027
	(0.987)	(0.120)	(0.978)	(0.120)
NIM	-4.805	-0.817	-5.780	-0.782
	(4.508)	(0.550)	(4.480)	(0.551)
LIQ	0.363	-0.041	0.303	-0.040
	(0.267)	(0.033)	(0.265)	(0.033)
CCLOAN	0.677	0.055	0.684	0.055
	(0.211) ***	(0.026) **	(0.209) ***	(0.026) **
NOMINT	-4.325	0.397	-4.204	0.391
	(3.333)	(0.406)	(3.301)	(0.406)
RES	2.233	0.018	2.877	-0.026
	(2.373)	(0.289)	(2.363)	(0.291)
LNGDP	0.041	0.001	0.045	0.001
	(0.025) *	(0.003)	(0.024) *	(0.003)
YEARDUM	Yes		Yes	
Obs.	298		298	
	16.2%	9.6%	17.9%	10.8%

Table 9 The association between derivative activities for trading or hedging purpose and banks' foreign exchange and interest rate risk exposures

This table reports the coefficient estimates and corresponding t-statistics (in parentheses) of the following system of seemingly unrelated regressions:

$$\beta_X=\alpha_0+\alpha_1 DER_i+\alpha_2 MAD_i+\alpha_3 MID_i+\alpha_4 SIZE_i+\alpha_5 ROE_i+\alpha_6 NIM_i+\alpha_7 EQRAT_i+\alpha_8 LIQ_i+\alpha_9 CCLOAN_i +\alpha_{10} NOMINT_i+\alpha_{11} RES_i+ +\alpha_{12} LNGDP_i+\alpha_{13} YEARDUM_i+\varepsilon_i.$$

$$\beta_r=\alpha_0+\alpha_1 DER_i+\alpha_2 MAD_i+\alpha_3 MID_i+\alpha_4 SIZE_i+\alpha_5 ROE_i+\alpha_6 NIM_i+\alpha_7 EQRAT_i+\alpha_8 LIQ_i+\alpha_9 CCLOAN_i +\alpha_{10} NOMINT_i+\alpha_{11} RES_i +\alpha_{12} LNGDP_i+\alpha_{13} YEARDUM_i+\varepsilon_i ,$$

The results show the effect of using derivatives for the trading (model (1) ~(2)) or hedging (model (3) ~(4)) purpose with different underlying assets on bank's risk. Please refer to Appendix 1 for the definition and construction of the variables. ***, ** and * indicate statistical significance at 1%, 5% or 10% level, respectively.

Dependent Variable	(1)		(2)		(3)		(4)	
	β_X	β_r	β_X	β_r	β_X	β_r	β_X	β_r
Intercept	0.008	-0.079	-0.360	-0.056	0.442	-0.081	0.401	-0.069
	(0.892)	(0.108)	(0.905)	(0.110)	(0.856)	(0.103)	(0.857)	(0.103)
TFEDER	0.221	0.002						
	(0.103) **	(0.014)						
TIRDER			0.320	-0.007				
			(0.117) ***	(0.003) ***				
HFEDER					-0.137	0.007		
					(0.126)	(0.015)		
HIRDER							0.136	0.005
							(0.103)	(0.012)
MAD	0.712	-0.057	0.687	-0.059	0.614	-0.058	0.615	-0.057
	(0.187) ***	(0.023) **	(0.181) ***	(0.022) ***	(0.182) ***	(0.022) ***	(0.182) ***	(0.022) ***
MID	-0.003	-0.013	-0.069	-0.010	0.060	-0.013	0.037	-0.012
	(0.250)	(0.030)	(0.251)	(0.031)	(0.249)	(0.030)	(0.250)	(0.030)
SIZE	-0.052	0.003	-0.037	0.002	-0.063	0.003	-0.061	0.002
	(0.025) **	(0.003)	(0.026)	(0.003)	(0.024) ***	(0.003)	(0.024) **	(0.003)
ROE	0.744	0.074	0.727	0.074	0.690	0.072	0.712	0.074
	(0.456)	(0.055)	(0.453)	(0.055)	(0.459)	(0.055)	(0.458)	(0.055)
EQRAT	0.923	0.031	1.076	0.026	0.834	0.030	0.863	0.031
	(0.996)	(0.120)	(0.992)	(0.121)	(1.000)	(0.120)	(0.999)	(0.120)
NIM	-4.726	-0.826	-5.646	-0.791	-4.386	-0.834	-4.814	-0.798
	(4.550)	(0.550)	(4.544)	(0.553)	(4.566)	(0.550)	(4.585)	(0.552)
LIQ	0.383	-0.416	0.354	-0.041	0.407	-0.040	0.341	-0.040
	(0.269)	(0.033)	(0.267)	(0.033)	(0.271)	(0.033)	(0.272)	(0.033)
CCLOAN	0.686	0.056	0.701	0.055	0.640	0.055	0.642	0.056
	(0.213) ***	(0.026) **	(0.212) ***	(0.026) **	(0.213) ***	(0.026) **	(0.213) ***	(0.026) **
NOMINT	-4.336	0.398	-4.198	0.392	-4.289	0.406	-4.179	0.388
	(3.361)	(0.406)	(3.340)	(0.406)	(3.379)	(0.407)	(3.379)	(0.407)
RES	1.615	0.036	2.073	-0.000	0.602	0.026	0.404	0.038
	(2.380)	(0.288)	(2.371)	(0.289)	(2.341)	(0.282)	(2.346)	(0.283)
LNGDP	0.035	0.001	0.040	0.001	0.025	0.001	0.027	0.001
	(0.025)	(0.003)	(0.025)	(0.003)	(0.024)	(0.003)	(0.024)	(0.003)
YEARDUM	Yes		Yes		Yes		Yes	
Obs.	298		298		298		298	
R^2	14.9%	9.6%	16.0%	10.7%	14.1%	9.7%	14.3%	9.7%

Appendix Definition of Variables

The table reports the variables that we examine in other studies and ours in this table.

Independent variables	Definition	Label
Dependent Variables (i)Bank Risk		
Bank risk	Standard deviation of local currency stock return	σ_{return}
Market risk	IR and FX exposure betas are estimated for each sample bank as follows: $R_{it} = \alpha_{it} + \beta_{mt} R_{mt} + \beta_{rt} S_{rjt} + \beta_{xt} R_{xjt} + u_{it}$	β_{mt}
Foreign exchange risk	where R_{it} is the monthly return on bank stock i during time period t; β_{mt}, R_{mt} are the market beta and the monthly return on the Local market index at time t; β_{rt}, S_{rjt} are the IR beta and the difference between lending and deposit rate in country j at time t; β_{xt}, R_{xjt} are the FX beta and the monthly return on a	β_{xt}
Interest rate risk	FX index for country j at time t; α_{it}, u_{it} are constant and random error terms, respectively.	β_{rt}
(ii) Bank Value		
Bank's franchise Value: Adjusted-noised Tobin's Q	We use maximum likelihood estimates of the following equation: $\ln(MVA_{i,t}) = \beta_0 + \beta_1 \cdot \ln(BVA_{i,t}) + \beta_2 \cdot (\ln(BVA_{i,t}))^2 + \varepsilon_{i,t}$, Hence, we specify a translog function when fitting a stochastic upper envelope to the natural logarithm of market value (MVA)of the natural logarithm of bank's assets (BVA). We also include time dummies in the equation, with 2008 as the reference period. The composite error terms $\varepsilon_{it} = v_{it} - u_i \cdot \exp(-\eta(t-T))$, consists of statistical noise, $v_{it} \sim iidN(0, \sigma_v^2)$, and systematic time-varying departures, $u_{it} \sim N^+(\mu, \sigma_\mu^2)$. From the estimation of this stochastic frontier model, we compute the noise-adjusted Tobin's Q ratio, $Q_{i,t}^{NA}$, This measure of the franchise value can be written as： $Q_{i,t}^{NA} = \exp(-u_{i,t}) \cdot \frac{\hat{MVA}_{i,t}}{BVA_{i,t}}$	Q^{NA}
Independent Variables		
(i) Derivative activities		
	Dummy variable equal to 1 if a bank use derivatives and 0 otherwise	DER
	Dummy variable equal to 1 if a bank use foreign exchange derivatives and 0 otherwise	FEDER
	Dummy variable equal to 1 if a bank use interest rate derivatives and 0 otherwise	IRDER

	Dummy variable equal to 1 if a bank use foreign exchange derivatives for trading and 0 otherwise	TFEDER
	Dummy variable equal to 1 if a bank use interest rate derivatives for trading and 0 otherwise	TIRDER
	Dummy variable equal to 1 if a bank use foreign exchange derivatives for hedging and 0 otherwise	HFEDER
	Dummy variable equal to 1 if a bank use interest rate derivatives for hedging and 0 otherwise	HIRDER
Asset diversity	$1-\left\lvert\frac{(\text{Net loans} - \text{Other earning assets})}{\text{Total earning assets}}\right\rvert$	MAD
Income diversity	$1-\left\lvert\frac{(\text{Net interst income} - \text{Other operating income})}{\text{Total operating income}}\right\rvert$	MID
Bank Size	The natural logarithm of a bank's total assets	SIZE
Bank Profitability	Return on equity	ROE
Net Interest Margin	The difference between total interest income and total interest expense divided by total assets.	NIM
Capital	Book value of equity capital / total assets	EQRAT
Liquidity	Liquidity assets / total assets	LIQ
Interest rate risk	Total Corporate and Commercial Loans / total assets	CCLOAN
	Non-interest income / total income	NOMINT
Credit risk	Loan Loss reserve / total assets	RES
Country-level factor	The natural logarithm of a country's GDP	LNGDP
(ii) Instrumental variables		
Financial Openness	The Chinn and Ito (2008) measure of financial openness	OPENNESS