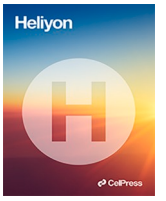
Heliyon 10 (2024) e38225

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

The development of the life insurance market and bank stability in developing countries

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ARTICLE INFO

JEL classification:
JEL Code: G10
G22
G52

Keywords:
Life insurance market
Bank stability
Inverted U-Shaped relationship
Developing country

ABSTRACT

This study investigates the relationship between the development of the life insurance market and bank stability within the context of developing countries. We used data from 2012 to 2020 across 108 developing countries and applied econometric techniques, including fixed-effect and system generalized method of moments (GMM) methods, to test the relationship between the life insurance market size, life insurance market growth, and bank stability at the country level. Our results indicate a positive relationship between life insurance market size and bank stability, i.e., a large life insurance market can help increase bank stability in developing countries. However, these countries should refrain from developing their life insurance markets too quickly; according to our empirical results, there is an inverted U-shaped relationship between life insurance market growth and bank stability. In the context of the growing life insurance market in developing countries as well as the increasing cooperation between banks and insurance companies towards expanding the life insurance market in these countries, our research provides important policy implications for ensuring the stability for financial markets in general.

Funding

This research is funded by Ho Chi Minh City Open University.

Data availability statement

Data will be made available on request.

1. Introduction

The intersection between the insurance sector and bank stability has become a focal point of academic research and policy discussions, particularly in the context of developing countries. Outreville [1] indicated that there exists a positive relationship between financial development and the development of the life insurance sector in developing countries, where financial markets develop rapidly. Similarly, Cheng and Hou [2] found the positive influence of live insurance on financial development and economic growth in 17 European countries. Meanwhile, bancassurance activities (mainly life insurance) in developing countries are becoming increasingly stronger, leading to the strengthening connection between the banking system and the life insurance market [3]. Therefore, the issue of

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https://doi.org/10.1016/j.heliyon.2024.e38225
Received 12 March 2024; Received in revised form 14 September 2024; Accepted 20 September 2024
Available online 20 September 2024

the impacts of the insurance-market development on the banking system in developing countries becomes more concerning. This paper delves into the relationship between life insurance development and bank stability with the aim of understanding the connections between these two vital components of the financial landscape.

The life insurance market in developing countries is much smaller than in developed countries. Fig. 1 shows that life insurance premium volume less than 2 % of the percentage of GDP in developing countries compared to more than 5 % in developed countries. This can be attributed to cultural characteristics, state management models, and the later development of the insurance market in developing countries compared to developed countries [1]. Fig. 1 also shows that the insurance market in these countries is undergoing rapid development. The demand for life insurance increased in developing countries after the COVID-19 pandemic, leading to the rapid development of the market [4]. Furthermore, bancassurance activities in developed countries are being increasingly promoted in recent years [5], making life insurance products more popular in these countries. This development potential could have significant impacts on the financial system, which will need to be controlled by banks, insurance companies, and policymakers.

Developing countries, characterized by evolving financial markets, demographic shifts, and increasing interconnectedness, present a unique backdrop for exploring the interplay between life insurance and banking stability. As these nations strive for economic growth and financial inclusion, life insurance plays a crucial role in mitigating risks and enhancing financial resilience. Simultaneously, the stability of the banking sector, as a linchpin of financial systems, plays a pivotal role in fostering economic development. However, few studies have evaluated the impact of the life insurance market development on the macroeconomy as well as the financial market.

Some studies have shown that the development of the life insurance market promotes economic growth. For example, Arena [6] found that insurance market activity is positively related to economic growth. Chen et al. [7] found that insurance market development increases economic growth; however, this effect is reduced in the middle-income countries and amplified in the low-income countries. While it is challenging to determine the precise impact of life insurance within the banking system, there are indications suggesting that fostering the life insurance market could boost personal savings levels, which could facilitate banks to mobilize capital more effectively, especially in developing nations [8].

Bancassurance activities are growing in developing countries, strengthening the connection between the insurance market and the banking market. Fiordelisi and Ricci [9] found that bancassurance increases the performance of both the banking and the insurance institutions. Chen and Tan [10] provided evidence that bancassurance activities increase bank value; however, there is no evidence that it increases systematic risk. Previous studies have found that the association between banks and insurance companies can bring profits to both banks and insurance companies. However, these studies have not mentioned the risks that banks may consequently face; for example, as the life insurance market develops, idle money can be transferred from banks to life insurance companies which, in the long term, can increase the bank's risk. Furthermore. rising profits do not have positive implications for banks because banking needs to maintain a controllable level of risk [11,12].

In the context that there seems to be no research evaluating the role of the life insurance market in the stability of the banking system in developing countries, where the life insurance market is strongly developed, our research provides some contributions to the literature as follows:

To the best of our knowledge, this is the first study to investigate the relationship between life insurance market size and bank stability in developing countries. Our results show that life insurance market size is positively correlated with banking stability at the country level. Further, this paper extends the literature about the impact of life insurance market growth on economic growth by investigating the impact of life insurance market growth on bank stability at the country level. We found an inverted U-shaped relationship between life insurance market development and bank stability. Although life insurance market development brings benefits to both banks and insurance companies, a rapidly developing insurance market will destabilize banks.

Through our analysis, we aim to contribute to the ongoing discourse on financial sector dynamics in developing countries, offering evidence-based insights that can inform policy decisions and strategic initiatives. By illuminating the influences of life insurance development and bank stability at the country level, this paper provides some important implications for regulators to enhance the resilience and sustainability of financial systems in developing countries in the pursuit of inclusive economic growth.

This paper is structured as follows: In section 2, we examine existing scholarly works to establish a theoretical framework and formulate our hypotheses, thus laying the groundwork for our research. In section 3, we outline the research design, data collection

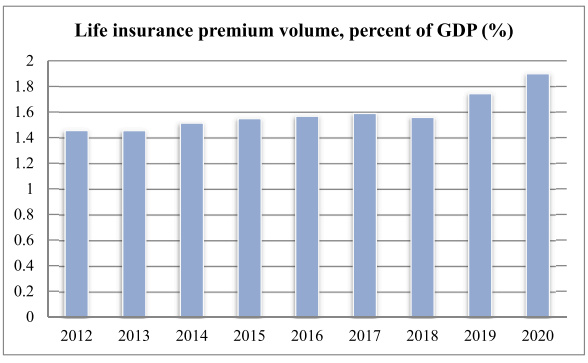

Fig. 1. Life insurance market growth in developing countries (2012–2020).
Source: Authors' calculations

methods, and analytical techniques employed to address our hypotheses. Section 4 presents our findings, followed by an in-depth interpretation and analysis of the results within the context of existing literature. We summarize our key findings, discuss their implications, and suggest avenues for future research in section 5.

2. Literature review and hypothesis development

The relationship between the life insurance market size and bank stability can be rationalized through several interconnected mechanisms. First, based on portfolio theory, a robust life insurance market indicates a thriving financial ecosystem with diverse investment opportunities [13]. When individuals and institutions purchase life insurance policies, they channel funds into long-term investment vehicles managed by insurance companies. Insurance companies often use these funds for safe investments [14,15]. These investments provide a stable financial source for the market and indirectly help the banking system operate with greater stability. In other words, based on portfolio theory, the development of the life insurance market will help diversify the financial market, thereby reducing unsystematic risk for the financial system and making financial institutions operate more stably. Second, life insurance policies provide financial security for borrowers. Banks will be safer than the borrowers who are participating in insurance contracts. In times of financial stress, policyholders may resort to borrowing against the cash value of their life insurance policies instead of defaulting on loans or withdrawing deposits from banks [16]. This behavior reduces the strain on banks' liquidity positions and helps maintain overall financial stability.

In addition, in developing countries, banks and insurance companies are closely linked, and strongly developed bancassurance activities can help banks increase their revenue and diversify their activities [17,18]. Income diversification also helps increase banks' stability [19,20] by helping banks better withstand fluctuations in interest rates or economic conditions that may affect core banking operations. Moreover, through intermediary activities for insurance companies, banks can strengthen their ties with customers, increasing customer retention and reducing the likelihood of deposit flight during economic uncertainty [21]. Stronger customer relationships also enable banks to cross-sell other financial products and services, further bolstering their revenue streams and stability. Based on the discussions above, we propose the following hypothesis.

H1. The life insurance market size is positively associated with bank stability.

Besides, growth in the life insurance market can help increase bank stability. The life insurance market in developing countries is usually not as large as in developed countries [22]. Promoting the development of the life insurance market in developing countries can have several benefits to banks and the financial system, such as income diversification, sustained customer loyalty, and minimized liquidity risks [7,13]. Therefore, developing the insurance market will increase life insurance market size and then help banks in developing countries operate more stably. With the hypothesis of insurance market growth, Chan [23] argues that the life insurance market in developing countries can experience rapid growth despite unfavorable cultural values and a population resistant to the concept of life insurance as a form of risk management. This helps the life insurance market in developing countries grow rapidly.

However, developing the life insurance market too quickly can have some negative impacts on bank operations and reduce bank stability. First, rapid growth in the life insurance market may result in increased competition for funds between insurance companies and banks [24]. Long-term bank deposits could decline significantly if idle money in the economy shifts to insurance companies. In the short term, this may reduce banks' long-term deposits. Banks may use short-term mobilized capital to finance long-term loans, which increases bank risk and reduces bank stability. Second, rapid growth is often accompanied by instability [25,26]. A rapid expansion of the life insurance market may lead to increased interconnectedness and systemic risk within the financial system [27]. Insurance companies, like banks, are financial intermediaries that play a critical role in mobilizing and allocating capital in the economy. If a significant portion of the financial system's assets becomes concentrated in the life insurance sector, any disruptions or failures within the insurance industry could have far-reaching implications for the stability of the entire financial system [28,29]. Such interconnectedness can amplify the transmission of shocks and increase the likelihood of contagion, posing systemic risks to banks. The promotion of bancassurance activities through intermediaries, such as the introduction of life insurance products, can result in banks becoming involved in disputes between insurance buyers and insurance companies, which negatively affects bank operations and increases bank risk [30]. Based on the discussions above, we expect life insurance market growth to increase bank stability; however, the rapid growth of the life insurance market can reduce bank stability in developing countries. Therefore, we propose the following hypothesis.

H2. There is an inverted U-shaped relationship between life insurance growth and bank stability.

3. Methodology

3.1. Research data

Our dataset has been collected from the World Bank and TheGlobalEconomy.com. Data on bank stability has been collected from the World Bank, whereas the other variables have been collected from TheGlobalEconomy.com. The developing countries in our study were identified on the basis of World Bank classification. However, we excluded developing countries that did not have research data available. The variables needed for the model were calculated based on available data published by the World Bank and TheGlobalEconomy.com. After excluding missing data, the research data is an unbalanced panel data consisting of 571 observations from 108 developing countries spanning the years 2012–2020. Data before 2012 and after 2020 was excluded due to the inability to

fully collect or supplement it from sources other than the World Bank and TheGlobalEconomy.com.

3.2. Econometric model and estimation method

To investigate the relationship between life insurance market size and bank stability (i.e., hypothesis H1), we applied the following equation:

$$BS_{it} = \alpha_0 + \alpha_1 LIMS_{it} + \alpha_j \sum CONTROL_{it} + \varepsilon \quad (1)$$

To test hypothesis H2 as well as investigate the inverted U-shaped relationship between life insurance growth and bank stability, we applied the following equation:

$$BS_{it} = \beta_0 + \beta_1 LIMG_{it} + \beta_1 LIMG_{it}^2 + \beta_j \sum CONTROL_{it} + \varepsilon \quad (2)$$

Where *BS* represents bank stability variables at the country level. In this study, we used two proxies of bank stability: the inverse of the non-performance loan ratio (1/NPL) and the Z-score. The Z-score is obtained by adding the ROA ratio and the equity-to-asset ratio, then dividing the sum by the standard deviation of the ROA. These indicators are averaged by year for each country. *LIMS* indicates the life insurance market size, which is the life insurance premium volume as percentage of GDP of each country in a year. The higher value of *LIMS* indicates a larger life insurance market. *LIMG* is the life insurance market growth measured by value of life insurance premium volume in year *t*, followed by subtracting the life insurance premium volume in year **t-1** and then divided by life insurance premium volume in year *t-1*.

The control variables (*CONTROL*) in Equations (1) and (2) include variables that were found to have an impact on bank stability in previous studies. First, we controlled for bank competition by using two variables: the HHI index (*HHI*) and bank concentration index (*BCON*), as bank competition can reduce bank stability [31,32]. Second, we control economic growth (GDP) by using the natural logarithm of gross domestic product per capita value. Creel et al. [33] found that there is a negative relationship between economic growth and financial stability. Some other macroeconomic variables have a potential relation to financial stability, including population growth (PPG), credit information sharing degree (CISH), and legal right (LER), which were found to relate to bank stability in previous studies [34–36]. In addition, Nguyen and Dang [37] found that institutional quality plays an important role in maintaining bank stability; therefore, we controlled for institutional quality by using the World Governance Index (WGI). Finally, we controlled for the income diversification of banks, which may increase bank stability by using a proportion of non-interest income to total income (NII) [19,38]. All variables are defined and explained in Appendix A. Finally, α and β are coefficients that need to be estimated, whereas ε is the error term.

To estimate Equations (1) and (2), we applied the two-way fixed-effect method after performing the Hausman test. The fixed-effect method is particularly appropriate for panel data due to its ability to account for unobserved heterogeneity across individual units that were found in the literature [39–41]. In addition, the results of the Hausman test show that the fixed-effect method rather than the random-effect method is more suitable for our data. However, many previous studies have argued that a potential dynamic endogeneity problem exists when the model has bank stability as the dependent variable [42–45]. Therefore, we used system GMM as a robustness test, along with using the J test and the AR2 test to ensure the validity of instrument variables as well as the reliability of the models. System GMM is an effective method to treat the dynamic endogeneity problem for panel data [46,47]. Moreover, by utilizing instrument variables and incorporating both lagged dependent variables and other exogenous variables, the system GMM method can also mitigate the bias that could arise from simultaneity and omitted variable problems [42,47], thus ensuring more reliable and accurate estimation of the dynamic interactions between the life insurance market development and bank stability.

4. Empirical result and discussion

4.1. Descriptive statistic and correlation matrix

The descriptive statistic of the variables used in our models is presented in Table 1. This table shows that the mean Z-score of 16.104 is lower than for developed countries (such as 30.03 in the EU) as shown in previous studies [48]. However, the min and max value of the Z-score are 2.731 and 44.514, respectively, indicating that there is a significant difference in banking stability between developing countries. The values of other variables are also specific to developing countries; for example, the values of GDP, LER, and WGI are much lower than developed countries.

Table 2 presents the correlation matrix of the variables in Equations (1) and (2) and the VIF values. The correlation matrix shows that there is a significantly positive correlation between LIMS and Z-score as well as LMG and 1/NPL, while the correlations of LIMG are statistically insignificant. The correlation coefficient in Table 2 shows a possible relationship between pairs of variables. However, it is not conclusive because bank stability depends on multiple factors. We continued conducting a multivariate analysis, which is described in the following sections. In addition, the VIF values in Table 2 are quite low, with the highest value in the correlation matrix being 0.66 (the coefficient of PPG and GDP). This suggests that multicollinearity is not a problem in our models.

4.2. Main results

In Table 3, we present the estimation results for Equation (1) by using the fixed-effect method. The results in this table indicate that

Table 1
Descriptive statistic.

Variable	Observation	Mean	Std. Dev.	Min	Max
Z-Score	571	16.104	8.170	2.731	44.514
1/NPL	414	7.237	7.047	0.660	54.820
LIMS	571	0.349	0.571	0.030	3.020
LIMG	571	0.169	1.715	−0.860	27.200
HHI	571	0.136	0.109	0.030	0.636
BCON	571	65.360	18.015	28.710	100.000
GDP	571	8.061	1.096	5.379	9.895
PPG	571	1.512	1.222	−1.760	3.870
CISH	571	4.103	3.458	0.000	8.000
LER	571	4.368	3.310	0.000	12.000
WGI	571	−0.328	0.570	−1.898	1.160
NII	571	37.786	11.982	7.180	94.990

Note: This table presents the descriptive statistic of the variables. All variables are defined and explained in Appendix A.

Table 2
Pearson's Pairwise correlation matrix and VIF value.

	ZS	NPL	LID	LIF	HHI	BCT	GDP	PPG	CISI	LRI	WGI	NII
Z-Score	**1.00**											
1/NPL	**−0.25**	**1.00**										
LIMS	**0.37**	**0.31**	1.00									
LIMG	0.04	−0.02	**0.10**	1.00								
HHI	**0.15**	**−0.19**	**0.29**	0.06	1.00							
BCON	0.05	**−0.12**	**0.16**	**0.10**	**0.10**	1.00						
GDP	**0.12**	**−0.27**	**0.32**	0.07	**−0.11**	**−0.09**	1.00					
PPG	−0.03	−0.07	**−0.21**	−0.03	**0.11**	0.11	**−0.66**	1.00				
CISH	**0.17**	**−0.21**	**0.23**	**−0.10**	0.05	**−0.39**	**0.39**	**−0.33**	1.00			
LER	−0.07	**0.12**	0.05	**−0.09**	−0.01	**−0.23**	0.01	**−0.17**	**0.21**	1.00		
WGI	−0.03	**−0.31**	**0.18**	0.05	−0.07	−0.07	**0.62**	**−0.49**	**0.35**	**0.20**	1.00	
NII	**−0.12**	**0.13**	**−0.24**	**−0.09**	**−0.10**	0.05	**−0.15**	**0.15**	**−0.24**	**−0.09**	**−0.27**	1.00
VIF	–	–	1.41	1.05	1.18	1.31	2.60	1.88	1.56	1.20	1.85	1.18

Note: This table reports the VIF value and correlation matrix of variables. The numbers in bold indicate statistically significant at 5 % or better. See Appendix A for variable definitions.

the coefficients on LIMS are positive and significant, with both Z-score and 1/NPL at the 1 %, level indicating that life insurance market size positively relates to bank stability. This result is consistent with our expectations and supports hypothesis H1. This result also supports the findings of Gründl and Gal [14] and Diehl et al. [15] that life insurance funds provide a stable and safe source of capital for commercial banks. On the other hand, This result is also consistent with the research results of Frimet and Murphy [16] when it showed that policyholders may resort to borrowing against the cash value of their life insurance policies instead of defaulting on loans or withdrawing deposits from banks. This is one of the reasons that the life insurance market enhances banking stability. Moreover, developing the life insurance market can help mitigate risks associated with income volatility and provide a safety net against unforeseen events, thus indirectly bolstering bank stability by reducing the prevalence of bad debts and defaults. This finding also supports the idea that the life insurance market is expanded through bancassurance activities, i.e., that banking is the distribution channel for life insurance products, which will help diversify the bank's activities, thereby making the bank more stable [17,18]. This research result is also consistent with the characteristics of developing countries; when most of the idle money is concentrated in commercial banks, diversifying investment channels in the financial system (including life insurance funds) will help reduce the problem of bank runs and maintain bank stability [49,50].

The life insurance market in developing countries is still small and tends to expand at scale. This research result has very important implications for policymakers as well as commercial banks in developing countries. Developing the life insurance market in these countries will help the financial market, specifically commercial banks, operate more stably. Policymakers need to pay attention to the harmonious development of different types of financial institutions instead of focusing on expanding the banking market. Policymakers should focus on fostering the growth of the life insurance sector by implementing regulations that encourage market entry and competition, ensuring transparency, and protecting policyholders' interests. By doing so, the life insurance market can attract more long-term investments, which in turn can enhance the stability of the banking sector. Commercial banks also need to evaluate life insurance contracts in credit appraisal and promote bancassurance activities. Coordination between banks and insurance companies will aid the stability of both. Once these financial institutions begin to operate stably, the financial markets of developing countries will be the driving force for economic development [33,51].

Regarding control variables, we find that credit information sharing and institutional quality positively relate to bank stability because the coefficients on CISH and WGI are positive and statistically significant at 10 % or more with dependent variables in regressions 1 and 2. These results are consistent with previous studies that found credit information sharing and institutional quality to play an important role in maintaining bank stability (e.g., Kusi et al. [52]; Nguyen [43], Kusi et al. [52]). The coefficients on NII are

Table 3
Regression results for the relationship between life insurance market size and bank stability.

Dependent variable	Z-score		1/NPL	
	(1)		(2)	
	Co.eff	t.stat	Co.eff	t.stat
LIMS	0.048***	2.24	0.162***	2.57
HHI	2.117**	2.16	0.151	1.07
BCON	0.009	0.73	0.000	0.53
GDP	0.935	1.42	0.130***	3.30
PPG	0.686*	1.75	−0.009	−0.35
CISH	0.090***	2.32	−0.003	−1.22
LER	0.052	1.30	−0.001	−0.24
WGI	3.347***	3.00	0.174***	2.58
NII	−0.033***	−2.73	−0.004**	−4.11
Cons	8.629	1.56	−0.716**	−2.14
Year fixed-effect	Yes		Yes	
Obs	571		414	
F-test (p.value)	0.00		0.00	

Note: This table reports the fixed-effect estimation results for Equation (1) by using the Z-score and 1/NPL as dependent variables. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively. All variables are defined in Appendix A.

negative and statistically significant with dependent variables in all regressions, indicating that income diversification reduces bank stability, which contradicted the findings of Adem [19] and Tariq et al. [38]. The findings support Ben Lahouel et al. [53] that, in the context of developing countries, banks that do not focus on their main business areas will increase banking risks and reduce bank stability.

Table 4 reports the fixed-effect estimation results for Equation (2) to test hypothesis H2. This table presents the empirical results that the coefficients on LIMG are positive and significant with both Z-score and 1/NPL in regressions 1 and 2, while the coefficients of LIMG2 (LIMG squared) are negative and statistically significant with both Z-score and 1/NPL. These imply that there is an inverted U-shaped relationship between life insurance market growth and bank stability. Thus, life insurance market growth can increase bank stability; however, if the life insurance market grows too rapidly, it can result in banks becoming unstable. This finding supports the arguments of Ahmed et al. [13] and Chen et al. [7] that the life insurance market can increase banks' income diversification, maintain customer loyalty, and minimize liquidity risks. Therefore, developing the insurance market will help banks in developing countries operate more stably. The inverted U-shaped relationship between life insurance market growth and bank stability and also supports Hou and Cheng [24], who found that rapid growth in the life insurance market may result in increased competition for funds between insurance companies and banks. Long-term bank deposits could decline significantly if idle money in the economy shifts to insurance companies. In addition, our findings support Alavudeen and Rosa [30], who found that banks promoting bancassurance activities through intermediaries to introduce life insurance products can result in the banks becoming involved in disputes between insurance buyers and insurance companies, which negatively affects bank operations and increases bank risk. Overall, our results support hypothesis H2 and are consistent with previous studies.

In the context of life insurance companies promoting market expansion in developing countries, this finding provides important

Table 4
Regression results for the relationship between life insurance market growth and bank stability.

Dependent variable	Z-score		1/NPL	
	(1)		(2)	
	Co.eff	t.stat	Co.eff	t.stat
LIMG	**0.117*** **	−2.59	**0.026***	1.64
LIMG2	**−0.001****	−2.19	**−0.003*****	−3.02
HHI	2.237	1.23	0.139	1.00
BCON	0.009	0.71	0.001	0.93
GDP	0.914	1.39	0.127***	3.22
PPG	0.656*	1.66	−0.016	−0.64
CISH	0.076**	1.95	0.004*	1.75
LER	0.048	1.19	−0.001	−0.41
WGI	3.404***	3.07	0.159***	2.40
NII	−0.035***	−2.87	−0.004***	−4.24
Cons	9.003	1.62	−0.632*	−1.89
Year fixed-effect	Yes		Yes	
Observation	571		414	
F-test (p.value)	0.00		0.00	

Note: This table reports the fixed-effect estimation results for Equation (2) using the Z-score and 1/NPL as dependent variables. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively. All variables are defined in Appendix A.

policy implications for regulators and banks. Specifically, managers need to note that the development of the life insurance market brings stability to banks; therefore, the development of this market is necessary for the stability of the financial market in general and of banks in particular. However, developing countries should avoid accelerating and growing too quickly, which could cause shocks to the financial system and reduce bank stability. Policymakers should focus on fostering balanced and sustainable growth in the life insurance sector. This can be achieved by implementing prudent regulatory frameworks, robust risk management practices, and capital adequacy requirements to prevent market overheating. Banks also need to control bancassurance activities and avoid excessively promoting these activities because such activities can affect mobilized capital, thereby negatively affecting the traditional operations of the bank.

4.3. Additional robustness tests

We performed two additional tests as robustness tests to ensure that the results are consistent with our expectations.

First, in order to test the heterogeneous effect of life insurance market development on bank stability, we separated the data into two sub-data categories: countries with low bank stability and countries with high bank stability. In a year, if the Z-score or 1/NPL of a country is lower than the average value of all countries, this country is classified as a low bank-stability country, and vice-versa.

Second, to treat the potential dynamic endogeneity problem, we applied the system GMM method for Equations (1) and (2) by adding the one-year lag of dependent variables in both models. Previous studies have suggested that a dynamic correlation exists in models, with bank stability being the dependent variable [42,54].

Table 5 shows the estimation results for Equation (1) using fixed-effect method for the two groups of countries. In this table, the coefficients on LIMS are positive in all regressions and statistically significant in regressions 1, 2, and 4, indicating a positive relationship between life insurance market size and bank stability in developing countries. The sign of LIMS does not differ between low and high bank-stability countries. However, there is no clear evidence of differences in the degree of correlation between life insurance market size and bank stability between the two groups. In addition, the signs of the control variables in Table 5 are not significantly different between the two groups, nor are they significantly different from the values in Table 3. Overall, the results in Table 5 are consistent with the results in Table 3, thus indicating that hypothesis H1 is strongly supported.

The results of estimating Equation (2) using the fixed-effect method for the two groups of countries are reported in Table 6. The sign of the LIMG coefficients in this table is the same as in Table 4. These coefficients are positive in all regressions (statistically significant in regressions 1, 3, and 4), which means that there is no difference between the two groups regarding the relationship between life insurance market growth and bank stability. Similarly, the coefficients on LIMG2 are negative and statistically significant at the 10 % level or better in all regressions. There is strong evidence of an inverted U-shaped relationship between life insurance market growth and bank stability in developing countries, and this relationship is not different between the two groups of countries. The sign of other variables are largely similar to the results in Table 4 and do not differ between the two groups. Overall, the results for the two groups continue to support hypothesis H2 and are consistent with our initial expectations.

As the second robustness test, we applied the system GMM method for Equations (1) and (2), and the results are reported in Table 7. First, the coefficients on LIMS are positive in regressions 1 and 2. Although only the coefficient of LIMS in regression 1 is statistically significant, it is still support hypothesis H1. Second, the coefficients on LIMG are positive and the coefficients on LIMG2 are negative and statistically significant with both the Z-score and 1/NPL in regressions 3 and 4. These results provide strong evidence of an inverted U-shaped relationship between the life insurance market growth and bank stability in developing countries. Therefore,

Table 5
Regression results for the relationship between life insurance market size and bank stability in low and high bank-stability countries.

Sub-sample	Low bank stability countries				High bank stability countries			
Dependent variables	Z-score		1/NPL		Z-score		1/NPL	
	(1)		(2)		(3)		(4)	
	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat
LIMS	0.023**	2.02	0.112***	2.43	0.031	1.54	0.197***	2.96
HHI	1.413	1.11	0.099	1.07	1.812*	1.73	0.132	1.57
BCON	0.012	0.92	0.003	1.21	0.002	0.71	0.001	0.98
GDP	0.232*	1.71	0.132***	2.45	0.501	1.38	0.146**	2.15
PPG	0.281*	1.77	−0.005	−0.91	0.357**	1.94	−0.012	−1.32
CISH	0.091***	2.34	−0.003	−1.41	0.068*	1.82	−0.001	−1.29
LER	0.061	1.34	−0.001*	−1.71	0.051	1.26	−0.002	−1.48
WGI	1.335***	3.21	0.144***	2.41	2.329**	2.12	0.115**	2.18
NII	−0.033***	−2.44	−0.024***	−3.10	−0.026*	−1.78	−0.003***	−3.17
Cons	6.614	1.36	−0.619***	−2.55	7.656***	2.76	−0.215***	−2.57
Year fixed-effect	Yes		Yes		Yes		Yes	
Observation	257		265		314		149	
F-test (p.value)	0.00		0.00		0.00		0.00	

Note: This table reports the fixed-effect estimation results for Equation (1) using the Z-score and 1/NPL as dependent variables. Regressions 1–2 and 3–4 show low and high bank-stability countries, respectively. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively. All variables are defined in Appendix A.

Table 6
Inverted U-shaped relationship between life insurance market growth and bank stability in low and high bank-stability countries.

	Low bank stability countries				High bank stability countries			
Dependent variables	Z-score		1/NPL		Z-score		1/NPL	
	(1)		(2)		(3)		(4)	
	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat
LIMG	0.098*	1.82	0.022	1.34	0.075***	3.81	0.019***	2.68
LIMG2	−0.012**	−2.03	−0.005**	−1.92	−0.002*	−1.83	−0.001***	−3.25
HHI	1.431	1.31	0.207	1.25	1.922	1.43	0.099	1.42
BCON	0.011	0.19	0.002	1.23	0.007	0.37	0.002	0.07
GDP	0.217	1.45	0.107***	3.47	0.712	1.48	0.146***	2.45
PPG	0.751*	1.82	−0.021	−1.03	0.426**	1.95	−0.011	−1.24
CISH	0.006*	1.81	−0.002	−1.38	0.032	1.63	−0.003	−1.33
LER	0.024	1.36	−0.001	−0.92	0.027*	1.86	−0.002	−0.27
WGI	2.421***	2.91	0.135***	2.39	1.523**	2.14	0.174**	1.98
NII	−0.022***	−2.42	−0.002***	−3.54	−0.011**	−2.21	−0.003***	−2.96
Cons	5.033	1.48	−0.531**	−1.93	4.348	1.35	−0.338	−1.23
Year fixed-effect	Yes		Yes		Yes		Yes	
Observation	257		265		314		149	
F-test (p.value)	0.00		0.00		0.00		0.00	

Note: This table reports the fixed-effect estimation results for Equation (2) using the Z-score and 1/NPL as dependent variables. Regressions 1–2 and 3–4 show the low and high bank-stability countries, respectively. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively. All variables are defined in Appendix A.

Table 7
Robustness test results using the system GMM method.

Dependent variables	Z-score		1/NPL		Z-score		1/NPL	
	(1)		(2)		(3)		(4)	
	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat	Co.eff	t.stat
Lag(SB)	0.887***	13.35	0.909***	11.25	0.952***	20.52	0.899***	17.15
LIMS	0.398**	1.95	0.007	1.34				
LIMG					0.672*	1.86	0.028***	2.61
LIMG2					−2.329***	−2.43	−0.584**	−2.15
HHI	2.377*	1.70	0.033	0.54	3.010***	2.33	0.059	1.12
BCON	0.008	0.69	0.000	0.20	0.006	0.70	0.000	−0.11
GDP	−0.120	−0.71	0.002	0.23	−0.187	−1.21	0.002	0.21
PPG	−0.018	−0.14	−0.010*	−1.77	−0.072	−0.72	−0.007	−1.39
CISH	0.121***	3.31	0.001	1.52	0.115***	3.67	0.001**	1.90
LER	0.061	0.83	−0.004	−0.91	0.020	0.29	−0.006	−1.04
WGI	0.287**	1.91	0.008*	1.76	0.113***	2.48	0.010	1.60
NII	−0.009**	−1.90	−0.002***	−3.31	0.007	0.78	−0.002***	−3.37
Cons	0.545	0.31	0.107	1.07	0.613	0.33	0.135	1.21
Observation	473		343		473		343	
Instrument	30		30		30		30	
AR(2)-p.value	0.782		0.311		0.681		0.564	
Hansen J-p.value	0.436		0.236		0.408		0.450	

Note: This table reports the system GMM estimation results for Equations (1) and (2) using the Z-score and 1/NPL as dependent variables. Regressions 1–2 and 3–4 show the results for Equations (1) and (2), respectively. Lag (BS) is the one-year lag of dependent variables. *, **, and *** indicate statistical significance at the 10 %, 5 %, and 1 % levels, respectively. All variables are defined in Appendix A.

hypothesis H2 is strongly supported. The coefficients on Lag (SB) are positive and statistically significant at the 1 % level, implying that bank stability in developing countries can be affected by past bank stability. The sign of the other variables is not significantly different from the initial results. The p-value of the AR2 test and the J test are higher than 10 %, indicating that system GMM estimation results are reliable and the instruments in our model are valid.

Overall, by performing some further tests including testing hypotheses for two groups of countries and using system GMM method to treat potential endogeneity problem, the results continue to support hypotheses H1 and H2. The alignment between the initial results and the robustness tests verifies the stability of our findings under different conditions or with variations in analysis. Based on the stability of the research results, our recommendations can be useful for regulators as well as banks in developing countries.

5. Conclusion

This study investigates the relationship between life insurance market development and bank stability in developing countries. The results have yielded valuable insights that could contribute to both academic literature and practical policymaking. Our primary

finding of a positive correlation between the size of the life insurance market and bank stability underscores the importance of a robust insurance sector in supporting bank stability. This suggests that, as the life insurance market grows, it can provide additional buffers and diversification opportunities for banks. Moreover, we provide evidence of an inverted U-shaped relationship between life insurance market growth and bank stability. While initial growth in the life insurance sector can have beneficial effects on bank stability, our analysis highlights the importance of monitoring this growth trajectory. Beyond a certain point, unchecked expansion in the life insurance market may introduce complexities and risks that could potentially undermine bank stability, necessitating careful regulatory attention and risk management practices.

These findings have significant implications for policymakers, regulators, and financial institutions operating in developing countries. By recognizing the symbiotic relationship between the life insurance market and the banking sector, policymakers can devise strategies to foster a well-balanced and resilient financial ecosystem. Policymakers and regulators should aim to foster balanced and sustainable growth in the life insurance sector by implementing prudent regulatory frameworks and ensuring effective risk management practices. This includes setting appropriate capital adequacy requirements, enforcing strict underwriting standards, and promoting diversified investment strategies to prevent market overheating and financial imbalances. Additionally, fostering coordination between insurance and banking regulators is crucial to monitor systemic risks and maintain financial stability. Financial institutions should focus on long-term, stable growth rather than aggressive expansion, adopting robust risk management practices and transparent consumer protection measures. By carefully managing the growth trajectory of the life insurance market, developing countries can leverage its benefits for bank stability without incurring the associated risks of rapid market development.

This study has a limitation of focusing only on developing countries and does not analyze in depth the mechanism of the relationship between the development of the life insurance market and bank stability. Additional research could explore the mechanisms of these relationships as well as investigate how contextual factors such as regulatory frameworks and economic conditions influence these relationships.

CRediT authorship contribution statement

Quang Khai Nguyen: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Variable Measures and Definitions

Variable	Calculation and Definition	Source
Z-score	Z-score, which is the proxy of bank stability which is calculated as the sum of the ROA ratio and equity-to-asset ratio divided by the standard deviation of ROA. The Z-score in this study is derived from the country-level published by the World Bank.	World Bank
1/NPL	Inverse of non-performing loan ratio, calculated as the average of non-performing loan ratio of a country in a year.	World Bank
LIMS	Life insurance market size, measured by life insurance premium volume (percent of GDP) of each country in a year.	TheGlobalEconomy.com
LIMG	Life insurance market growth, measured by value of life insurance premium volume in year *t* minus life insurance premium volume in year *t-1*, then divided by life insurance premium volume in year *t-1*.	TheGlobalEconomy.com
HHI	Herfindahl-Hirschman Index, which indicates bank market concentration, as published by the World Bank.	World Bank
BCON	Bank concentration index, used to measure bank competition, as published by the World Bank.	World Bank
GDP	Natural logarithm of GDP per capita of each country as a proxy of economic growth.	World Bank
PPG	Population growth ratio, as published by the World Bank.	World Bank
CISH	Credit information sharing, with values from 0 to 8 used to indicate the level of information sharing in each country.	TheGlobalEconomy.com
LER	Legal Rights Index, which gauges how well collateral and bankruptcy laws safeguard the interests of both borrowers and lenders, thereby easing the process of lending. This index spans from 0 to 12, with higher values suggesting that these laws are more effectively structured to enhance credit accessibility.	World Bank
WGI	World Governance Index, calculated as the average of six indicators (regulatory quality; voice and accountability; political stability and absence of violence/terrorism; control of corruption; rule of law; government effectiveness).	World Bank
NII	Non-interest income ratio, which is the ratio of non-interest income to total income of banks in a country in a year.	TheGlobalEconomy.com

Appendix B. List of Countries in Sample

No	Name	No	Name	No	Name	No	Name	No	Name	No	Name	No	Name	No	Name	No	Name
1	Afghanistan	13	Albania	25	Algeria	37	Angola	49	Argentina	61	Armenia	73	Azerbaijan	85	Bahrain	97	Bangladesh
2	Barbados	14	Belarus	26	Belize	38	Benin	50	Bhutan	62	Bolivia	74	Bosnia and Herzegovina	86	Botswana	98	Brazil
3	Bulgaria	15	Burkina Faso	27	Burundi	39	Cambodia	51	Cameroon	63	Chad	75	Chile	87	China	99	Colombia
4	Costa Rica	16	Djibouti	28	Dominican Republic	40	Ecuador	52	El Salvador	64	Ethiopia	76	Fiji	88	Gabon	100	Georgia
5	Ghana	17	Guatemala	29	Guinea	41	Guyana	53	Haiti	65	Honduras	77	India	89	Indonesia	101	Iraq
6	Jamaica	18	Jordan	30	Kazakhstan	42	Kenya	54	Kuwait	66	Lebanon	78	Lesotho	90	Liberia	102	Libya
7	Madagascar	19	Malawi	31	Malaysia	43	Maldives	55	Mali	67	Mauritania	79	Mauritius	91	Mexico	103	Moldova
8	Mongolia	20	Montenegro	32	Morocco	44	Mozambique	56	Namibia	68	Nepal	80	Nicaragua	92	Niger	104	Nigeria
9	North Macedonia	21	Oman	33	Pakistan	45	Panama	57	Papua New Guinea	69	Paraguay	81	Peru	93	Philippines	105	Poland
10	Qatar	22	Romania	34	Rwanda	46	Saudi Arabia	58	Senegal	70	Serbia	82	Seychelles	94	Sierra Leone	106	South Africa
11	Sri Lanka	23	Sudan	35	Suriname	47	Tajikistan	59	Tanzania	71	Thailand	83	Togo	95	Trinidad and Tobago	107	Tunisia
12	Turkey	24	Turkmenistan	36	Uganda	48	Ukraine	60	Uruguay	72	Uzbekistan	84	Vietnam	96	Zambia	108	Zimbabwe

Note: The developing countries are as classified by the World Bank.

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