Deriving value or risk? Determinants and the impact of emerging market banks' derivative usage

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"I view derivatives as time bombs, both for the parties that deal in them and the economic system." –Warren Buffet (Berkshire Hathaway annual report 2002)

"So should we fear derivatives? The answer is "no." We should have a healthy respect for them."- (Stulz, 2010)

Abstract

This paper examines the determinants of the emerging market banks' derivative usage and the impact of derivative usage on bank value, total risk and bank stability. Our empirical evidence first suggests that derivative usage is driven primarily by net interest margin, bank concentration and institutional strength. In addition, although derivative usage appears to reduce emerging market bank value, it does not affect total risk. Moreover, emerging market banks can reduce bank instability using derivatives. Our findings have important implications for investors and policy makers focusing on emerging derivatives markets.

Introduction

Banks play an important role in growth and development but also in the propagation of financial turmoil (Instefjord, 2005; Huang *et al.*, 2012; Aoki and Nikolov, 2015; Brunnermeier, Dong and Palia, 2020). Financial derivatives are a key tool used by banks to hedge their risk exposures, provide hedging opportunities elsewhere in the economy and generate alternative sources of income; however, financial derivatives also have been responsible for propelling bank risk and failure, such as the increase in both experienced during the 2009 financial crisis (Chiaramonte and Casu, 2013). Despite the ramifications of the crisis for global financial markets, global derivative activity largely continued to increase both during and post crisis. According to data from the Bank of International Settlements (BIS), which surveys the sales desks of dealer banks worldwide, the notional amount of over-the-counter-traded financial derivatives rose substantially over the last two decades in both developed and emerging markets. Figures 1 and 2 show the evolution of daily turnover of interest rate and foreign exchange derivatives, respectively, for a group of developed and emerging market countries [1]. Although the data show that emerging country derivatives markets are approximately 20 times smaller than developed markets, the turnover growth for both subgroups has been strong. For instance, for OTC foreign exchange derivatives (Figure 2), the daily turnover in developed markets increased from approximately 3 trillion in 2010 to 5 trillion in 2019, marking a growth of 166%, while over the same period, the emerging market turnover rose from 130 billion to 290 billion, marking a growth of 223%. These numbers underscore the growing importance

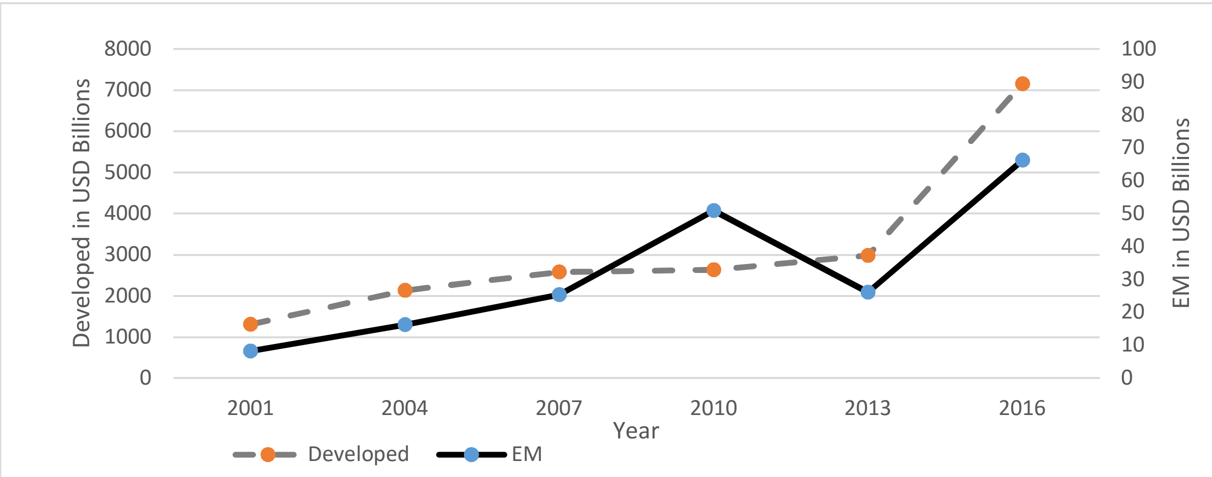
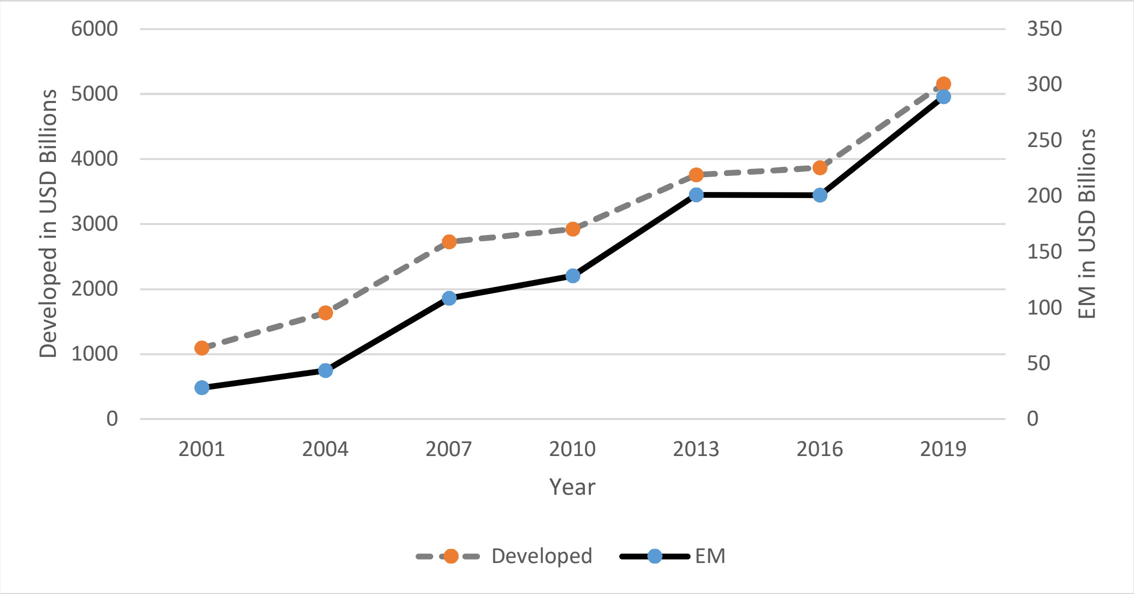


Fig 1. OTC interest rate derivatives average daily turnover EM vs. DEV on a "net-gross" basis. Daily averages, in billions of US dollars (BIS Triennial Survey 2019)

of

[1] The EM countries include the following: Argentina, Bahrain, Brazil, Bulgaria, Chile, China, Colombia, Czech Republic, Estonia, Hungary, India, Indonesia, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Thailand, Turkey, United Arab Emirates.
The developed countries include the following: Australia, Austria, Belgium, Canada, Chinese Taipei, Denmark, Finland, France, Germany, Hong Kong SAR, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom, United States
https://www.bis.org/statistics/rpfx19.htm?m=6%7C32%7C617

derivatives across the globe and in emerging markets. Despite the strong growth of the emerging country derivatives markets, our knowledge of emerging market bank operations in these markets is limited. Although emerging market banks play an important role as dealers, as users and providers of hedging and as speculators, we know little about the determinants behind emerging market bank derivative usage and the implications for banks' value, risk, and stability. Given the increasing integration of emerging market financial institutions in global



financial markets, it is important, however, that we increase our understanding of this topic. In this paper, we seek to address this gap in the literature by empirically assessing the determinants and risk, stability and value implications of emerging market bank derivative usage for a unique hand-collected database of emerging market banks.

Fig 2. OTC foreign exchange derivatives average daily turnover EM vs. DEV: "net-gross" basis. In Billions of US dollars (BIS Triennial Survey 2019)

An important factor enabling the growth of derivative usage in emerging markets is financial liberalization. Since the early 1990s, a wave of regulatory reforms has swept through the primarily bank-based financial systems of emerging countries, removing barriers for increased usage of financial derivatives either for hedging bank risk exposures or for speculative/revenue generating purposes. Although removing regulatory restrictions is important for market development, classical finance theory does not necessarily imply that this will lead to an increased usage of derivatives, especially for hedging purposes. According to M&M (Modigliani and Miller, 1958) under the assumption of perfect capital markets, the value of a firm, including that of a financial institution, is the present value of the cash flows produced by the firms' existing assets and new investments. Cash flow risk is appropriately accounted for through a cost of capital estimate that captures the cash flow stream's inherent systematic risk exposure. To the extent that investors want different risk exposures, they themselves will readjust their positions and do not need or want companies to spend resources in doing this for them.

Real world capital markets, however, due to frictions, such as agency, bankruptcy, contract, information, and transaction costs as well as commissions and taxes, are far from resembling the M&M ideal type (Damodaran, 2003; Crouhy, Mark and Galai, 2006; S. Choudhry, 2008). Building on this, Stulz (1984) developed a model based on exchange rate dynamics, hedging costs and managerial compensation and in which profit-maximizing firms engage in hedging, particularly in forward contracts. Smith and Stulz (1985) show how firms, subject to a convex tax schedule, can reduce fluctuations in pretax income and consequently the overall tax liability by appropriately using hedging derivatives. Corporate risk management can also shield firms from underinvestment problems caused by financial frictions (Geczy, Minton and Schrand, 1997; Bartram, 2000; Crouhy, Mark and Galai, 2006; Aretz, Bartram and Dufey, 2007), and hedging can reduce the costs of financial distress, which harms shareholders in the event of bankruptcy and makes bondholders require higher yields (Aretz, Bartram and Dufey, 2007).

In addition to hedging purposes, bank derivative usage is driven to a great extent by speculative motives and the search for alternative sources of income. Proprietary trading in derivatives is used to generate profits mainly through commissions and fees and without an obvious hedging objective (Li and Marinč, 2014). Because of the high potential for fee income generation, banks also offer risk management services, the provision of which has become a growing trend, especially over the last decade, to counter the decline in the spreads of traditional bank lending services (Egly and Sun, 2014).

Compared to developed markets, emerging markets, on the one hand, are characterized by higher exchange rates, interest rates, capital flows and growth volatility levels and more severe financial frictions (Harvey, 1995; Henisz and Zelner, 2010; Soedarmono, Machrouh and Tarazi, 2013). In addition to the greater opportunities for speculation and alternative income generation, financial liberalization can be expected to create strongly developed derivative markets in emerging countries with high trading volumes. However, foreign exchange and interest rate derivatives in emerging markets account for merely 10% of global derivative market turnover (Upper and Valli, 2016), and this is primarily due, on the one hand, to a lack of liquidity and know-how and, on the other hand, the absence of a sound financial infrastructure permitting convenient trade through the provision of sufficient legal, counterparty and liquidity risk safeguards.

Derivative market development in emerging countries is facing two main obstacles. First, to hedge a risk exposure, counterparties need to be present to take the opposite side of the contract. Emerging markets often suffer from a dearth of speculators willing to take on interest and exchange rate risk in highly volatile markets, which often suffer from substantial political instability (Upper and Valli, 2016). Second, emerging derivatives markets are not only smaller but also trade fewer complex contracts than their counterparts in developed countries. This is likely due to the absence of the necessary know-how and expertise in emerging market financial institutions but also implies that available derivatives contracts may not be effective in hedging all corporate and financial risk exposures.

The potential for growth in emerging derivative markets is substantial, however, and could be realized if effective measures are put in place to better deal with counterparty, operational, and legal risks. Counterparty risk mitigation can be achieved through improved netting and collateralization of counterparty risk exposures and can lead to a reduction in regulatory capital requirements by almost 70% (Avellaneda, 2008). Central clearing parties or clearing houses can further help to reduce counterparty risk, but most are currently in developed countries, with few operating in emerging markets (Sukumar *et al.*, 2019). Operational risk (e.g., fraud, systems failure and technological malfunctions) is generally known to be higher in emerging market contexts (Ray and Das, 2010; Smimou, 2014). This risk could be mitigated, however, in emerging derivatives markets by automating trading with exchanges and clearing houses, but such automated trading systems are currently largely absent in emerging markets. Finally, legal risk is a major issue in emerging markets, in which the rule of law, governance and institutional environment is weaker than in developed markets (Chen, Chen and Wei, 2009). Legal risk in emerging derivatives markets could be reduced by increasing contract and netting agreement standardization, a practice that is widely used in developed markets in which derivatives trading occurs more through organized electronic exchanges and less over the counter.

We conduct an empirical analysis by using random and fixed panel regression models to investigate the relationship between financial derivatives, on the one hand, and bank risk, stability, and value, on the other hand, in an emerging market context. In addition, we investigate the determinants of derivative usage by emerging country banks. Numerous studies have examined the relationships between financial derivatives and bank risk, stability, and value for developed market banks (Li and Marinč, 2014; Mayordomo, Rodriguez-Moreno and Peña, 2014; Bliss, Clark and DeLisle, 2017; Chang, Ho and Hsiao, 2017), but few studies have been dedicated to analyzing these relationships in emerging market banks (Keffala, De Peretti and Chan, 2011, 2013; Keffala, 2015; Titova, Penikas and Gomayun, 2018). To further our understanding of emerging market bank derivative usage, we analyze a unique dataset by hand collecting derivative data from the financial statements of listed banks and classifying derivatives according to their main purpose, namely, hedging or speculation. In the context of emerging markets, to estimate the effect of derivative usage on bank stability, risk, and bank value, we match this information with data on bank- and country-specific variables. We control for country-specific variations, including the World Governance Indicators (WGI), bank competition, the World Uncertainty Index (WUI), and financial openness indicators.

In terms of key findings, in line with other research (Chang, Ho and Hsiao, 2017), we first find that the net interest margin, bank concentration and the strength of the institutional environment are major determinants of derivative usage in emerging markets. Second, we find evidence of a significant negative relationship between derivative usage and bank value as measured by Tobin's Q. Third, our panel analysis indicates that higher derivative usage contributes positively and significantly to bank systematic risk but does not contribute significantly to total volatility or idiosyncratic risk. These results are in line with Chang, Ho and Hsiao's (2017) findings regarding systematic risk but are different from their findings for bank value and total risk[2]. Finally, we find that derivative usage by emerging market banks reduces their instability as measured by the Z-score.

The paper contributes to the literature on different levels. First, our unique, hand-collected dataset allows us to add to the derivative usage literature by exploring the determinants of bank derivate usage and the effects of this usage on bank risk and value for a wide sample of emerging market banks, a topic that until now has remained unexamined in the literature. Prior research was conducted mainly on U.S. banks or European markets and to our knowledge, our dataset has a much wider emerging market bank coverage than previous studies. Second, this is the first paper that investigates the effects of derivative usage on both value, risk and stability measures for a large sample of emerging market banks in the post-financial crisis era. Finally, for emerging market bank derivative usage, we highlight the importance of the institutional environment, a dimension left largely unexplored in previous research.

The remainder of this paper is organized as follows. Section 2 highlights the literature review, and Section 3 describes the data and methodology. Section 4 analyzes the regression models and discusses the results. Finally, Section 5 concludes the paper.

[2] Chang, Ho and Hsiao, (2017) find that total derivatives, foreign exchange derivatives and interest rate derivatives are significantly positively related to bank risk, systematic risk and value. Their sample is based on developed European markets.

2. Literature Review

The literature to date on the determinants and implications for bank derivatives usage is limited, especially for emerging market contexts. First, a few existing studies examine the determinants and impact of derivative usage for European banks in both advanced and emerging market countries. For instance, for a sample of European bank and bank holding companies from 30 European countries and covering the period 2004 to 2008, Chang, Ho and Hsiao (2017) find that derivative usage is positively related to profitability, lower net interest rate margins and inflows into transaction deposits. Derivative usage is also shown to be positively related to bank stock volatility and value as measured by Tobin's Q. Along the same lines, for a sample of European banks from 2005 to 2010, Titova, Penikas and Gomayun (2018) examine the impact of hedging and trading derivatives on bank risk and value. They find that the use of hedging derivatives lowers bank risk and increases bank value but that this occurs primarily during the pre-crisis period. Although the samples in both papers cover emerging market countries, such as Romania, Hungary, Russia and Turkey, neither paper presents separate results for emerging country subsamples. This leaves open the question of whether the same relationships would hold in an emerging market context or if the results are primarily driven by developed market banks. Other recent studies have focused on the US market. Ghosh (2017), for instance, finds for a sample of commercial banks and in a period covering 2001 to 2016 that aggregate derivatives, including FX and interest rate derivatives, reduce bank insolvency risk as measured by the Z-score but that this effect disappears for the post-crisis era.

One of the only studies that focuses exclusively on emerging market banks is Keffala (2015), in which the author compares the effect of derivatives on bank stability in the pre- and post-financial crisis eras. Derivatives are classified by contract type[3], and bank stability is captured by the Z-score. The sample includes 66 banks from 24 emerging market countries over the time frames 2003-2006 and 2007-2011. The results show that futures and options weaken bank stability, while forwards and swaps have a minimal effect.

The remaining literature on derivative usage in emerging market contexts predominantly covers non-financial firms. For instance, Trang, Papanastassiou and Nguyen (2017) examine the effect of corruption on derivative usage. For a sample of 881 non-financial firms in East Asia, they conclude that low levels of corruption increase the usage of derivatives. Corruption is one factor that can lead to a difference in the effect and usage of derivatives in emerging versus developed countries, but the literature is divided on the direction of its impact. Some papers argue that corruption increases uncertainty and transaction costs, disrupts a firm's operations (Quazi, 2014) and therefore disincentivizes banks from investing in a large-scale derivatives infrastructure. On the other hand, corruption can act as a "helping hand" in weak regulatory environments and facilitate economic counterparty selection and screening (Bardhan, 1997). Furthermore, for a sample of large Columbian non-financial firms, Gómez-González, Rincón and Rodríguez (2014) find that the use of hedging derivatives is positively related to value as measured by Tobin's Q.

Finally, although not exclusively focusing on emerging countries, a couple of studies have focused on the moderating impact of corporate governance on the relationship between derivative usage and value. To the extent that emerging market economies are predominantly

[3] Keffala (2015) identifies derivatives by contract type, namely, forwards, futures, swaps and options, regardless of whether their purpose is for hedging or trading.

characterized by weaker levels of corporate governance, these studies therefore may shed some light on what to expect for our emerging market bank sample. For a sample of US firms, Fauver and Naranjo (2010) find that firms with weaker governance exhibit a negative relation between Tobin's Q and derivative usage. Firms that use derivatives and have higher agency costs and supervisory problems are claimed to channel these costs by virtue of excessive speculation with and mismanagement of derivative securities. Finally, for a sample of non-financial firms in 39 countries, Allayannis, Lel and Miller (2012) find that strong corporate governance or strong country-level institutional environments strengthen the positive value impact of foreign currency derivatives.

Overall, our literature review indicates that there is scant research on the determinants and implications of derivative usage by emerging market banks. Part of the reason is undoubtedly the limited accessibility of data, and we address this limitation by hand collecting derivative data from the financial statements of a broad sample of emerging market financial institutions. Nevertheless, gaining a better understanding of derivative usage in emerging markets is important for at least several reasons. First, the use of financial derivatives may amplify the negative effects of financial liberalization reforms put in place in several emerging markets in recent years. According to Soedarmono, Machrouh and Tarazi (2013), financial liberalization increases competition in the banking sector, resulting in lower capital ratios, increased volatility and a higher insolvency risk in banks. The use of financial derivatives can amplify the negative effects of competition and contribute to higher bank risk and instability (McClintock, 1996; Elyasiani and Choi, 1997; Hirtle, 1997, 2009; Instefjord, 2005; Minton, Stulz and Williamson, 2009; Dewally and Shao, 2013; Chang, Ho and Hsiao, 2017). Second, the risk shifting mechanisms enabled by financial derivatives contribute to bank instability in the presence of high corporate vulnerability (Stiglitz and Weiss, 1981). This "vulnerability" is especially prominent in the emerging countries' private sector, which suffers from poor accounting standards, weak corporate governance, high levels of corruption and weak protection for shareholders. Finally, the emerging market banks, which are comparatively smaller than their counterparts in developed countries, may lack experience and capital to efficiently manage risk through innovative instruments such as derivatives. In particular, Tufano (1989) points to the first-mover advantage in investment banking and highlights the higher costs associated with developing new product and service offerings. Additionally, as appealing as financial derivatives may seem for banks, the dealing and trading of derivatives requires substantial investment in financial, reputational and intellectual capital (Sinkey and Carter, 2000). Building these key resources, however, takes time, and emerging market banks relatively new to derivative usage might not be capable of dealing effectively and efficiently with derivative securities for hedging or speculative purposes.

3. Data and Method

3.1 Data source

Our sample covers publicly listed[4] emerging market commercial banks for the period 2010 to 2017. To identify emerging markets, we first use the Morgan Stanley MSCI emerging market index, which classifies 54 countries as emerging. The disclosure of information by banks on financial derivative usage is voluntary; however, when disclosing, most banks explain their derivative usage and report the notional and/or fair values in the notes on financial statements

[4] To have stock market information available to calculate different bank level risk measures, we require banks to be listed.

of their annual reports. However, as stated by Acharya and Bisin (2014), the lack of common standards on derivative reporting limits the ability to use derivative data in research. In response to this and to ensure derivatives reporting is as consistent as possible across countries and banks, we sample banks exclusively from countries adopting IFRS accounting standards. Figure 3 below gives an overview of the countries adopting IFRS standards: the countries adopting the IFRS standards are shown in dark gray, and those adopting other principles, such as US GAAP, China GAAP or country-specific standards, are shown in light gray[5].

IFRS differs primarily from other accounting standards in that it is principle based, while other accounting standards such as US GAAP are rule based, resulting in possible differences in the reporting practices of disclosing banks across accounting regimes. Moreover, all banks in our sample consistently follow IFRS standard IAS39, which “establishes principles for recognizing and measuring financial assets, financial liabilities and some contracts to buy or sell non-financial items”. Starting in 2018, this standard will be replaced progressively by IFRS9, but

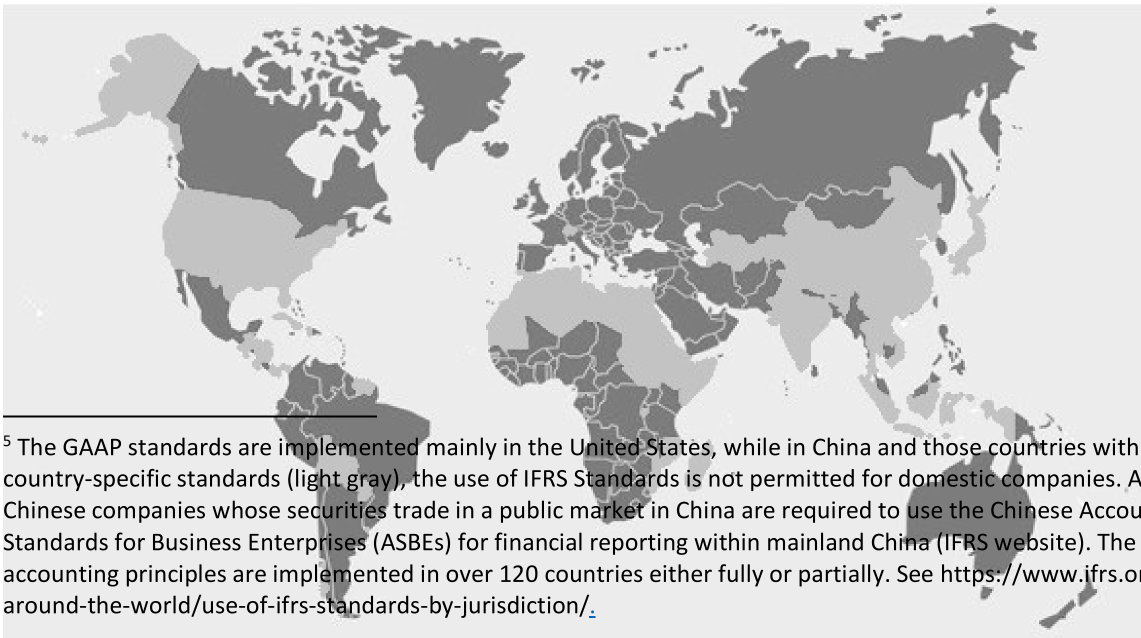


Figure 3. IFRS adopting countries (Dark Gray) vs. non IFRS adopting countries (Light Gray)

[5] The GAAP standards are implemented mainly in the United States, while in China and those countries with country-specific standards (light gray), the use of IFRS Standards is not permitted for domestic companies. All Chinese companies whose securities trade in a public market in China are required to use the Chinese Accounting Standards for Business Enterprises (ASBEs) for financial reporting within mainland China (IFRS website). The IFRS accounting principles are implemented in over 120 countries either fully or partially. See https://www.ifrs.org/use-around-the-world/use-of-ifrs-standards-by-jurisdiction/.

because our sample finishes in 2017, this change has no impact on our sample. After excluding countries that do not adopt IFRS accounting standards[6] and others with underdeveloped banking sectors with no listed banks, our final sample includes banks from 24 emerging market countries [7].

For these 24 countries, we initially identified 435 listed financial firms, but after the exclusion of non-commercial banks, Islamic banks [8], subsidiaries and banks that do not report on financial derivative usage in their financial statements, we are left with 115 entities. We further need to discard 10 banks with unclear information on financial derivatives[9] and achieve a final sample of 105 listed domestic banks over the time period 2010-2017. Where available, data from unconsolidated statements is used to avoid double counting. Financial statement data on derivative usage are then matched with bank- and country-level data from Bloomberg, the World Bank and DataStream.

The number of banks in our sample is limited primarily due to lack of data availability, as IFRS standards do not oblige banks to report on financial derivative usage. Nevertheless, overall, our sample size is consistent with samples used in relevant emerging market literature. Table 1

[6] Some of the countries that do not follow the IFRS standards include North African countries, China, India, Indonesia, and some other countries. For other countries no information on derivatives can be found and those, such as Kenya, Bangladesh, Benin, Burkina Faso no listed banks can be found.
[7] The dataset contains banks from 24 Middle Eastern, East Asian, African, East European and Latin American countries. Domestic commercial banks are identified by the availability of data on derivative usage as indicated by notional amounts reported in annual reports and financial statements. Table 1 presents the countries and number of banks in each country.
[8] We exclude Islamic banks since "Islamic" derivatives are still not standardized and follow ununified legal provisions and accounting standards. Moreover, finance theories governing conventional derivatives are different for Islamic finance that is governed by Shariah that forbids speculation or profit from interest or guaranteed return.
[9] Banks in our sample clearly report derivative usage in the notes on financial statements. We discarded banks that do not clearly report financial derivatives or report only the fair values without the notional amounts.

below gives an overview of the countries represented in our sample and the number of banks per country.

Table 1. Number of banks (between parenthesis) by country and region

Europe	Middle East		Africa	Asia	Latin America
Poland (7)	Bahrain (2)	Qatar (5)	SA (6)	Georgia (1)	Argentina (2)
Hungary (1)	Jordan (7)	Turkey (10)	Nigeria (3)	Kazakhstan (2)	Brazil (5)
Croatia (2)	Kuwait (5)		Togo (1)	Pakistan (6)	Chile (3)
Russia (4)	Lebanon (3)			Sri Lanka (4)	
	UAE (7)			Malaysia (7)	
	KSA (8)			Philippines (4)	
	Oman (5)				

3.2 Model specification

The regression models explain the main research questions: (a) the determinants of derivative usage in emerging markets, (b) the effects of financial derivatives on bank risk, value and stability, and (c) the effect of derivative usage on systematic risk.

3.2.1 Variable Specifications

3.2.1.1 Derivatives (DER)

Financial derivatives can be measured by their notional amounts, which reflect the value of the underlying assets, or by their fair value. According to the Office of the Comptroller of the Currency's (OCC) Quarterly Reports on Bank Trading and Derivatives Activities, notional amounts of derivatives provide insight into the productivity and operational issues of banks. Thus, we follow the literature and use the notional amount to assess bank performance and profitability (Bliss, Clark and DeLisle, 2017; Chang, Ho and Hsiao, 2017; Titova, Penikas and Gomayun, 2018). The data on financial derivatives are collected manually from the financial statements of the banks in our sample, and apart from collecting total derivative usage data, we further distinguish between the subcategories of trading and hedging derivatives. Derivatives were originally reported in local currencies, so we need to convert the values into millions of USD for consistency across countries and to match our control variables[10].

3.2.1.2 Bank Risk and stability

To measure bank risk, consistent with Brewer, Jackson and Moser (1996)**,** Bartram, Brown and Conrad (2011) and Chang, Ho and Hsiao (2017), we use the standard deviation of weekly stock returns (σ_{return})**.** We follow the literature in assuming that net risk exposure can be estimated by using bank stock price volatility. The data on the weekly stock price for banks were collected from Bloomberg.

Furthermore, in addition to its impact on overall volatility, we also evaluate the effect of derivative usage on bank stability or insolvency risk. As a proxy of bank insolvency, we use the Z-score (Laeven and Levine, 2009; Duran and Lozano-vivas, 2013; Ashraf, Zheng and Arshad, 2016; Ashraf *et al.*, 2020). Based on accounting data, this indicator is calculated as follows:

$Zscore = \frac{\frac{E_{i,t}}{TA_{i,t}} + ROA_{i,t}}{\sigma ROA_{i,t}}$, where $ROA_{i,t}$ and $\sigma ROA_{i,t}$ denote the return on assets and its standard deviation, respectively, for Bank *i* at time *t* and *E* and *TA* denote the total equity and total assets, respectively, for bank *i* at time *t*. Moreover, we use the natural logarithm of the Zscore

[10] We use the exchange rates reported by the BIS to convert the notional derivative usage from the local currency value reported in the annual reports, to millions of USD and match it with the bank-specific control variables collected from the Bloomberg database.

to reduce skewness (Ahamed and Mallick, 2017; Albaity, Mallek and Noman, 2019). The Zscore is an inverse measure of insolvency risk, and a higher Zscore value indicates higher bank stability and lower insolvency risk.

3.2.1.3 Bank Value (TOB_Q)

As a proxy for bank value, we follow Jin and Jorion (2006), Laeven and Levine (2007), and Gómez-González and Rincón and Rodríguez (2014) and use Tobin's Q, which is calculated as the sum of the market value of common equity, the book value of preferred shares and the book value of total debt all divided by the book value of total assets.

3.2.1.4 Independent Variables

To estimate our regressions, we identify several major accounting variables from the literature. We use total return on equity (*ROE*) as a proxy of bank profitability. Profitable banks are more resilient to financial shocks and far from distress; they thus are more comfortable in dealing with trading derivatives without considering them threatening (Mahieu and Xu, 2007). We also observe the impact of the net interest rate margin (*NIM*), which is calculated as a ratio of net interest income and total assets. Banks with a lower net interest margin may engage more in financial derivatives to increase their income and achieve higher stability; on the other hand, banks with a higher net interest margin may engage in financial derivatives to "lock-in" their profits and secure their "spreads" (Sinkey and Carter, 2000). Furthermore, we observe the effect of the flow of deposits (*DEP_ASSETS*), calculated as the ratio of deposits to total assets. This flow acts as a natural hedge against liquidity risks (Chang, Ho and Hsiao, 2017) and encourages banks to engage more in speculative behavior such as derivative trading (Minton, Stulz and Williamson, 2009). Another variable that may affect financial derivatives usage is bank capital (*EQRAT*), calculated as a ratio of equity capital to total assets (Minton, Stulz and Williamson, 2009). Banks with more capital are better able to deal with the drawbacks of derivative usage and are able to invest more in such assets. Another variable is bank size (*LNTASS*), calculated as the natural logarithm of total assets (Sinkey and Carter, 2000). Bank size may correlate with the banks' ability and know-how to deal with financial derivatives. Due to a "too big to fail" moral hazard problem, larger banks may also be inclined to engage more in risky behavior through derivatives trading (Ashraf, 2017). We also consider commercial loans (*CCLOANS*) scaled by total assets. As pointed out by Hirtle (2009), banks that are more exposed to credit risk through loans are more inclined to engage in financial derivatives to hedge such risks. Dividends (DIV) have an effect on derivative usage, and this variable is calculated as the ratio of dividend payout to total assets. In times of distress, banks can reduce dividend payments as an alternative to engaging in risky assets, such as financial derivatives. To control for cross-country differences in financial openness, we use the variable (*KAOPEN*)[11] developed by Chinn and Ito (2008). This variable, which is based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), captures the extent of financial liberalization through cross-border financial transactions. To capture the effect of competition, we use the three- bank concentration ratio (*CNTRN*) from the Financial Development and Structure Database maintained by Cihak *et al.* (2012). This variable is calculated as the ratio of the assets of the three largest banks in a country as a share of the assets of all commercial banks. We use this variable as a proxy for competition in the banking sector, in which banks in a highly competitive environment may engage more in financial derivatives to gain an edge over

[11] The KAOPEN variable developed by Chinn and Ito (2008) is available at http://web.pdx.edu/~ito/.

competitors and increase their profit. We also control for the strength of the institutional environment (*WGI_AVR*) by using an average of the World Government Indicators from the World Bank database. As the six indicators are highly correlated, we consider the average as a proxy of institutional strength. Furthermore, we use the World Uncertainty Index (WUI)[12] as a proxy of political and economic uncertainty. "Uncertainty" affects the pricing of financial derivatives (Pan *et al.*, 2020) in addition to the trading volume and bank liquidity (Berger *et al.*, 2020). Finally, we control for the annual rate of inflation, as the literature argues that through excessive competition, high inflation can affect bank behavior (Kasman and Yildirim, 2006) and can affect bank margins and overhead costs (Demirgüç-Kunt and Detragiache, 2005). Finally, EXCH_VOL is the exchange rate volatility of the local currency in a certain country per year and is calculated from the average monthly exchange rates as reported by the World Bank. Higher volatility can affect derivative usage and can especially impact the volume and price of foreign exchange derivatives used to hedge exchange rate risk.[13]

3.2.2 Econometric Models

3.2.2.1 Determinants of derivative usage

To establish the main determinants of bank derivative usage, we use a panel data regression model. This will allow us to test whether several factors known to drive derivative usage in developed markets drive emerging market derivative usage. We estimate our regression by using a random effects model, as pointed out by the results of the Hausmann test. We use bank

[12] The WUI is a panel index of uncertainty for a large set of developed and developing economies and is based on the frequency counts of "uncertainty" in the quarterly Economist Intelligence Unit (EIU) country reports for 189 countries. The dataset is built by Ahir, Bloom and Furceri (2018) and provided by the IMF. See https://worlduncertaintyindex.com/data/

[13] Details on the variables' description are reported in the Appendix

clustered random errors and control for both bank-specific and country-level variables, as shown in Equation 1:

$$DER_{it} = \alpha_0 + \alpha_1 ROE_{it} + \alpha_2 NIM_{it} + \alpha_3 DEP\_ASSETS_{it} + \alpha_4 EQRAT_{it} + \alpha_5 LNTASS_{it} + \alpha_6 CCLOAN_{it} + \alpha_7 DIV_{it} + \alpha_8 KAOPEN + \alpha_9 CNTRN_{it} + \alpha_{10} WGI\_AVR_{it} + \alpha_{11} WUI_{it} + \alpha_{12} INF_{it} + \alpha_{13} EXCH\_VOL_{it} + v_{it} + E_{it}. \quad (1)$$

DER represents the dependent variable for derivative usage: the total, trading or hedging derivatives measured in notional amounts.

3.2.2.2 Effects of derivative usage on bank risk and bank value

To capture the effect of financial derivatives on bank total risk and bank value, as implied by the Hausman test, we estimate the following panel regressions by using a fixed effect panel regression model. This model usage also controls for the problem of endogeneity that can occur because of unobserved variations. We also control for time by using year dummies, and we correct for heteroscedasticity by using bank clustered standard errors.

$$Risk_{i,t} = \gamma_0 + \gamma_1 DER_{it} + \gamma_2 ROE_{it} + \gamma_3 NIM_{it} + \gamma_4 DEP\_ASSETS_{it} + \gamma_5 EQRAT_{it} + \gamma_6 LNTASS_{it} + \gamma_7 CCLOAN_{it} + \gamma_8 DIV_{it} + \gamma_9 KAOPEN_{it} + \gamma_{10} CNTRN_{it} + \gamma_{11} WGI\_AVR_{it} + \gamma_{12} WUI_{it} + \gamma_{13} INF_{it} + v_i + E_{it}. \quad (2)$$

$$TOB\_Q = \eta_0 + \eta_1 DER_{it} + \eta_2 ROE_{it} + \eta_3 NIM_{it} + \eta_4 DEP\_ASSETS_{it} + \eta_5 EQRAT_{it} + \eta_6 LNTASS_{it} + \eta_7 CCLOAN_{it} + \eta_8 DIV_{it} + \eta_9 KAOPEN_{it} + \eta_{10} CNTRN_{it} + \eta_{11} WGI\_AVR_{it} + \eta_{12} WUI_{it} + \eta_{13} INF_{it} + v_i + E_{it}. \quad (3)$$

In this study, $Risk_{i,t}$ represents the risk measures, which are the bank stock price volatility of weekly returns and the Zscore.

3.2.2.3 Effect of derivative usage on systematic and idiosyncratic risk

In addition to testing the relationship between derivative usage and total bank volatility, we test whether and how derivatives for trading and hedging purposes might affect bank systematic risk and bank idiosyncratic risk, respectively. Following Elyasiani and Choi (1997), Shyu and Reichert (2002), Au Yong, Faff and Chalmers (2009) and Chang, Ho and Hsiao (2017), we estimate systematic and idiosyncratic risk for a given bank and year by applying a simple market model to stock returns:

$$R_{is} = \alpha_i + \beta_{it} R_{ms} + e_{is}$$

Systematic risk is then captured by the coefficient on the appropriate market index, β_{it}, and idiosyncratic risk is the standard deviation of the residual, σ_{it}. We use the same regression specification as before to determine the relationship between derivatives and systematic and idiosyncratic risk. The Hausman test again indicates the use of a fixed effects model, and we again use standard errors clustered at the bank level.

$$\beta_{it} = \eta_0 + \eta_1 DER_{it} + \eta_2 ROE_{it} + \eta_3 NIM_{it} + \eta_4 DEP\_ASSETS_{it} + \eta_5 EQRAT_{it} + \eta_6 LNTASS_{it} + \eta_7 CCLOAN_{it} + \eta_8 DIV_{it} + \eta_9 KAOPEN_{it} + \eta_{10} CNTRN_{it} + \eta_{11} WGI\_AVR_{it} + \eta_{12} WUI_{it} + \eta_{13} INF_{it} + v_{it} + E_{it}. \quad (4)$$

$$\sigma_{it} = \eta_0 + \eta_1 DER_{it} + \eta_2 ROE_{it} + \eta_3 NIM_{it} + \eta_4 DEP\_ASSETS_{it} + \eta_5 EQRAT_{it} + \eta_6 LNTASS_{it} + \eta_7 CCLOAN_{it} + \eta_8 DIV_{it} + \eta_9 KAOPEN_{it} + \eta_{10} CNTRN_{it} + \eta_{11} WGI\_AVR_{it} + \eta_{12} WUI_{it} + \eta_{13} INF_{it} + v_{it} + E_{it}. \quad (5)$$

3.3 Summary Statistics

Table 2 presents the descriptive statistics of the variables used in the study. All variables are winsorized at the 1 and 99% levels to reduce the effect of outliers. Hedging derivatives represent 10% of the total derivatives in the data collected, and this percentage is consistent with the findings of Upper and Valli (2016), in which total derivatives are dominated by trading derivatives.

Table 2. Descriptive Statistics For Bank-Level And Country-Level Variables

Variable	Obs.	Mean	Std.Dev.	Min.	Max.
STK_RTN	817	0.038	0.018	0.007	0.103
TOB_Q	809	1.027	0.118	0.158	1.2174
ZSCORE	714	3.599	0.738	-0.245	4.889
BETA	768	0.212	0.406	-1.421	1.681
IDIO	672	0.152	0.162	0	0.952
TOT_DER	794	0.540	1.127	3.85E-05	9.001
TRD_DER	794	0.488	1.096	0	9.001
HDG_DER	774	0.051	0.134	0	0.833
ROE	823	13.128	6.368	-12.684	30.248
NIM	830	0.164	0.757	0.013	5.227
DEP_ASSETS	822	64.887	16.738	0.076	86.292
EQRAT	835	0.116	0.0368	0.052	0.2804
DIV	829	0.005	0.005	0	0.0298
CCLOANS	809	60.305	13.139	25.196	82.328
LNTASS	837	9.786	1.443	6.085	12.989
CNTRN	848	57.991	17.301	28.508	99.979
KAOPEN	848	0.581	1.321	-1.210	2.359
WGI_AVR	848	0.060	0.603	-1.248	1.211
WUI	848	0.075	0.068	0	0.418
INF	848	4.981	7.946	-25.958	41.119
EXCH_VOL	848	0.014	0.016	0	0.087

Table 2 presents the following: the number of observations (Obs.) per variable; the mean and the standard deviation (Std.Dev.) of the variables; and the variables' minimum and maximum values.

3.4 Correlation Matrix

Table 3 reports the correlation matrix for the dependent and independent variables in our regression models. The correlation coefficients are low, which indicates the absence of a multicollinearity problem.[14]

[14] The variance inflation factors are reported in the appendix and further confirm the absence of multicollinearity in the models used.

Table 3
Correlation Matrix

Variables	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
(1) STK_RTN	1																		
(2) TOB_Q	-0.07**	1																	
(3) Zscore_log	-0.28***	0.15***	1																
(4) BETA	0.01	0.02	-0.08**	1															
(5) TOT_DER1	-0.01	0.09**	0.05	0.15***	1														
(6) TRD_DER1	-0.02	0.09**	0.05	0.15***	0.99***	1													
(7) HDG_DER1	0.15***	0.02	-0.01	0.06	0.3***	0.18***	1												
(8) ROE	0.05	0.23***	0.23***	-0.01	-0.08**	-0.08**	-0.05	1											
(9) NIM1	-0.02	-0.76***	-0.42***	-0.01	-0.09**	-0.09**	-0.06*	-0.19***	1										
(10) DEP_ASSETS	-0.14***	0.42***	0.33***	0.07**	0.04	0.03	0.03	0.15***	-0.68***	1									
(11) EQRAT1	0.04	0.07*	0.05	-0.16***	0.27***	0.29***	-0.06*	-0.14***	-0.04	-0.05	1								
(12) DIV	-0.18***	0.30***	0.01	-0.06*	0.22***	0.24***	-0.15***	0.23***	-0.01	-0.02	0.31***	1							
(13) CCLOANS	0.01	0.1***	-0.02	-0.04	0.27***	0.24***	0.23***	-0.05	-0.01	0.13***	-0.01	-0.07*	1						
(14) LNTASS	-0.06	-0.05	0.21***	0.01	-0.02	-0.04	0.13***	0.21***	-0.02	-0.07**	-0.28***	-0.03	-0.01	1					
(15) _CNTRN	-0.17***	0.17***	0.27***	-0.2***	-0.27***	-0.25***	-0.20***	-0.01	-0.25***	0.08**	0.13***	0.1***	0.02	-0.12***	1				
(16) KAOPEN	-0.11***	-0.01	0.11***	-0.26***	0.03	0.04	-0.04	-0.2***	0.04	0.01	0.35***	0.11***	0.23***	-0.1***	0.31***	1			
(17) WGI_AVR	-0.11***	0.25***	0.15***	-0.05	0.32***	0.31***	0.15***	-0.05	-0.21***	0.14***	0.13***	0.11***	0.6***	0.08**	0.22***	0.51***	1		
(18) WUI	0.23***	-0.09***	-0.07*	-0.04	0.05	0.04	0.13***	0.05	0.03	-0.21***	-0.12***	-0.0	-0.01	0.16***	-0.15***	-0.32***	-0.14***	1	
(19) INF	0.26***	-0.01	-0.12***	-0.01	-0.06	-0.05	-0.05	0.16***	0.08**	-0.14***	-0.02	-0.04	-0.13***	-0.11***	-0.05	-0.26***	-0.28***	0.19***	1
(20) EXCH_VOL	0.27***	-0.22***	-0.31***	0.12***	0.14***	0.12***	0.18***	0.01	0.29***	-0.37***	-0.24***	-0.08**	0.04	0.13***	-0.37***	-0.44***	-0.13***	0.44***	0.2*

4. Regression results and discussion

4.1 Determinants of Derivative Usage

In Table 4, we present the results of the random effects panel regression model and obtain several important findings. First, in models 1 and 2, the coefficient of net interest margin (NIM) is significant and negative, a result in line with previous findings in the literature (Chang, Ho and Hsiao, 2017). This finding suggests that banks with a lower NIM will engage more in derivatives, especially trading derivatives, to increase their profits and protect their net interest income[15] (Sinkey and Carter, 2000). Second, the ratio of total loans to assets is significant and positive in models 1 and 3. This finding is consistent with the assumption that banks with proportionally larger lending activities may use more hedging derivatives to manage their lending activity-related exposures. Banks may, for instance, actively hedge to limit potential distress costs and reduce balance sheet rigidity. These results are consistent with the findings of Brewer, Minton and Moser (2000). Third, the coefficient for total assets is significant in model 3, indicating that larger banks use more derivatives for hedging purposes. This finding supports the argument in the literature that there are non-negligible set-up and operating costs associated with active derivative usage (Sinkey and Carter, 2000; Chang, Ho and Hsiao, 2017) and that larger banks are more willing to accept these costs. Larger banks also likely possess more "in-house" knowledge, expertise and resources to hedge various portfolio risk exposures on a continuous basis. Fourth, the coefficient for bank concentration is significant and negative in models 1 and 2, which indicates that banks in more competitive environments, i.e., with lower bank concentration,

[15] NIM is a measure of intermediation profitability, and banks will attempt to increase their fee income through derivative trading to compensate for a decrease in NIM (Sinkey and Carter, 2000)

engage more in trading financial derivatives to gain a competitive advantage and increase their profitability over competitors. Fifth, institutional strength is significant and positive in models 1 and 2; this finding indicates a tendency of banks in stronger institutional environments to engage more in financial derivatives mainly through trading. This is consistent with the findings of Bartram, Brown and Conrad (2011) that banks in more developed countries use more financial derivatives and in line with the arguments made above that the quality of the market infrastructure will drive to a substantial extent the banks' participation in derivate markets . Along similar lines, we also find that higher levels of country-level uncertainty significantly reduce bank derivative usage. Higher political and economic uncertainty is not conducive to a market environment supporting the infrastructure for derivatives trading. Note that despite what might have been expected, exchange rate volatility does not increase the banks' usage of derivatives for hedging or trading. This is in line with the findings of Au Yong, Faff and Chalmers (2009), who in a sample of 110 Asia-Pacific banks ,find no significant association between exchange rate exposure and derivative usage.

In addition to being statistically significant, our results also have an important and economically meaningful impact on bank derivative usage. In our sample, the average ratio of derivatives to total assets is approximately 0.54 (table 2), indicating that on average, banks use derivatives in an amount equal to approximately half the value of their total assets. If we now increase a bank's net interest margin (NIM) by one standard deviation, then our results indicate that the ratio of total derivatives to total assets drops by approximately 7 percentage points to 0.47[16], a substantial reduction. Along the same lines, we find that the institutional environment is

[16] The average derivative usage ratio to assets is 0.54. An increase in one standard deviation of NIM (0.76) will decrease the average derivative usage ratio by 0.07 to 0.47.

potentially of even greater importance. A one standard deviation increase in the World Uncertainty Index (WUI) results in a 4 percentage point drop in the ratio of total derivatives to total assets, while a one standard deviation increase in the World Governance Index results in a 15 percentage point increase. This causes a large difference in the derivative usage of banks in stronger versus weaker institutional environments.

Table 4. Random Effects Model Panel Regression: Determinants of Derivative Usage In Emerging Markets

	Model 1	**Model 2**	**Model 3**
	TOT_DER	**TRD_DER**	**HDG_DER**
Cons	-0.154(0.564)	0.001(0.551)	-0.216(0.086) **
ROE	-0.001(0.006)	-0.005(0.055)	-0.004(0.005)
NIM	-0.093(0.043) **	-0.084(0.041) **	-0.0061(0.055)
DEP_ASSETS	-0.002(0.003)	-0.002(0.003)	-0.0024(0.044)
EQRAT	-0.096(0.986)	-0.119(0.913)	0.036(0.114)
DIV	3.675(6.825)	4.103(6.456)	-0.213(0.519)
CCLOANS	0.007(0.004) *	0.005(0.003)	0.001(0.001) **
LNTASS	0.058(0.043)	0.045(0.041)	0.019(0.007) ***
CNTRN	-0.004(0.001) ***	-0.004(0.001) ***	0.024(0.016)
KAOPEN	-0.061(0.043)	-0.052(0.042)	-0.007(0.005)
WGI_AVR	0.257(0.139) *	0.242(0.138) *	0.005(0.014)
WUI	-0.677(0.367) *	-0.666(0.364) *	-0.029(0.036)
INF	0.001(0.003)	0.002(0.003)	-0.009(0.034)
EXCH_VOL	1.726(1.669)	1.593(1.579)	0.056(0.207)
Year	Yes	Yes	Yes
Obs.	766	766	752
R-Square	25.32	24.57	6.07

Table 4 reports the results of Equation. (1) estimated by using a random effects panel regression model. The models are estimated by using bank clustered standard errors. We report the coefficients, with the standard errors shown between the parentheses. The dependent variable in model 1 is total derivative usage, in model 2, the dependent variable is denoted by trading derivatives, and in model 3, the dependent variable is denoted by hedging derivatives. Multicollinearity is tested by using the variance inflation test and yields very low values. To test for autocorrelation, we perform Wooldridge's test, which does not detect any autocorrelation. As a robustness check, we replace ROA with ROE (return on equity), which yields the same results. We also report the number of observations and the R-square for each model. See the "Appendix" for a detailed definition of the variables. ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

4.2 Derivative usage, Bank Risk and Bank Value

Table 5 presents the effect of financial derivative usage on bank risk and bank value. We estimate equations 2 and 3 by using a fixed effects model, as implied by the Hausman test. In models 1, 2 and 3, the dependent variable is Tobin's Q, a standard proxy for bank value. Interestingly, contrary to the findings of Chang, Ho and Hsiao (2017) for developed markets, we find a significant negative relation between derivative usage and bank value in emerging markets. This finding suggests that derivative usage in emerging markets decreases bank value, and the results support the strand of literature that points to the contribution of derivatives to a loss in bank value and the relation of derivative usage to financial turmoil (Jin and Jorion, 2006; Acharya and Richardson, 2009; Greenberger, 2010; Khediri, 2012). In addition to severe financial friction and information asymmetry, the high-risk environment in emerging markets (higher operational, documentation, contract risks, etc.) and the absence of a well-developed financial infrastructure may all contribute to the inability of emerging market banks to use derivatives efficiently to increase value. In contrast, increased derivative usage by emerging market banks seems to reduce the banks' value.

In models 4, 5 and 6 of table 5, we investigate the impact of derivative usage on total risk measured by the standard deviation of weekly stock returns expressed in the local currency (Brewer, Jackson and Moser, 1996). Since the financial crisis in 2008, derivative activity has become controversial. The literature on the effect on bank risk is divided: one strand finds a significant positive effect of derivative usage on bank risk (Hassan, Karels and Peterson, 1994; Chang, Ho and Hsiao, 2017), while another does not (Venkatachalam, 1996; Hirtle, 1997; Peek and Rosengren, 1997). In this study, we find no evidence of a relationship between derivative usage and total bank risk. Our results are in line with the findings of Cyree, Huang and Lindley (2012), who find no compelling evidence that banks' derivative usage contributes to higher risk. This could be attributed to the relatively lower volume of derivatives traded in emerging markets but also to their simpler structure compared to that of the complex derivatives used in developed markets (Upper and Valli, 2016). However, even though derivative usage does not appear to contribute to total risk or volatility, this does not imply that there could not be independent and perhaps counteracting effects on total risk's two subcomponents, namely, systematic risk and idiosyncratic risk. In the next section, we decompose total risk into systematic and idiosyncratic risk and investigate this possibility.

Table 5. Fixed Effects Model Panel Regression: Derivative Usage Effect on Bank Value and Bank Risk in Emerging Markets

Model	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable	***TOB_Q***			***STK_VOL***		
Cons	0.908(0.267) ***	0.909(0.267) ***	0.887(0.263) ***	0.065(0.071)	0.065(0.070)	0.064(0.071)
TOT_DER	-0.006(0.003) **			-0.001(0.001)		
TRD_DER		-0.005(0.003) **			-0.001(0.001)	
HDG_DER			-0.071(0.025) ***			-0.009(0.011)
ROE	0.001(0.001) ***	0.001(0.005) ***	0.001(0.005) ***	-0.012(0.017)	-0.011(0.017)	-0.076(0.0165)
NIM	-0.321(0.345)	-0.327(0.345)	-0.275(0.365)	0.013(0.003) ***	0.013(0.003) ***	0.013(0.003) ***
DEP_ASSETS	0.001(0.001) **	0.001(0.001) **	0.001(0.004) **	-0.023(0.015)	-0.023(0.015)	-0.026(0.015)
EQRAT	0.233(0.188)	0.234(0.188)	0.225(0.189)	0.056(0.038)	0.056(0.038)	0.056(0.038)
DIV	3.301(1.167) ***	3.295(1.168) ***	3.170(1.168) ***	0.300(0.219)	0.299(0.219)	0.295(0.219)
CCLOANS	-0.001(0.001) **	-0.001(0.005) **	-0.001(0.005) **	0.008(0.0139)	0.008(0.014)	0.001(0.001)
LNTASS	0.017(0.026)	0.017(0.026)	0.018(0.026)	-0.002(0.007)	-0.002(0.007)	-0.002(0.007)
CNTRN	-0.004(0.002) *	-0.004(0.002) *	-0.004(0.002)	0.023(0.067)	0.023(0.067)	0.024(0.068)
KAOPEN	-0.008(0.004) *	-0.007(0.004) *	-0.006(0.005)	-0.045(0.002)	-0.044(0.002)	-0.001(0.002)
WGI_AVR	0.047(0.022) **	0.047(0.022) **	0.051(0.021) **	-0.007(0.006)	-0.007(0.006)	-0.007(0.006)
WUI	0.012(0.052)	0.012(0.052)	-0.005(0.053)	0.001(0.013)	0.001(0.013)	0.003(0.013)
INF	0.001(0.004)	0.001(0.001)	0.001(0.004)	0.014(0.001)	0.014(0.009)	0.014(0.009)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	722	722	708	726	726	712
R Square	40.41	40.35	41.11	9.45	9.45	9.62

Table 5 reports the results of the fixed effects regression in which the year dummies and the robust standard errors are estimated by using bank clustering. We report the coefficients, and the robust standard errors are in parentheses. The dependent variables in Models 1, 2 and 3 (4, 5 and 6) are Tobin's Q (stock return volatility). All variables are calculated based on millions of USD and by using the BIS yearly rate of exchange. The derivatives are scaled by total assets, and to deal with outliers, all variables are winsorized to the 1 and 99th percentiles. TOT_DER, TRD_DER and HDG_DER denote total, trading and hedging derivatives, respectively. See the "Appendix" for a detailed variable description.

***, **,* denote statistical significance at the 1%, 5%, and 10% levels, respectively

4.3 Derivative Usage and Systematic and Idiosyncratic Risk

Table 5 pointed out that derivative usage did not impact total bank volatility, but it is still possible that there is an impact on its two subcomponents, namely, systematic market risk and idiosyncratic risk. The results in table 6 indicate that this is indeed the case. Bank usage of trading derivatives increases systematic risk but not idiosyncratic risk. It therefore appears that banks take speculative positions that amplify systematic risk factors, and this result is consistent with the findings of Chang, Ho and Hsiao (2017). Hedging derivatives, on the other hand, neither affect systematic nor idiosyncratic risk in a systematic way. Note, however, that although trading derivatives do not affect idiosyncratic risk in a significant way, the coefficient is negative and thus appears to cancel out the positive impact of trading derivatives on systematic risk, leaving total risk or volatility unchanged.

TABLE 6. Fixed Effects Regression Model of Derivative Usage Effect On Systematic And Idiosyncratic Risk

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent Variable	*BETA*			*Idiosyncratic risk*		
CONS	-1.866(0.837) **	-1.872(0.836) **	-1.917(0.855) **	0.461(0.668)	0.462(0.668)	0.435(0.667)
TOT_DER	0.035(0.014) **			-0.004(0.009)		
TRD_DER		0.037(0.014) **			-0.004(0.009)	
HDG_DER			-0.069(0.326)			-0.002(0.107)
ROE	0.003(0.003)	0.003(0.003)	0.003(0.003)	-0.001(0.002)	-0.001(0.002)	-0.001(0.002)
NIM	0.023(0.085)	0.023(0.085)	0.027(0.086)	1.078(1.383)	1.081(1.383)	1.021(1.474)
DEP_ASSETS	0.004(0.002) **	0.004(0.002) **	0.005(0.002) ***	-0.001(0.001)	-0.001(0.001)	-0.002(0.001)
EQRAT	0.418(0.946)	0.421(0.946)	0.435(0.976)	0.396(0.565)	0.396(0.566)	0.377(0.572)
DIV	-1.877(5.323)	-1.88(5.319)	-1.858(5.352)	2.118(1.907)	2.119(1.907)	2.156(1.843)
CCLOANS	-0.002(0.003)	-0.002(0.003)	-0.002(0.003)	0.001(0.002) **	0.001(0.002) **	0.001(0.002)
LNTASS	0.180(0.081) **	0.181(0.081) **	0.182(0.083) **	-0.041(0.068)	-0.041(0.067)	-0.038(0.067)
CNTRN	0.002(0.001)	0.002(0.001)	0.002(0.001)	0.001(0.001)	0.001(0.001)	0.001(0.001)
KAOPEN	0.029(0.029)	0.029(0.029)	0.025(0.029)	0.011(0.015)	0.011(0.017)	0.014(0.018)
WGI_AVR	-0.297(0.118) **	-0.297(0.118) **	-0.302(0.119) **	-0.012(0.072)	-0.012(0.072)	-0.004(0.072)**
WUI	0.323(0.268)	0.323(0.268)	0.301(0.274)	0.066(0.125)	0.066(0.124)	0.073(0.126)
INF	-0.005(0.003) *	-0.005(0.003) *	-0.004(0.003) *	0.001(0.001)	0.001(0.001)	0.001(0.001)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	689	689	675	689	689	675
R Square	9.53	9.55	9.57	6.38	6.38	6.5

Table 6 reports the results of the fixed effects panel regression of the effects of derivative usage on systematic risk and idiosyncratic risk. We report the coefficients, and the robust standard errors are in parentheses. Systematic Risk (BETA) is captured by the coefficient on the appropriate market index, β, in a standard one-factor market model. Idiosyncratic risk is calculated as the standard deviation of the residuals in that model. We estimate robust standard errors by using bank clustering. We report the presence of year dummies (Year) and the R-Square and number of observations (Obs.) for each model. ***, **,* denote statistical significance at the 1%, 5%, and 10% levels, respectively

4.4 Derivative usage and Bank Stability (Zscore):

Finally, although stock volatility is a key indicator of bank risk and uncertainty, it is not the only indicator. Next, we explore the impact of derivative usage on bank stability or the risk of bank failure. Bank stability in the literature is traditionally captured by the Z-score, and previous studies, such as Ghosh (2017), that examine the effect of derivative usage on the Z-score, find that aggregate derivatives reduce a bank's insolvency risk. In addition, Elyasiani and Choi (1997), for a sample of 59 banks in the period spanning 1975-1992, find that different derivative contracts may reduce bank instability. Keffala (2015), one of the few papers examining derivative usage in emerging markets, found that unlike forwards and swaps, which do not affect bank stability, options and futures decrease bank stability. On the other hand, Hirtle (1997) find that bank instability is amplified by derivatives. Our findings in table 7 are in line with Ghosh (2017), who also pointed to a positive significant relationship between derivative usage and bank stability as proxied by the Z-score[17]. This relationship is more significant for hedging derivatives, which seem to be used more efficiently in emerging markets to promote bank stability.

[17] The Zscore is an inverse measure of bank stability/insolvency; an increase in the Zscore implies more stability and less insolvency risk.

Table 7. Fixed Effects Panel Regression Model: The Effect of Derivative Usage On Bank's Insolvency Risk in Emerging Markets

Zscore	Model 1	Model 2	Model 3
Cons	1.549(0.568) ***	1.543(0.567) ***	1.519(0.572) ***
TOT_DER	0.024(0.011) **		
TRD_DER		0.025(0.011) **	
HDG_DER			0.003(0.073) ***
ROE	0.012(0.003) ***	0.012(0.003) ***	0.012(0.003) *
NIM	0.254(0.149) *	0.254(0.149) *	0.254(0.151)
DEP_ASSETS	-0.001(0.001)	-0.001(0.001)	-0.001(0.001)
EQRAT	7.601(0.554) ***	7.602(0.554) ***	7.581(0.553) ***
DIV	-4.737(3.114)	-4.745(3.115)	-4.619(3.138)
CCLOANS	0.003(0.001)	0.004(0.001)	0.001(0.001)
LNTASS	0.103(0.054) *	0.103(0.054) *	0.106(0.055) *
CNTRN	-0.001(0.001)	-0.001(0.001)	-0.001(0.001)
KAOPEN	0.046(0.021) **	0.046(0.021) **	0.049(0.021) **
WGI_AVR	-0.035(0.048)	-0.034(0.048)	-0.029(0.047)
WUI	0.091(0.085)	0.091(0.085)	0.053(0.089)
INF	0.001(0.001)	0.002(0.001)	0.004(0.001)
Year	Yes	Yes	Yes
Obs.	654	654	644
R Square	74.14	74.14	74.17

Table 7 reports the results of the fixed effects regression of derivative usage on the Zscore, with year dummies and robust standard errors estimated by using bank clustering. We report the coefficients, and the robust standard errors are in parentheses. The dependent variable in Models 1, 2 and 3 is the natural logarithm of the Zscore. See the "Appendix" for a detailed variable description.

***, **,* denotes statistical significance at the 1%, 5%, and 10% levels, respectively

5. Conclusion

In this paper, we examine the determinants of emerging market banks' derivative usage and the effect of derivatives on total bank risk, bank value, systematic risk, and bank stability. We find that for total and trading derivatives, an important bank-level stimulant of derivative usage is the net interest margin and that for hedging derivatives, an important bank-level stimulant is the amount of total assets and loans. Country-level determinants include higher competition, a stronger institutional environment and "uncertainty", as presented by the World Uncertainty Index. We also find that derivative usage undermines bank value for our sample of emerging market banks. Given the presence of factors, such as higher financial friction in emerging markets, higher information asymmetry and weaker institutional environments, that contribute to operational risk, unlike financial derivatives in developed countries, financial derivatives in emerging countries are not value adding but are rather value undermining. Moreover, our findings regarding the positive effect of derivative usage on systematic risk are in line with those of Chang *et al*. (2017), but unlike them, we do not find a significant effect on bank total risk. Nevertheless, it seems that banks in our sample use derivatives, especially hedging derivatives, in an efficient way that promotes stability and decreases insolvency risk. Overall, for policy makers and investors, the paper has important implications regarding the assessment of banks' value, risk, and stability. Following the recent financial crisis, a debate has been ongoing regarding the impact of derivatives on bank value and stability. In the extant literature, this paper helps fill the gap regarding our understanding of the effects of derivative usage on banks in emerging markets. The research in emerging market contexts is often hindered by the lower reliability of data sources and the outright unavailability of data on certain dimensions. One of the current paper's limitations, which is a shortcoming also common in the emerging market literature, is the relatively small sample size on which we work. Because our sample covers banks from a wide variety of emerging market countries, however, our results nevertheless yield important insights for market practitioners and policy makers. Future research could investigate in more detail the impact of bank-level and country-level institutional variables on derivative usage and derivative impact. In particular, it would be interesting to link the impact of derivative usage to different dimensions of bank-level governance to discern, for instance, whether the positive impact of derivative usage on bank value is more pronounced in banks with stronger board oversight. Similarly, how financial market regulation in emerging markets affects bank derivative usage is a largely open question that merits further investigation.

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Appendix

This table identifies the dependent and independent variables

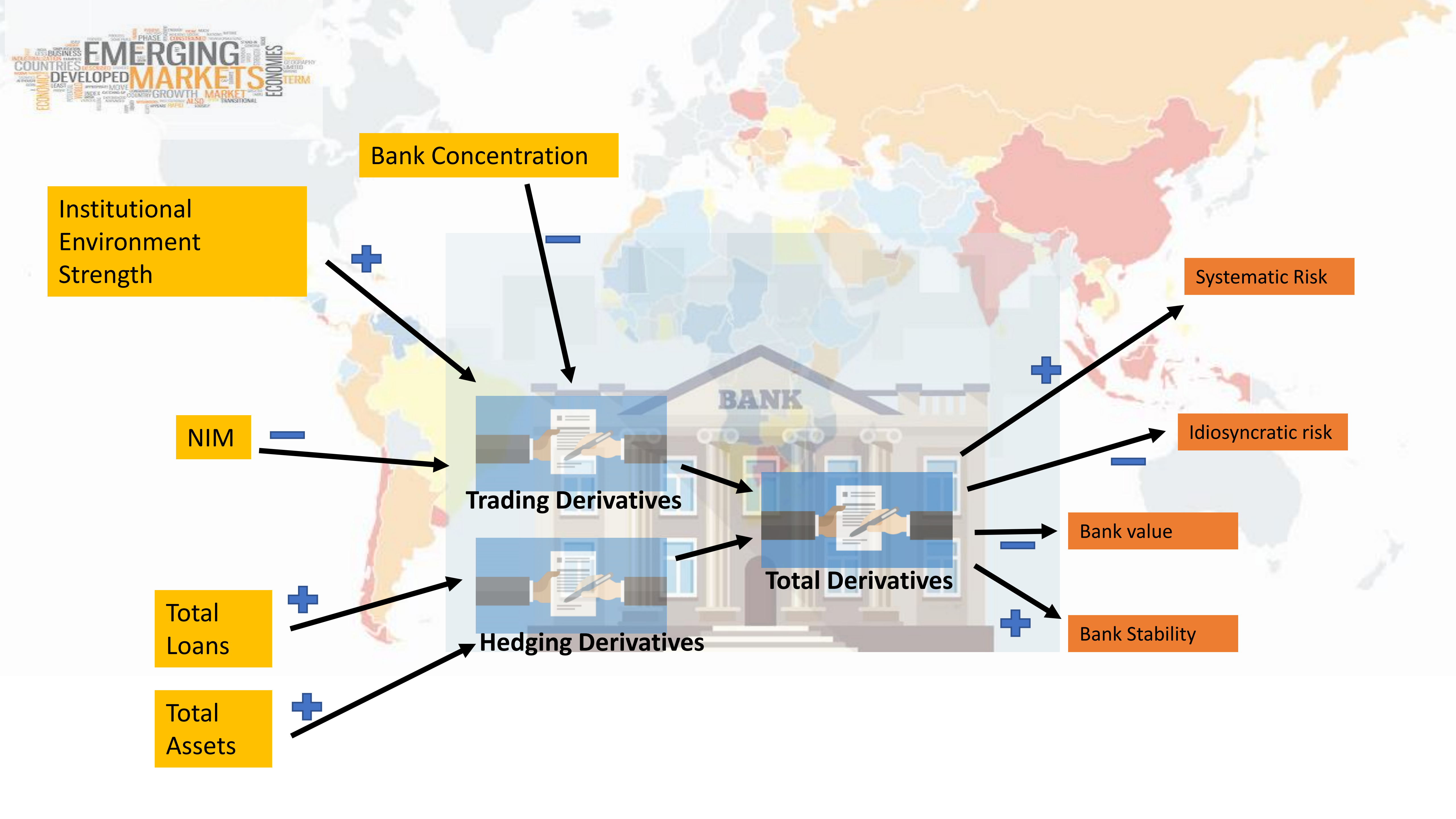
Variable	*Definition*

Dependent variables	
TOT_DER	Notional amount of Total Derivatives divided by total assets
TRD_DER	Notional amount of Trading Derivatives divided by total assets
HDG_DER	Notional amount of Hedging Derivatives divided by total assets
σ_{return}	Standard deviation of stock return as a proxy of bank total risk
Zscore	A proxy used for the bank's stability (insolvency risk); calculated by using the banks' returns on assets, and its volatility, and its leverage ratio; the natural logarithm of the Zscore is used to solve for skewness, as is common in the literature (Albaity, Mallek and Noman, 2019); an inverse measure that implies that a higher value indicates higher stability/lower insolvency risk
TOB_Q	Tobin's Q, as calculated by Laeven and Levine (2007); the ratio of market value to the book value of assets.
BETA	Bank level systematic risk estimated by using weekly stock returns against an appropriate country level broad stock market index.
Independent variables	
ROA	Return on assets
ROE	Return on equity
NIM	Difference between total interest income and total interest expense to total assets
DEP_ASSETS	Ratio of total deposits to assets
CNTRN	Three-bank concentration ratio from the Financial Development and Structure Database maintained by Anginer, Demirguc-Kunt and Zhu (2014)
EQRAT	Ratio of book value of equity to total assets
LNTASS	Natural logarithm of total assets
CCLOANS	Total commercial loans normalized by total assets
DIV	Dividends paid by total assets
KAOPEN	A measure of financial openness developed by Chinn and Ito (2008)
WGI_AVR	Average of the six World governance Indicators as a proxy of institutional environment strength
WUI	World Uncertainty index, as estimated by Ahir, Bloom and Furceri (2018)
INF	Inflation annual rate

This Table Presents the Variance Inflation Factors (VIFs) for the different models used in our analysis

Determinants			Beta			Stock Volatility		
Variable	VIF	1/VIF	Variable	VIF	1/VIF	Variable	VIF	1/VIF
ROE	1.35	0.741729	*TOT_DER*	1.38	0.722335	*TOT_DER*	1.37	0.728537
NIM	2.37	0.421404	*ROE*	1.43	0.698508	*ROE*	1.32	0.758235
DEP_ASSETS	2.5	0.400762	*NIM*	1.83	0.54635	*NIM*	1.77	0.564592
EQRAT	1.45	0.691144	*DEP_ASSETS*	1.89	0.528742	*DEP_ASSETS*	1.82	0.548151
DIV	1.25	0.802826	*EQRAT*	1.42	0.705157	*EQRAT*	1.42	0.70561
CCLOANS	1.86	0.538973	*DIV*	1.26	0.793282	*DIV*	1.24	0.808865
LNTASS	1.32	0.756761	*CCLOANS*	2.05	0.487828	*CCLOANS*	1.95	0.512895
_CNTRN	1.43	0.699172	*LNTASS*	1.47	0.682355	*LNTASS*	1.34	0.746115
KAOPEN	2.37	0.421386	*_CNTRN*	1.57	0.638967	*_CNTRN*	1.51	0.662477
WGI_AVR	2.76	0.362001	*KAOPEN*	2.25	0.444202	*KAOPEN*	2.19	0.457166
WUI	1.54	0.651147	*WGI_AVR*	3.03	0.329733	*WGI_AVR*	2.91	0.343997
INF	2.04	0.490676	*WUI*	1.45	0.689328	*WUI*	1.42	0.704933
EXCH_VOL	2.17	0.461889	*INF*	1.98	0.505802	*INF*	1.98	0.50614
Mean VIF	2.02		*Mean VIF*	1.98		*Mean VIF*	1.92	

Tobin's Q			*Zscore*		
Variable	VIF	1/VIF	Variable	VIF	1/VIF
TOT_DER	1.37	0.728777	*TOT_DER*	1.55	0.646714
ROE	1.44	0.695031	*ROE*	1.49	0.671528
NIM	1.5	0.666562	*NIM*	2.65	0.377133
DEP_ASSETS	1.73	0.577603	*DEP_ASSETS*	2.46	0.405789
EQRAT	1.54	0.648237	*EQRAT*	1.43	0.698003
DIV	1.51	0.663858	*DIV*	1.28	0.781645
CCLOANS	2.02	0.495693	*CCLOANS*	1.95	0.511604
LNTASS	1.37	0.727279	*LNTASS*	1.39	0.718833
_CNTRN	1.53	0.652008	*_CNTRN*	1.83	0.545133
KAOPEN	2.19	0.456693	*KAOPEN*	2.34	0.427908
WGI_AVR	2.93	0.341253	*WGI_AVR*	3.03	0.330187
WUI	1.42	0.704041	*WUI*	1.47	0.678693
INF	1.98	0.505154	*INF*	1.99	0.502426
Mean VIF	1.93		*Mean VIF*	2.41	


EMERGING
MARKETS
COUNTRIES
DEVELOPED
ECONOMIES
GROWTH
MARKET
BUSINESS
TERM
Bank Concentration
Institutional
Environment
Strength
NIM
Total
Loans
Total
Assets
BANK
Trading Derivatives
Hedging Derivatives
Total Derivatives
Systematic Risk
Idiosyncratic risk
Bank value
Bank Stability