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Goodwill and derivatives for bank loan rate-setting determination: Evidence from selected Asian countries

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ABSTRACT

The article develops a contingent claim model and uses the Hausman-Taylor estimation to investigate how bank goodwill and derivatives impact loan rate-setting determination. The development concerns the bank interest margin analysis in selected Asian countries, including China, Indonesia, Malaysia, the Philippines, and Thailand, over 2005~2020. Results show that bank goodwill investment and risk-taking by holding derivative liabilities makes the bank reduce the loan rate-setting and thus deteriorates interest margin, considering the six selected countries as a whole market. Those analyses are not statistically applicable to an individual country. Our empirical tests suggest future avenues for improving the theoretical analysis.

Keywords: Goodwill; Bank interest margin; Derivatives; Down-and-out call

JEL CLASSIFICATION
G21; G28

1. INTRODUCTION

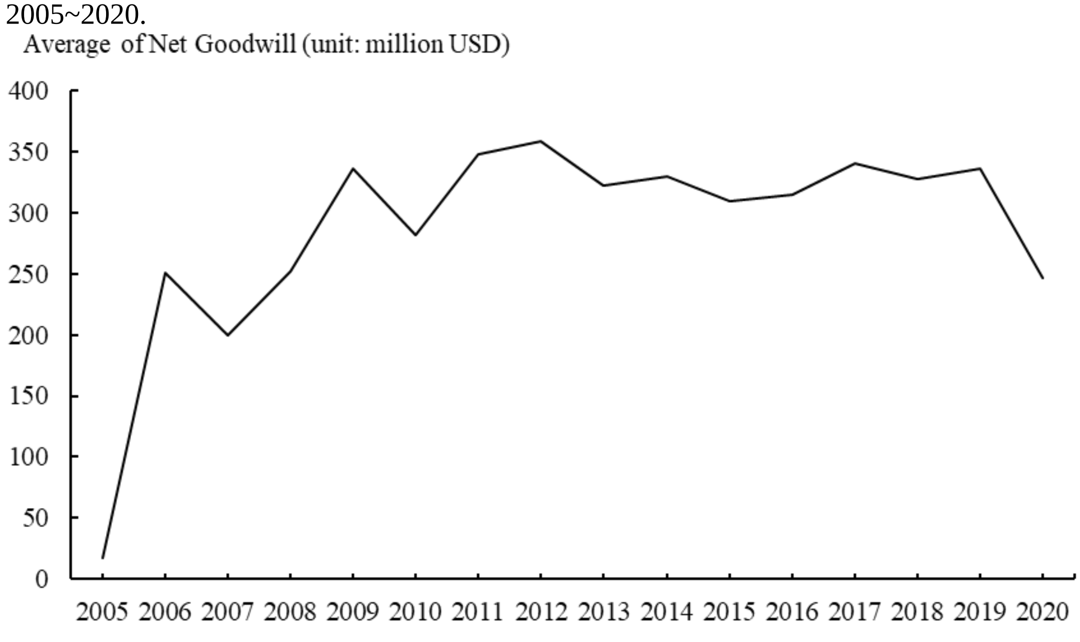
An extensive amount of studies investigates bank interest margin based on the pioneering research by Ho and Saunders (1981).1 One direction is that many studies undertake bank interest margin determination across the countries following their work. For example, there are Saunders and Schumacher (2000) in a several-country case, Maudos and de Guevara (2004) in the European banking system, Doliente (2005) in four southeast Asian countries (Indonesia, Thailand, Philippines, and Malaysia): Claeys and Vander Vennet (2008) in the European countries, Kasman et al. (2010) in the old and new European Union members and candidate countries, and Qi and Yang (2017) in foreign bank presence in China. The article also focuses on selected Asian countries (China, Indonesia, Philippines, Malaysia, and Thailand). Specifically, we aim at a contingent claim model development as a base for empirically analyzing the interest margin determination in the selected Asian countries.

Our aim is crucial because of the following reasons. First, the bank interest margin conveys vital information about the efficiency of the banking system. Bank interest margin determination, related to bank asset-liability matching management, is critical in banks' and regulators' decisions concerning banking stability. There are at least two aspects where a thorough understanding of bank behavior in asset-liability matching management is essential. One is the loan rate-setting behavior in an imperfectly competitive loan market faced by the bank. Previous research ignores the rate-setting behavior except for Lin and Hung (2013): Chang (2014): and Li et al. (2021). Another is the portfolio risk in the bank's investment. Thus, the research can present the optimal bank interest margin determination by integrating the portfolio theory with the firm-theoretic loan rate-setting behavior as the analytical apparatus in a contingent claim analysis.

Second, we empirically explore the interest-margin determinant effect on the optimal loan rate-setting behavior (and thus on the bank interest margin) based on the contingent claim model with data from selected Asian countries. The literature's determinants of bank interest margin are very diversified, depending on the issues the studies want to analyze. Begley et al. (2006) use a residual income approach with an empirical test for modeling goodwill for banks. Our research applies for their conceptual work and attempts to exploit a contingent claim approach with a practical test for modeling the effects of goodwill investment and derivative transactions on bank interest margin. The data set includes the selected Asian countries. The empirical study focuses on testifying the different determinants of bank interest margin where the banking market in each country or aggregate of the selected Asian countries. Our testified results suggest that banks might focus on different determinants for interest margin determination within an individual country or in aggregate selected countries.

Third, goodwill is an intangible asset but different from most other intangible assets, having an indefinite life, while most intangible assets have a finite useful life (Hargrave(2021). In aggregate, bank goodwill assets in China and some selected Southeast Asian countries (Indonesia, Malaysia, the Philippines, and Thailand) increased sharply before the 2009 financial crisis and the sudden drop in the beginning year of the coronavirus pandemic (see Figure 1). Berkowitz (2020) reports a potential sign of more challenging times. The trend raises fundamental issues about the role of bank goodwill assets, particularly from a bank profitability (bank interest margin) viewpoint. Banks are in the business of lending and borrowing money. Earnings from bank interest margins, the spread between the loan rate and deposit rate, account for a part of profits. Bank earnings inevitably depend on goodwill in asset-liability management. As the margin is essential to bank profitability, optimally determining and adjusting to changes in the banking environment deserve closer scrutiny.

Figure 1. Bank net goodwill assets in China, Indonesia, Malaysia, Philippines, and Thailand over 2005~2020.



Source: From “[52300] Goodwill” in the BankFocus database where [52300] is a code number.

Other literature on bank interest margin identifies determinants such as interest rate volatility (e.g., Angbazo, 1997; Saunders and Schumacher(2000; Valverde and Fernández(2007; Entrop et al. (2015): and credit risk (Angbazo, 1997; Maudos and de Guevara(2004; Hawtrey and Liang(2008). Their findings are a positive relationship between the above factors and bank interest margin, implying the consistent co-existence between high risk and high return. Begley et al. (2006) employ a residual income approach with an empirical test to model goodwill for banks, particularly examining the relationship between stock valuations and accounting numbers for a prototypical banking firm. Both the ties might create goodwill derivative-asset/-and liability attempts for the banking interest margin determination.

We complement the literature above as follows. (i) We develop a contingent claim model to determine the optimal bank interest margin considering market power literature on loan rate-setting behavior, mainly adding goodwill, goodwill volatility, derivative-asset/-liability, and derivative volatility determinants. (ii) Using the developed model as a base, we empirically investigate the effect of bank interest margin in the five selected countries in aggregate (China, Indonesia, Malaysia, the Philippines, and Thailand) and each country to understand whether the comparative statics results are consistent. Accordingly, our paper contributes to the prior research by clarifying how a contingent claim approach can be extended to settings. In particular, bank interest margin (i.e., market-value bank profits) is created from financial assets and liabilities in either an aggregate market or each selected country.

Most bank interest margin literature omits bank loan rate-setting behavioral mode where the studies have adopted a conventional assumption of perfectly competitive market structure to investigate bank interest margin. The investigation is under a very restrictive assumption. The traditional belief does not apply to a loan market, usually concentrated in some industries or regions. The application implies that we should assume that loan markets are imperfectly competitive to reexamine bank interest margins (e.g., Li et al. (2021; Lin et al. (2021). The current research is novel, the first study to model comparative statics based on a contingent claim framework to investigate the effects of goodwill and derivatives on the bank interest margin. Accordingly, the study develops a down-and-out call option model of bank spread behavior that considers goodwill and derivative transactions under capital regulation. The approach’s principal advantage is the explicit treatment of uncertainty and loan rate-setting behavior, which have played a prominent role in bank asset-liability risk management, considering a case of premature default risk.

Moreover, we employ a dataset consisting of 5 selected developing countries (China, Indonesia, Malaysia, the Philippines, and Thailand) over 2005~2020 and use the Hausman-Taylor panel estimation to consider imperfectly competitive loan markets and derivative transactions under capital regulation based on the contingent claim analysis. The former implies loan rate-setting behavior, while the latter implies derivative transactions in financial liberalization. Both have been commonly critical economic features in the banking industry for the past decades.

The main findings are as follows. (i) We show the positive effect of goodwill, derivative liabilities, capital-to-deposits ratio, or derivative liability volatility on bank interest margin in the selected five-country markets in aggregate. Those findings are also applicable to the four Southeast Asian countries. In both the group markets, stringent capital regulation enhances bank goodwill. (ii) Individually, only capital regulation is statistically significant to determine bank interest margin in Indonesia. In Malaysia, three key factors determine bank interest margin: goodwill, derivative liability, and capital regulation. The goodwill and derivative liabilities are statistically significant to decide on the margin in Thailand and China. The impact on the margin from increases in goodwill is negative in Thailand but positive in China. (iii) The four factors are statistically insignificant to explain the margin in the Philippines. Overall, results based on the five-country dataset may not extend to the individual case.

One immediate application of this research is to evaluate the intangible goodwill effect on bank interest margins proposed as different strategic lendings in the domestic or international markets. In conclusion, the paper shows that the empirical study based on the risk perspective down-and-out call valuation is intimately relevant to bank interest margin in regional or respective countries. However, our model is outperformed by the popular contingent claim model for bank interest margin analysis. We can formally reject one of our crucial modeling assumptions. Our empirical tests suggest future avenues for improving the theoretical analysis.

The remainder of this paper is as follows. The following section presents two strands of the literature as a background for our study. Section 3 develops a contingent claim model of bank interest margin considering goodwill and derivatives. Section 4 theoretically derives the comparative statics and presents empirical findings. The final section concludes.

2. BACKGROUND

A substantial literature has emerged discussing the impacts of interest margin determinants (mainly goodwill and derivatives) on bank loan rate-setting behavior (and thus bank interest margin determination) in individual countries and regions. This section discusses the bank interest margin issue in selected countries and regions. Consequently, this section discusses the bank goodwill effect on interest margin determination. Finally, we also discuss the bank derivatives issue. Considering the similarity between papers that focus on bank goodwill and derivatives, this section discusses the link of the two points based on a contingent claim model developed in this article. The article further conducts an empirical study based on the developed model to testify the validity of individual-country or regional-country cases.

First, studies on bank interest margins in selected Asian countries are abundant. Zhou and Wong (2008) investigate the determinants of Chinese commercial banks' net interest margins over 1996~2003. The results indicate that the determinants of bank interest margins consist of market competition, operating costs, risk aversion degree, transaction size, interest payments, reserve opportunity cost, and management efficiency. Liu and Sathye (2019) also study how bank-specific factors influence bank interest margins in China over 1988~2015. Their findings show significant relationships between the interest margin and bank-specific factors (i.e., credit quality, risk aversion, and liquidity risk).[2] Raharjo et al. (2014) analyze the determinant factors of commercial bank interest margin in Indonesia over 2008~2012. Bank asset growth, profitability, efficiency, capital adequacy, liquidity, and risk are internal factors. Results show that the internal factors are statistically significant to affect the bank interest margin determination. Tan (2012) conducts a bank-level interest margin analysis in the Philippines. Findings indicate that bank interest margins rise with bank size, capitalization, foreign ownership, overhead costs, and tax rates. Doliente (2005) examines the bank interest margin determinants in four selected Southeast Asian countries. Results show that bank-specific factors (i.e., operating expenses, capital, loan quality, collateral, and liquid assets) interpret the region's bank interest margin.

The bank interest margin contributors above are Zhou and Wong (2008) and Liu and Sathye (2019) in China, Raharjo et al. (2014) in Indonesia, Tan (2012) in the Philippines, and Doliente (2005) in four selected Southeast Asian countries. The literature above commonly remains silent on imperfectly competitive loan market structures and a critical factor of goodwill influencing bank interest margin. We develop a contingent claim model of bank interest margin. We use a dataset of selected Asian countries (i.e., China, Indonesia, Malaysia, the Philippines, and Thailand) for the comparative static analyses. Our investigation of goodwill's effect on the loan rate-setting takes our research in a different direction.

The second strand is the goodwill literature. Begley et al. (2006) model goodwill for banks and use a residual income approach to test the effect of the bank goodwill on performance. Gu and Lev (2011) find that overpriced shares of acquirers tend to suffer from goodwill write-offs in the years following the acquisition. Kimbro and Xu (2016) investigate the relationship between goodwill and future returns. Their study focuses on how goodwill information before and after Statement of Financial Accounting Standards 142 affects idiosyncratic return volatility (IVOL). Their research shows that high IVOL is a function of low information on future earnings and defines goodwill as a growth option that could price through IVOL. Li and Sloan (2017) empirically show that firms with higher goodwill and lower profitability have lower stock returns in the future. He et al. (2019) examine goodwill and stock price crash risk using data from 43 markets worldwide. Empirical evidence shows that goodwill and future crash risk are significant for firms with fewer incentives to provide transparent disclosure. Wu and Lai (2020) examine the relationship between intangible intensity and stock price crash risk for the United States listed firms from 1983 to 2017. Results show that the decomposition of intangible intensity indicates goodwill as a vital driving force and documents its predictability for future impairment events.

The previous studies also commonly focus on bank goodwill; however, they ignore bank interest margin determination when considering goodwill in banking liquidity management. Analysts often treat bank interest margin as an essential indicator of financial intermediation efficiency. While we also examine bank goodwill using a dataset of the selected countries, our focus on the margin management aspects of bank goodwill takes our analysis differently to contribute to the literature. Specifically, our study aims to develop a contingent claim model as a base for the empirical comparative static research to gain an insight into the effect of goodwill on bank loan rate-setting behavior under capital regulation.

Third, we focus on the issue of bank derivatives. Chang and Chen (2016) investigate the relationships between credit risk transfers and the optimal bank interest margin determination. A result shows that credit risk transfers enhance the bank interest margin. Credit risk transfers reduce (increase) the bank default risk when the bank acts as a protection buyer (seller). Choi et al. (2016) explore the effect of derivatives held by US bank holding companies on their market valuations from 2000 to 2010. One main finding is that derivative instruments held for hedging rather than trading enhance market values. Aktug (2017) analyzes the US banking system during the 2007-2013 period by incorporating specific hedging and trading variables. This study discovers that even though hedging might reduce profitability and firm value, it might minimize tail risks by reducing asset volatility. Shen and Hartarska (2018) provide empirical evidence on how the profitability of small community banks was affected by derivatives use before/after the 2008 crisis. The results show that derivative transactions help reduce the sensitivity of profitability to credit risks and improve profitability for most specialists. However, for the most significant number of banks which are non-user non-specialists, deviates use would have resulted in a lower return on assets had they used derivatives post-2008. Our research also discusses derivative transactions where banks can play a seller or buyer in the derivatives market. Notably, we contribute to the bank interest margin literature by considering the role played by banks in the derivatives market.

3. THEORETICAL MODEL

The equity valuation explicitly considers bank goodwill assets and derivatives, which are our focus. For our research purpose, the bank has the balance sheet at the beginning of the period:

$$L+B+DA+G=DL+D+K=DL+K(D/K+1)=DL+K(1/q+1) \quad (1)$$

where the capital-to-deposits ratio ($q=K/D$) reflects a binding balance sheet. In Eq. (1): the asset side of the balance sheet consists of loans (L): liquid assets (B): derivative assets (DA): and goodwill assets (G). The liabilities include derivative liabilities (DL) and deposits (D). The bank equity capital is K.

The bank's loans mature at the end of the period. The bank faces an imperfectly competitive loan market that sets the loan rate R_L. The loans are risky because of their likely non-performance. Bank goodwill is an intangible asset (a portion of the purchase price): higher than the sum of the net fair value of all assets purchased in the acquisition and the liabilities assumed in the process. The bank's goodwill generally comes from its brand name, solid borrower/depositor base, good customer relations, employee relations, and proprietary management technology.[3] Liquid assets held by the bank during the period earn the security-market interest rate R. The promised payments on deposits occur in a perfectly competitive market. The deposit supply faced by the bank is perfectly elastic at a market deposit rate R_D. Thus, the bank interest margin is the spread rate between the loan and deposit rates, focusing on our study.

3.1 Objective

Our equity model applies Episcopos (2008) for the market-based valuation. Specifically, a bank's equity valuation is a down-and-out call option on its assets because of considering the likely premature default features. The option is the equity value that the bank's equity holders are residual claims on its underlying investments after all liabilities have been met. The option value equals zero if its asset value is less than its liability value. In the valuation, the underlying assets () follows a geometric Brownian motion as follows:

$$dV_A / V_A = \mu \, dt + \sigma_A \, dW \tag{2}$$

where the underlying assets are associated with instantaneous drift (μ) and instantaneous volatility (σ_A). The symbol W is a standard Wiener process for the underlying assets. The underlying investments in nature are risky, including the loan repayments and the goodwill assets net of derivative liabilities:

$$V_A = (1+R_L)L + G - DL \tag{3}$$

The term G is the net goodwill value. The positive value is the net goodwill assets, and the negative value is the net goodwill liabilities. Including the derivative liabilities is that the bank also plays a risk buyer role in the derivative swap transaction market to pay a default-risk compensation to its counterparties. The down-and-out call's strike price (Z) is the book value of the bank's net obligations. The strike price is the net-obligation payments, consisting of the deposit payments, default-free derivative repayments, and liquid-asset repayments, that is:

$$Z = (1+R_D)D - DA - (1+R)B \tag{4}$$

where

$$B = DL + K(1/q+1) - L - DA - G$$

The strike price directly indicates the capital regulation in our model setting. Then, we can formulate the bank's down-and-out call equity as follows:

$$S(V_A, Z) = SC(V_A, Z) - DIC(V_A, Z)$$

$$= [V_A N(d_1) - Ze^{-(R-R_D)} N(d_2)] - [V_A (\frac{M}{V_A})^{2\eta} N(b_1) - Ze^{-(R-R_D)} (\frac{M}{V_A})^{2\eta-2} N(b_2)] \tag{5}$$

where

$$d_1 = \frac{1}{\sigma_A}(\ln\frac{V_A}{Z} + (R-R_D) + \frac{\sigma_A^2}{2}), \quad d_2 = d_1 - \sigma_A$$

$$M = \beta Z, \quad 0 < \beta < 1, \quad \eta = \frac{R-R_D}{\sigma_A^2} + \frac{1}{2}$$

$$b_1 = \frac{1}{\sigma_A}(\ln\frac{M^2}{V_A Z} + (R-R_D) + \frac{\sigma_A^2}{2}), \quad b_2 = b_1 - \sigma_A$$

Eq. (5) includes two parts: the standard call option (SC) and the down-and-in call option (DIC). The first part is the value with time to expiration at the end of the period, while the second is when the barrier (M) occurs. The second value is a deduction of the equity value because it likely captures the premature default risk. The discounted rate is the difference between the security-market rate and the deposit rate. The knock-out value is M, and the barrier-to debt ratio is β. The distribution $N(\cdot)$ is the cumulative density function of the standard normal distribution.

We partially differentiate Eq. (5) concerning the loan rate R_L, the first-order condition (i.e., $\partial S / \partial R_L = 0$) determines the bank's equity maximization' optimal loan rate. The optimal loan rate exists when the second-order condition (i.e., $\partial^2 S / \partial R_L^2 < 0$) is valid.

3.2 Comparative statics

We consider the bank interest margin effect from goodwill assets, derivative liabilities, market risks ($RISK$): and capital regulation changes for our research purposes. Implicit differentiation of the first-order condition for the parameter i ($i = G$, DL, $RISK$, and q) yields:

$$\frac{\partial R_L}{\partial i} = -\frac{\partial^2 S}{\partial R_L \partial i} / \frac{\partial^2 S}{\partial R_L^2} \tag{6}$$

Capturing the response of the goodwill assets to a change in capital regulation evaluated at the optimal loan rate yields the following:

$$\frac{dG}{dq} = \frac{\partial R_L}{\partial q} / \frac{\partial R_L}{\partial G} \tag{7}$$

The following section investigates the comparative static impacts by using a dataset.

4. EMPIRICAL COMPARATIVE STATIC ANALYSIS

This section has the following research design based on our model development. These include data sources, the loan rate determinant regression, statistical analysis, and comparative static analyses and applications.

4.1 Data and summary statistics

Our research dataset is from the BankFocus, a database of individual-level financial institutions.[4] From the BankFocus, we establish a dataset containing commercial banks in China, Indonesia, Malaysia, the Philippines, and Thailand over 2005~2020 for research purposes.[5] After excluding banks with observations spanning less than 5 consecutive years, our final sample constitutes an unbalanced panel dataset with 448 observations.[6] We specify the loan-rate determinant function according to the previously developed theoretical model. We identify the dependent variable as $R_L =$ Interest Income / Loans. The explanatory variables are likely in the following: $x_1 = L$ (loans): $x_2 = G$ (goodwill): $x_3 = DA$ (derivative assets): $x_4 = DL$ (derivative liabilities): $x_5 =$ equity / (deposits and short-term funding) (capital-to-deposits ratio): $x_6 = RL$ (loan volatility): $x_7 = RG$ (goodwill asset volatility): $x_8 = RDA$ (derivative asset volatility): and $x_9 = RDL$ (derivative liability volatility). The four volatility variables above capture $N(\cdot)$ and M as a whole. We take the corresponding coefficients of their variations to measure historical loan volatilities, net goodwill assets, derivative assets, and derivative liabilities. Table 1 presents the basic summary statistics.

TABLE 1 Sample descriptive statistics: all countries over 2005~2020

Variable	Mean	Median	Minimum	Maximum	St. dev.
Interest income / loans	8.4427	7.6209	2.5355	26.2370	3.3518
Loans	207.4840	29.0508	0.7243	2337.0000	434.7283
Goodwill	0.3131	0.1175	0	1.8985	0.4348
Derivative assets	1.1757	0.1276	0.0000	18.7846	2.6040
Derivative liabilities	1.1115	0.1229	0.0000	17.0611	2.4442
Capital-to-deposits ratio	12.6454	11.3685	3.6877	35.3991	5.4800
Loan volatility	0.3676	0.3593	0.0893	0.6195	0.1268
Goodwill asset volatility	0.3881	0.2802	0.0052	2.3860	0.4691
Derivative asset volatility	0.7451	0.6508	0.2212	2.1862	0.3462
Derivative liability volatility	0.8092	0.8006	0.2190	1.8927	0.3287

Notes: R_L and x_5 are in %, and $x_1 \sim x_4$ are in billion USD. St. dev. = Standard deviation. 39 commercial banks are in China, Indonesia, the Philippines, Malaysia, and Thailand.

4.2 Estimation and robustness tests

Based on information about the dependent and explanatory variables presented in the pre-subsection, the loan rate regression equation is:

$$R_{Lit} = \alpha + \mathbf{x}'_{it}\boldsymbol{\beta} + \mathbf{w}'_i\boldsymbol{\gamma} + \alpha_i + \varepsilon_{it} \quad (8)$$

Here, the vector $\mathbf{x}_{it}$ is observable time-variant variables, while the vector $\mathbf{w}_i$ is visible time-invariant variables. Both the vectors $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are corresponding coefficients. The two error terms (i.e., α_i and ε_{it}) are any other unobservable time-invariant and time-varying variables, respectively. In subsequent estimates, we assume the existent individual effects (i.e., $\alpha_i \neq 0$) as a starting point. We also take the error term (α_i) correlated with $\mathbf{x}_{it}$ or $\mathbf{w}_i$ in the fixed-effects (FE) model. In contrast, we take the error term (α_i)uncorrelated with the observable variables in the random-effects (RE) model. Table 2 reports the results of FE and RE models' estimates.

TABLE 2 FE and RE Regressions: all countries over 2005~2020

Variables	FE	RE
	-0.0004 (-0.99)	-0.0005 (-1.33)
	-0.7515 (-0.79)	-1.2469* (-1.79)
	0.1959** (2.23)	0.2049** (2.25)
	-0.2972** (-2.64)	-0.3066** (-2.64)
	-0.1920** (-2.62)	-0.1481** (-2.41)
	-	-5.1311 (-1.25)
	-	0.7629 (0.85)

	-	-1.8173 (-0.72)
	-	6.6491** (1.91)
Constant	11.2885*** (12.70)	8.4877*** (6.29)
	3.2075	2.2510
	1.6381	1.6381
	0.7931	0.6538
Numbers of groups	39	39
Observations per group	6 to 15	6 to 15
Numbers of observations	448	448
(within)	0.1294	0.1249
(between)	0.1145	0.2690
(overall)	0.0327	0.2135

Notes: t-statistics are reported in parentheses for the FE model, and Z-statistics are reported for the RE model. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. A Hausman-test for the FE and RE models reports that Prob> χ^2 =0.0917.

As shown in Table 2, the variables $x_3 \sim x_5$ and x_9 are beyond the statistical significance at the 5% level. Referring to the RE model results, we can argue that the derivative liability volatility significantly affects the loan-rate setting, as predicted by the theoretical model. The time-invariant empirical volatilities for each individual in panel data show that a RE model is a more appropriate apparatus than an FE model.7 The estimated coefficient x_2 is significant at the 10% level. The findings also incentivize conducting a reduced-form regression using the RE approach. Although Hausman-Taylor-test ascertains that the random-effects modeling can be accepted, RE modeling needs more unrealistic assumptions. Besides, banks optimally adapt their derivative assets to their risk perception and regulation intensity changes. At least such an endogeneity problem exists about the explanatory variable x_3 and thus needs to be addressed further.

TABLE 3 Reduced-form regressions: RE model, instrumental-variables (IV) regression model, and Hausman-Taylor estimator over 2005~2020

Variables	RE model	IV regression	Hausman-Taylor estimator
	-1.4209** (-2.27)	-1.4389*** (-2.87)	-1.1766** (-2.04)
	-0.1523*** (-3.89)	-0.1421*** (-2.79)	-0.1534*** (-3.07)
	-0.1323** (-2.40)	-0.1337*** (-4.59)	-0.1557*** (-5.23)
	4.7365*** (3.32)	4.7422*** (4.45)	4.6838*** (3.18)
Constant	6.9502*** (8.88)	6.9579*** (6.88)	7.2291*** (5.32)
	2.0915	2.1106	2.8750

	1.6366	1.6387	1.6306
	0.6202	0.6239	0.7566
Instrumented variable	-		,
Instrumental variables	-	,,	-
(within)	0.1180	0.1187	-
(between)	0.2448	0.2426	-
(overall)	0.1969	0.1950	-

Notes: Z-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

The reduced-form regressions in Table 3 present the main factors affecting the bank's loan rate-setting. The significance of the regressors' coefficients is significantly enhanced, while the signs consistently remain unchanged. Here, we need to confirm that our findings remain unchanged among a host of robustness tests. We present the instrumental-variables (IV) regression results and the Hausman-Taylor estimator for the following reasons. The former intends to partly solve the model's endogeneity problem, while the latter relaxes the RE model's assumptions.

First, we experiment with the endogeneity existence and thus regress the IV work. The endogeneity of the derivative assets rises because it is also an explanatory variable influenced by the factors that affect banks' loan-rate setting. We suggest that the banks adapt their derivative assets to hedge and diversify. In the IV regression, we take the three variables (x_4, x_7, and x_8) as the instrumental variables for the endogenous variable x_3. Our theoretical model does not give derivative liabilities the possibility of affecting the loan-rate setting. Moreover, the volatilities of assets other than loans do not statistically affect interest rates.

Second, we perform the Hausman-Taylor estimator due to some solid random-effect model assumptions, as mentioned previously. The endogenous variables x_2 and x_3 that we discussed earlier potentially correlate with the individual-specific-level effect α_i. Under the circumstances, we are likely to use the Hausman-Taylor estimator to handle time-invariant regressors x_9. As shown in Table 3, the coefficients for all interesting variables are in the exact directions and of similar magnitude and statistical significance. We can intuitively discuss the findings based on the Hausman-Taylor estimator's results without loss of generality.

4.3 Comparative static results

The Hausman-Taylor estimation in 5 countries presents four main results as follows. First, a finding shows that an increase in the bank's goodwill assets increases loans at a reduced loan rate (and thus a reduced bank interest margin). Intuitively, as the bank increases goodwill investment (e.g., customer relations, employee relations, and brand recognition): it must provide a return to a more extensive asset portfolio base. The bank may attempt to augment its total returns by shifting its asset portfolio to its loans and away from its liquid assets. The bank takes its goodwill to pursue more risky loans by reducing its loan rate since its goodwill assets imply good quality metaphors. However, the reduced loan rate-setting behavior deteriorates bank interest margin and profitability. Therefore, bank goodwill enhances its loan market share at the cost of profit deterioration. The results suggest that the strategic goodwill investment limits banks operating in the 5-country marketwide. As mentioned previously, Li and Sloan (2017) find that higher goodwill and lower profitability yield low future returns.

Although Li and Sloan (2017) investigate the non-banking industries, our result is consistent with their findings.

Second, the bank's optimal interest margin is negatively related to its derivative financial liabilities. The bank gets involved in more derivative-liability transactions, implying that it absorbs more risk as a risk buyer in the swap transaction markets. Now, the bank provides returns at a higher risk base. Under the circumstances, the bank may increase risky loan investment by reducing its loan rate-setting (and thus a reduced interest margin). If loan demand is relatively rate-elastic, more significant loan amounts are possible at a reduced loan rate-setting. Financial derivative liabilities, as such, deteriorate bank interest margin and thus bank profitability. As a result, financial derivative liabilities adversely enhance banking stabilities. Again, the strategic liability hedging limits banks operating in the 5-country markets. Our work in large is consistent with Maudos and de Guevara (2004): stronger risk aversion (less significant holding derivative liabilities in our discussion) enhances bank interest margin, although they remain silent on the loan rate-setting behavior.

Third, increasing the capital-to-deposits ratio increases the bank's loans at a reduced loan rate (and thus bank interest margin). The result can be interpreted as follows. As the financial regulatory authorities regulate the bank to increase its capital relative to its deposits, the bank must now provide a return to a more extensive capital base. The bank may attempt to augment its total returns by shifting to loans from liquid assets at a reduced loan rate-setting. Therefore, stringent capital regulation harms bank interest margins. Capital regulation makes the bank more prone to risk-taking, adversely affecting the banking stability.

Finally, evidence indicates that derivative liability volatility enhances bank interest margin. If the bank is a risk buyer in swap transaction markets, it returns at a higher risk base. The bank is to augment its total returns to reduce its loan businesses at an increased loan rate-setting (and thus increased bank interest margin). Therefore, we argue derivative liabilities and loans as substitutes for efficient asset-liability management. Derivative liability volatility makes the bank more prudent to loan risk-taking, thereby contributing to the banking system's stability.

One application allows investigating the effect of capital regulation on bank goodwill when considering the optimal loan rate determination.[8] Our empirical study in Table 3 demonstrates that stringent capital regulation increases bank goodwill. The intuition is very straightforward. Strict capital regulation makes the bank more prudent operations, perhaps by improving good customer relations, employee relations, and brand recognition, leading to increased bank goodwill. Therefore, we suggest that stringent capital regulation should adapt to prevent future distresses for banks, which supports Berger and Bouwman (2013).

TABLE 4 Reduced-form regressions: all countries, all countries except China, China, Indonesia, the Philippines, Malaysia, and Thailand over 2005~2020

Countries					Constant	Observations
All countries	-1.1766** (-2.04)	-0.1534*** (-3.07)	-0.1557*** (-5.23)	4.6838*** (3.18)	7.2291*** (5.32)	448
Countries except China	-2.1614*** (-2.94)	-0.6527* (-1.71)	-0.1675*** (-4.99)	5.2240*** (3.14)	7.6382*** (5.06)	332
Indonesia	16.1754 (0.87)	-8.2150 (-0.77)	-0.2930*** (-4.11)	4.1483 (0.88)	13.7237** (2.28)	66
Malaysia	-1.7626*** (-4.57)	-0.6401*** (-2.86)	-0.1596*** (-3.41)	-1.6919 (-1.06)	9.7920*** (7.63)	93

Philippines	-0.6254 (-0.08)	-7.0684 (-0.81)	-0.1326 (-1.20)	0.8250 (0.42)	10.6327*** (4.87)	93
Thailand	-3.6739*** (-4.14)	-0.9137*** (-3.13)	0.0141 (0.50)	1.8171 (1.25)	7.0254*** (7.64)	70
China	2.031838** (2.31)	-0.2287*** (-4.81)	0.0002 (0.00)	-1.6104 (-0.46)	9.7497*** (2.94)	126

Notes: Hausman-Taylor estimator with the endogenous variables x_2 and x_4 -statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Table 4 shows that the optimal bank interest margin is negatively related to goodwill, derivative liabilities, and capital regulation but negatively related to derivative liability volatility in five selected countries' banking firms in Asia. It is interesting to narrow down our focus on the goodwill issue. There are two categories: the Southeast-Asia group includes Indonesia, Malaysia, the Philippines, and Thailand, and each country comprises Indonesia, Malaysia, the Philippines, and Thailand in our study. We present the Hausman-Taylor estimators of the two categories in Table 4.

First, goodwill, derivative liabilities, or stringent capital regulation on the bank's interest margin is negative. The impact of derivative liability volatility on the margin is positive in the Southeast-Asia group. The same pattern as previously applies. We might suggest that an international bank operating businesses in the four countries of Southeastern Asia could consistently increase its market share in the loan market when goodwill investment, derivative-liability transactions, or capital regulation increases. Thus, the four countries are from the international bank perspective. Besides, we argue that the five-country group's four effects are consistently less significant than those in the Southeast-Asia group. The argument may imply that the factors of goodwill, derivative liabilities/volatility, and stringent capital regulation explaining the loan rate-setting behavior in China are an offset force. The reason may be the sample Chinese banks in our study are state-own ones. State-owned commercial banks dominate China's banking sector and usually provide funds to state-owned firms (Chong et al. (2013). Since the 1980s, the state-owned banks' branches are spread almost uniformly throughout China to follow one county-one-branch rule's regulatory requirement (Zhang et al. (2020). Overall, the state-owned banks anticipatedly carry much more government-oriented than market-oriented mechanisms.

Second, we are interested in investigating loan rate-setting behavior in an individual country in the five-country group's spirit. In Indonesia, capital regulation is only one significant factor to explain the bank's loan-rate setting behavior. There are goodwill, derivative liabilities, and capital regulation significantly interpreting the bank's loan rate-setting behavior in Malaysia. The four factors cannot account for the loan rate-setting behavior in the Philippines. Both the goodwill and the derivative liabilities explain the bank's loan rate-setting behavior in Thailand and China. Overall, the results yield the following patterns.

The four determinants (goodwill, derivative liabilities, capital regulation, and derivative-liability volatility) are statistically significant to explain bank interest margins in the four-country market as a whole (Indonesia, Malaysia, Philippines, and Thailand) than in the five-country market (the four countries plus China). However, the results do not have a consistent interpretation of bank spread behavior in each of the five countries. Therefore, we suggest that bank managers realize different determinants of interest margin in individual countries and regions, yielding other strategic determinations.

Table 4 documents one immediate application of bank lending diversification versus focus. Financial internationalization in developing countries is significantly emerging, particularly in China and South-west Asian countries. If a bank's international lending activities diversify among the five countries, its loan rate-setting behavior statistically depends on goodwill, derivative liabilities, capital-to-deposits ratio, and derivative liability volatility. The result also applies to the case of the four countries in Southeast Asia. However, a bank focuses its lending activities on a single country; the loan rate-setting behavior relies on various determinants, as mentioned previously. Our finding contributes to the literature that our study's international evidence indicates cross-countries determinant variations in bank lending activities. Our result should interest bank managers, regulators, and investors.

5. CONCLUSION

The paper provides a Hausman-Taylor regression for bank loan rate-setting behavior based on the down-and-out call option framework of Episcopos (2008). Our empirical study aims at 39 banks in China, Indonesia, Malaysia, the Philippines, and Thailand over 2005~2020. An empirical finding shows that goodwill, derivative liabilities/risk, and capital regulation are vital determinants for the five-country group's bank loan rate-setting behavior (and thus bank interest margin). The finding is also applicable to the four Southeast Asian countries (i.e., Indonesia, Malaysia, the Philippines, and Thailand). More importantly, stringent capital regulation enhances banking lending at a reduced bank loan rate. Capital regulation makes the banks more prone to loan risk-taking, adversely affecting bank profitability and banking stability.

We should stress that the current study focuses on the balance-sheet determinants and does not deal with the many other crucial international lending areas. For example, we remain silent on exchange-rate risk or an individual country's macroeconomic features. While there are significant issues, the bank loan rate-setting behavior may make more sound, particularly from the bank regulation perspective. In addition, we validate our contingent claim model using empirical analysis and explain coefficients in light of our modeling assumptions. However, we can formally reject one of our assumptions, reconsidering the results presented in our research.

APPENDIX

The 39 banks include: Agricultural Bank of China Limited, Bank of China, Bank of Communications, China Citic Bank Corporation, China Construction Bank, China Everbright Bank, China Merchants Bank, Chongqing Rural Commercial Bank, Industrial & Commercial Bank of China, Industrial Bank, Ping An Bank, in China; Bank Commonwealth, Bank Danamon Indonesia Tbk, Bank Mandiri (Persero) Tbk, Bank Permata Tbk, Pt Bank Maybank Indonesia Tbk, Pt. Bank Panin Tbk, in Indonesia; Affin Bank Berhad, Alliance Bank Malaysia Berhad, Cimb Bank Berhad, Hong Leong Bank Berhad, Malayan Banking Berhad - Maybank, Public Bank Berhad, Rhb Bank Berhad, In Malasia; Asia United Bank Corporation, Bdo Unibank, China Banking Corporation - Chinabank, East West Banking Corporation, Metropolitan Bank & Trust Company, Philippine National Bank, Rizal Commercial Banking, Security Bank Corporation, Union Bank of The Philippines, In Phillipines; Bank of Ayudhya Public, Kasikornbank Public, Kiatnakin Bank Public, Thanachart Bank Public, The Siam Commercial Bank Public, Tmb Bank Public, in Thailand.

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1 Bank interest margin is usually defined as the difference between interest revenue and interest expense as percentage of average earning asset. Bank interest margin in our research is defined as the different interest margin between the loan rate-setting and the deposit rate-taking because of focusing imperfectly competitive loan markets faced by banks.

2 Shi et al. (2021) confirm that all types of China's commercial banks need to focus on the efficiency of non-performing loans and return on capital.

3 See Hargrave (2021).

4 The information of BankFocus is sourced by Bureau van Dijk from a combination of annual reports,

information providers and regulatory sources. See https://bankfocus.bvdinfo.com/.

5 Results to be derived from our dataset do not extend to the alternative datasets.

6 The dataset consists of 39 commercial banks, including 11 Chinese banks, 6 Indonesian banks, 7 Malaysian banks, 9 Philippine banks, and 6 Thai banks. See Appendix.

7 We use instrumental regression to solve the endogeneity problem below instead of using three-stage least squares estimator because of the same reason.

8 The mathmatical expression in our model is $dx_2 / dx_5 = -(\partial R_L / \partial x_5) / (\partial R_L / \partial x_2) > 0$.