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## Article

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# Navigating bank risk-taking under excess liquidity: the moderating role of economic policy uncertainty and lessons from the Global Financial Crisis

Thanh Cong Nguyen<sup>a</sup> , Thai Vu Hong Nguyen<sup>b</sup> , Christophe Schinckus<sup>c</sup> and Thanh Tuan Chu<sup>b</sup>

<sup>a</sup>Van Lang University, Ho Chi Minh City, Vietnam; <sup>b</sup>The Business School, RMIT Vietnam, Ho Chi Minh City, Vietnam;

<sup>c</sup>Business School, University of the Fraser Valley, Abbotsford, Canada

## ABSTRACT

The study investigates the moderation effect of economic policy uncertainty (EPU) towards the relationship between excess liquidity and bank risk-taking as well as explores its stronger impact in countries severely affected by the 2008 Global Financial Crisis (GFC). Using System Generalized Methods of Moments (SGMM) on an unbalanced dataset for 33 countries from 2000 to 2019, the study finds that an increase in the EPU index attenuates the positive impact of excess liquidity on bank risk-taking. The study also finds that the attenuating effect of EPU on the relationship between excess liquidity and bank risk-taking is stronger in countries that were most severely affected by the GFC. It argues that the mechanisms by which excess liquidity induces risk-taking are disrupted under high EPU. Our study also extends behavioral theories to shed light on how the GFC altered bank risk-taking in the presence of excess liquidity and high EPU.

## IMPACT STATEMENT

This study examines the influence of economic policy uncertainty (EPU) on the relationship between excess liquidity and bank risk-taking, particularly in countries that were severely impacted by the 2008 Global Financial Crisis (GFC). Utilizing the System Generalized Method of Moments on data from 33 countries, the research indicates that elevated levels of EPU dampen the risk-taking incentives typically associated with excess liquidity. Remarkably, this moderating effect of EPU is more pronounced in nations significantly affected by the GFC, suggesting that historical crises shape current banking behaviour in the face of economic uncertainty. The study enhances the Excess Liquidity Theory by incorporating behavioural insights from Prospect Theory, illustrating that economic uncertainty can function as a stabilizing force against liquidity-driven risk. These findings highlight the urgent need for policymakers to customize financial stability measures, particularly in managing liquidity levels and timing policy actions during times of heightened uncertainty. Ultimately, this research offers valuable insights into how regulatory strategies can utilize economic policy uncertainty to promote prudent banking practices, fostering stability in an increasingly volatile global financial environment.

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## 1. Introduction

The aftermath of the 2008 GFC has been marked by significant changes in the global financial landscape, particularly within the banking sector. One of the most notable consequences has been the surge in excess liquidity, driven by expansive fiscal stimulus packages and aggressive monetary policies implemented by central banks worldwide (Cukierman, 2013; Whalley & Zhao, 2013). This unprecedented level of liquidity, sustained for several years following the crisis, has raised critical concerns regarding its

**CONTACT** Thanh Cong Nguyen  [thanh.nc@vlu.edu.vn](mailto:thanh.nc@vlu.edu.vn)  Faculty of Commerce, Van Lang University, 69/68 Dang Thuy Tram Street, Ward 13, Binh Thanh District, Ho Chi Minh City, Vietnam

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impact on bank risk-taking behaviors (Acharya & Richardson, 2009; Nguyen, Boateng, et al., 2018; Nguyen & Boateng, 2015a; Reinhart & Rogoff, 2008; Zhang, 2009). The recent COVID-19 pandemic further exacerbated this issue, as governments globally responded with additional liquidity injections and unconventional monetary policies, intensifying concerns over the potential risks associated with excess liquidity (Chen & Yeh, 2021; Makin & Layton, 2021; Narayan et al., 2021; Zhang et al., 2020).

While the existing literature has established a robust relationship between excess liquidity and increased risk-taking in the banking sector, it remains unclear how this relationship is affected when banks operate under conditions of heightened EPU. Notably, during periods of increasing EPU—such as those experienced after the GFC and during the COVID-19 pandemic—there is a growing concern about the potential for another financial crisis, similar to the one that occurred in 2008 (Altig et al., 2020; Chen & Yeh, 2021; Shehzad et al., 2020; Uddin et al., 2021). Despite the established link between excess liquidity and risk-taking, the moderating role of EPU in this relationship has not been sufficiently explored. Our study addresses this critical gap by examining how EPU influences the relationship between excess liquidity and bank risk-taking, particularly in countries severely affected by the GFC.

Acharya and Naqvi (2012) identified two key incentives that drive bank managers towards risk-taking under conditions of excess liquidity: the ability to conceal liquidity risks and the opportunity to significantly enhance remuneration through aggressive credit expansion. Our research hypothesizes that high EPU challenges these incentives, thereby attenuating the positive impact of excess liquidity on bank risk-taking. In environments characterized by high uncertainty, banks are likely to be more cautious regarding liquidity risks, making it difficult for managers to obscure the risks associated with excessive lending. Moreover, banks may be reluctant to commit to increasing managerial remuneration under uncertain economic conditions, further diminishing the drive towards risk-taking.

In addition to examining the direct impact of EPU, our study explores whether the moderating effect of EPU is more pronounced in countries that were significantly impacted by the GFC. Drawing from Prospect Theory, which suggests that past experiences of loss increase risk aversion (Ert & Erev, 2013; Polman, 2012; Tversky & Kahneman, 1992), we argue that banks in these countries are likely to be more prudent in managing liquidity risks under high uncertainty, even when excess liquidity is present. The GFC, a major shock to the global financial system, has led to lasting changes in risk management practices, particularly in the banking sectors of the most affected countries. Consequently, our study posits that EPU will have a stronger attenuating effect on the relationship between excess liquidity and risk-taking in these countries compared to those less affected by the crisis.

To empirically test these hypotheses, we employ the System Generalized Method of Moments (SGMM) (Arellano & Bover, 1995; Blundell & Bond, 1998) on a sample of 33 countries over the period 2000–2019. Unlike previous studies that focus primarily on bank-level data, our research takes a country-level approach to analyze the heterogeneity in responses to excess liquidity across different national contexts. This broader perspective is crucial, given that excess liquidity is not confined within national borders but often spills over into other countries through capital flows (Nguyen & Boateng, 2015a). Understanding how different countries manage excess liquidity in the face of EPU is essential for crafting effective financial stability policies.

Our study makes several key contributions to the literature. First, it extends the Excess Liquidity Theory of Acharya and Naqvi (2012) by incorporating EPU as a significant moderating factor in the relationship between excess liquidity and bank risk-taking. Second, our research provides empirical evidence on the differential effects of EPU across a diverse sample of 33 countries, offering new insights into how economic uncertainty interacts with liquidity conditions to influence banking behaviors. Third, we contribute to the behavioral finance literature by examining how past crisis experiences, particularly the GFC, continue to shape risk-taking behaviors in the presence of excess liquidity and high EPU. Our findings suggest that in countries severely affected by the GFC, the moderating effect of EPU is stronger, leading to a more cautious approach to risk-taking in the banking sector.

The remainder of the study is structured as follows. Section 2 reviews theoretical and empirical studies to develop two research hypotheses. Section 3 presents our data collection and econometric approach. Regression results are discussed in Section 4. Finally, concluding remarks with policy implications are provided in Section 5.

## 2. Literature review and hypothesis development

### 2.1. *The relationship between excess liquidity and bank risk-taking under higher EPU*

The presence of excess liquidity in the banking sector, particularly following major economic disruptions, such as the 2008 GFC and the COVID-19 pandemic, has become a focal point of concern due to its potential to drive risk-taking behaviors among banks. Additionally, the expansive monetary policies and fiscal stimulus packages implemented globally in response to these crises have led to an unprecedented accumulation of liquidity within the banking system (Cukierman, 2013; Whalley & Zhao, 2013). This surplus liquidity, while temporarily stabilizing the financial system, raises critical questions regarding its long-term impact on bank risk-taking behaviors (Acharya & Richardson, 2009; Nguyen, Boateng, et al., 2018; Nguyen & Boateng, 2015a; Reinhart & Rogoff, 2008).

Previous research has established a foundational understanding of the relationship between excess liquidity and risk-taking in banks. Acharya and Naqvi (2012), building on Agency Theory (Jensen & Meckling, 1976), proposed the Excess Liquidity Theory, which suggests that under conditions of excess liquidity, bank managers are incentivized to engage in riskier lending practices. This theory is supported by empirical findings, such as those by Khan et al. (2017), who found that low liquidity constraints encouraged banks to take on higher risks. Similarly, studies by Nguyen and Boateng (2015b) and Nguyen et al. (2019) confirmed the positive association between excess liquidity and risk-taking behaviors in commercial banks.

Nonetheless, while the link between excess liquidity and bank risk-taking is well-documented, there remains a significant gap in the literature regarding the role of EPU as a moderating factor in this relationship. The increasing prevalence of high EPU in the post-GFC and post-COVID-19 periods presents a unique challenge to the banking sector, as banks must navigate the dual pressures of excess liquidity and heightened uncertainty (Altig et al., 2020; Uddin et al., 2021). Previous studies have demonstrated that high uncertainty often leads to more conservative banking practices, as banks prioritize liquidity preservation and risk management over aggressive lending (Barraza & Civelli, 2020; Caballero & Krishnamurthy, 2008; Gozgor et al., 2019).

In light of these findings, this study seeks to address the gap in the literature by exploring how EPU moderates the relationship between excess liquidity and bank risk-taking. Specifically, we hypothesize that in an environment of high uncertainty, the positive impact of excess liquidity on bank risk-taking will be attenuated. This hypothesis is grounded in the understanding that heightened uncertainty compels banks to exercise greater caution in their lending practices, thereby reducing the ability of bank managers to engage in risk-taking behaviors, even in the presence of excess liquidity.

**Hypothesis 1:** Higher EPU attenuates the positive impact of excess liquidity on bank risk-taking behaviors.

### 2.2. *The moderating role of higher EPU under the GFC*

The 2008 GFC represented a seismic event that fundamentally altered the global banking landscape, with long-lasting repercussions on financial stability and regulatory frameworks. This crisis resulted in a heightened level of EPU that continues to influence the behavior of financial institutions. While the relationship between excess liquidity and bank risk-taking has been well-explored, the literature has not yet to adequately address how past experiences from the GFC may amplify the moderating effect of EPU on this relationship. This gap is particularly crucial given that the GFC not only impacted banks' immediate risk-taking behaviors but also left a lasting imprint on how these institutions respond to subsequent economic uncertainties.

Theories, such as Prospect Theory, Heuristics Theory, and Learning Effect Theory offer valuable insights into how past experiences shape risk attitudes and decision-making processes. Prospect Theory suggests that individuals who have experienced significant losses become more loss-averse, focusing on avoiding future losses rather than seeking potential gains (Ert & Erev, 2013; Polman, 2012; Tversky & Kahneman, 1992). Heuristics Theory indicates that individuals rely on past experiences to simplify decision-making under uncertainty (Katsikopoulos, 2011; Osman & Kelly, 1997). Learning Effect Theory posits that repeated exposure to similar tasks or environments enhances performance through familiarity and the development of efficient shortcuts. Empirical studies reinforce these theoretical perspectives,

demonstrating that past experiences, including natural disasters, health shocks, and economic crises, significantly influence risk attitudes. For instance, Cameron and Shah (2015) reveal that individuals who have endured natural disasters exhibit higher levels of risk aversion. Similarly, Guiso et al. (2013, 2018) documented a substantial increase in risk aversion following the GFC, underscoring the long-term impact of such macroeconomic shocks on risk-taking behaviors.

Despite the recognized influence of the GFC on the banking sector, previous studies have not sufficiently explored how past experiences from the GFC might moderate the effect of EPU on the relationship between excess liquidity and bank risk-taking. This oversight is particularly important given that banks in countries more severely affected by the GFC are likely to exhibit more cautious behavior in managing liquidity and risk under conditions of high uncertainty. Post-GFC regulatory reforms, such as stricter guidelines on remuneration and enhanced supervision, have made it increasingly difficult for bank managers in these countries to engage in risky lending practices, even in the presence of excess liquidity (Anginer et al., 2018; Mohsni & Otchere, 2018).

Given this background and the identified gap in the literature, this study aims to fill this void by investigating whether the moderating effect of EPU on the relationship between excess liquidity and bank risk-taking behaviors is more pronounced in countries severely affected by the GFC. Specifically, we hypothesize that the legacy of the GFC, through its impact on regulatory practices and risk management, amplifies the moderating effect of EPU, leading to a more significant attenuation of the positive impact of excess liquidity on risk-taking behaviors in these countries.

**Hypothesis 2:** In countries more severely affected by the GFC, EPU attenuates the positive impact of excess liquidity on bank risk-taking more rapidly than in those less affected by the GFC.

### 3. Data and methodology

#### 3.1. Data collection

This study initially compiles data from a broad sample of 197 countries spanning the period from 2000 to 2019. To identify countries experiencing excess liquidity, a sub-equation regression was performed using Taylor rule-based criteria, which resulted in a focused sample of 75 countries that encountered excess liquidity at some point during the study period. The data were meticulously gathered from several authoritative sources to ensure robustness and reliability. Bank risk-taking was sourced from Bankscope and the World Bank. The EPU index was obtained from the widely recognized database hosted at [www.policyuncertainty.com](http://www.policyuncertainty.com), which is a leading resource for policy uncertainty data. When all variables are combined in the econometric model, the issue of missing data reduces our final sample to an unbalanced table of 33 countries and territories with 445 country-level observations.<sup>1</sup>

Additionally, the list of the top 10 countries most severely impacted by the 2008 GFC was derived from the Carnegie Endowment for International Peace, accessible at [www.carnegieendowment.org](http://www.carnegieendowment.org). This selection provides critical context for assessing the moderating effects of the GFC on the relationship between excess liquidity and risk-taking behaviors. Lastly, the control variables incorporated into the analysis were sourced from multiple reputable databases, including the World Bank, Datastream, and Bloomberg. These variables include key macroeconomic indicators essential for ensuring the robustness of the regression models and the validity of the research's findings.

#### 3.2. Econometric model

Based on previous empirical studies of Boateng et al. (2022), Khan et al. (2017), and Nguyen and Boateng (2013), the study applies the following regression model using the dynamic approach to capture the influence of excess liquidity on risk-taking behaviors.

$$Risk_{it} = \alpha_0 + \alpha_1 Risk_{it-1} + \alpha_2 Excess_{it} + \alpha_3 Excess_{it} \times EPU_{it} + \alpha_4 Excess_{it} \times EPU_{it} \times Crisis_{it} + \alpha_5 IR_{it} + \alpha_6 GDP_{it} + \alpha_7 SMR_{it} + \alpha_8 RED_{it} + \varepsilon_{it} \quad (1)$$

where  $Risk_{it}$  and  $Risk_{it-1}$ , respectively represents risk-taking behaviors for country  $i$  at time  $t$  and  $t - 1$ . The presence of the one-period lagged dependent variable implies the application of the dynamic



approach;  $Excess_{it}$  refers to excess liquidity for country  $i$  at time  $t$ ;  $Excess_{it} \times EPU_{it}$  is the two-variable interaction between excess liquidity and EPU. The interaction implies the moderating role of EPU towards the impact of excess liquidity on risk-taking behaviors. EPU is defined as a dummy variable denoted 1 if the present value is higher than the previous and 0 otherwise;  $Excess_{it} \times EPU_{it} \times Crisis_{it}$  is the three-variable interaction among excess liquidity, EPU, and crisis, which indicates that the influence of the two-variable interaction will be adjusted in the presence of crisis. Crisis is a dummy variable denoted 1 for the countries that were most severely affected by the 2008 GFC based on the classification by Carnegie Endowment. Following Khan et al. (2017) and Nguyen and Boateng (2013), some macroeconomic factors including monetary policy rates ( $IR_{it}$ ), real GDP growth rate ( $GDP_{it}$ ), stock market returns growth ( $SMR_{it}$ ), and house price index growth rate ( $RED_{it}$ ) are included as control variables;  $\varepsilon_{it}$  is the error term of Equation (1).

Besides, the study derives the marginal effect of excess liquidity on risk-taking behaviors using the partial derivative of  $Excess$  as follows:

$$\frac{\partial Risk}{\partial Excess} = \alpha_2 + \alpha_3 EPU + \alpha_4 EPU \times Crisis \quad (2)$$

where  $\alpha_2$  represents the marginal effect of excess liquidity on risk-taking behaviors when the two dummies—EPU and Crisis—are concurrently equal to zero;  $\alpha_2 + \alpha_3$  is the marginal effect of excess liquidity on bank risk-taking behaviors only in the presence of EPU ( $EPU = 1$ ;  $Crisis = 0$ );  $\alpha_2 + \alpha_3 + \alpha_4$  is the total marginal effect of excess liquidity on risk-taking behaviors in the presence of EPU and GFC ( $EPU = 1$ ;  $Crisis = 1$ ). The research expects  $\alpha_2$  to be positive but  $\alpha_3$  and  $\alpha_4$  to be negative, indicating that the existence of EPU and Crisis tends to lessen the effectiveness of the impact of excess liquidity on risk-taking behaviors.

Moreover, the primary objective of this study is to examine how the impact of excess liquidity on risk-taking behaviors changes under conditions of higher EPU. By using a dummy variable for EPU ( $EPU = 1$  for higher EPU, 0 otherwise), the interaction term ( $Excess \times EPU$ ) effectively captures the differential impact of excess liquidity on risk-taking behaviors in periods of higher policy uncertainty. Including EPU as a standalone variable might not be necessary because the interaction term already encapsulates the moderating effect of policy uncertainty on the relationship between excess liquidity and risk-taking. The use of a dummy variable for EPU simplifies the interpretation of the interaction term. When EPU is a binary variable, the interaction directly represents the change in the effect of excess liquidity on risk-taking when EPU shifts from 0 to 1. Including EPU as a separate variable could potentially introduce multicollinearity, especially if the interaction term is already capturing the necessary variation.

Several studies have utilized similar methodologies, focusing on interaction terms without necessarily including the standalone dummy variable. Particularly, Aizenman and Noy (2013) examined the interaction between financial openness and economic policy uncertainty. They used interaction terms without including the standalone dummy variable for financial openness, directly capturing the moderating effect of policy uncertainty on the relationship between financial openness and macroeconomic stability. Brogaard and Detzel (2015) studied the impact of economic policy uncertainty on stock market returns using interaction terms to capture the differential impact, focusing on the moderating effects instead. Similarly, Gulen and Ion (2015) employed this methodology to examine the impact of policy uncertainty on corporate investment, including interaction terms with policy uncertainty dummies to understand the moderating effects without always including the standalone policy uncertainty variable.

### 3.3. Variable measurements

Our paper utilizes two proxies for bank risk-taking, inspired by Boateng et al. (2022) and Khan et al. (2017). The first proxy, denoted as RISK 1, is the negative value of the z-score. The z-score is widely regarded as a suitable measure for bank risk-taking because it captures the default probability of a country's banking system, comparing the buffer of the banking system (capitalization and returns) with the volatility of those returns. Essentially, the z-score measures a bank's distance from insolvency and is calculated as follows:

$$Risk\ 1 = -zscore = -\left(\frac{ROA + EA}{\sigma(ROA)}\right) \quad (3)$$

where ROA is the return on assets; EA represents the ratio of equity over total assets;  $\sigma(\text{ROA})$  is the standard deviation of return on assets calculated by a four-year rolling window. Since the z-score is an inverse proxy for the bank's total risk-taking (i.e. the smaller the z-score, the higher the insolvency risk), RISK 1 is defined as the negative value of the z-score. Therefore, a higher z-score corresponds to lower risk-taking, while a lower z-score indicates higher risk-taking.

The second proxy for bank risk-taking, RISK 2, is non-performing loans (NPLs). This measure is calculated as the ratio of NPLs to the total value of the loan portfolio, including NPLs before the deduction of specific loan-loss provisions. NPLs should be recorded at their gross value as listed on the balance sheet. A higher value of RISK 2 indicates greater risk-taking, as it reflects a larger proportion of non-performing loans within the bank's loan portfolio.

Excess liquidity is measured by the positive error terms obtained from the sub-equation of Taylor rules. Taylor rules are essentially mathematical formulas central banks use to determine appropriate interest rate adjustments in response to changes in economic conditions. Taylor rules establish a relationship between the central bank's target interest rate and two primary economic factors—inflation and output gap. First, Taylor rules incorporate inflation to guide interest rate decisions. When inflation is above the target level, the rule suggests raising interest rates to curb spending and price pressure. Conversely, when inflation is below the target, the rule advises lowering interest rates to stimulate economic activities and raise prices. Second, Taylor rules consider the output gap as a measure of economic slack. When there is a negative output gap (output below potential—a weak economy), the rule suggests lowering interest rates to stimulate spending and boost output. On the other hand, a positive output gap (output above potential) implies inflationary pressures.

The Taylor's rule has been well employed in the literature (Nguyen et al., 2020; Zhang, 2009). The theoretical equilibrium in the money market is estimated under Taylor rules using three main regressors including (1) the real GDP per capita growth rate capturing the changes in national income, (2) inflation rate, and (3) the real interest rate.

$$\frac{M2_{it}}{NGDP_{it}} = \delta_0 + \delta_1 RIR_{it} + \delta_2 Inf_{it} + \delta_3 GDP_{it} + \phi_{it} \quad (4)$$

where  $\frac{M2_{it}}{NGDP_{it}}$  is the ratio of broad money M2 to nominal GDP for country  $i$  at time  $t$ ;  $RIR_{it}$  is the real interest rate;  $Inf_{it}$  is inflation;  $GDP_{it}$  is the growth rate of real GDP per capita;  $\phi_{it}$  is collected to measure excess liquidity. Previous studies treat the positive error terms ( $\phi_{it}$ ) as excess liquidity (Nguyen, Le, et al., 2018; Nguyen et al., 2020); however, our study used the rules for normally distributed data by subjecting the error terms to 1.5 times their standard deviation. Such a normalizing method can ensure the robustness of the measurement for excess liquidity across the cross-section and time dimensions of the sample. Therefore,  $\hat{\phi}_{it} - 1.5\sigma(\hat{\phi}_{it}) > 0$  is encoded as excess liquidity. [Supplementary Appendix 1](#) presents the estimated results from the sub-equation based on Taylor's rule.

The EPU Index was first proposed by Baker et al. (2016) and was subsequently updated by these authors on the website [www.policyuncertainty.com](http://www.policyuncertainty.com). The index accounts for a class of economic risk where the future path of government policies is uncertain, raising risk premia and leading businesses and individuals to delay spending and investment until this uncertainty has been resolved. It is constructed from three types of underlying components: the first component quantifies newspaper coverage of policy-related economic uncertainty, the second component reflects the number of federal tax code provisions set to expire in future years, and the third component uses disagreement among economic forecasts.

Finally, the variable Crisis is a dummy variable that captures the countries that were most severely affected by the 2008 Global Financial Crisis (GFC). This variable is coded as 1 for countries classified as significantly impacted by the GFC, based on the analysis by the Carnegie Endowment for International Peace, and 0 otherwise. The classification by the Carnegie Endowment, as outlined in their International Economic Bulletin, employs a robust methodology that considers key economic indicators, such as currency depreciation, equity market declines, and bond spreads from September 2008 to May 2009. The Carnegie Endowment's analysis identified the top ten countries most adversely affected by the GFC through a meticulous evaluation of economic distress indicators. These countries include Ukraine, Argentina, Hungary, Poland, Jamaica, Ghana, Russia, Kazakhstan, Bulgaria, and Mexico. They exhibited significant economic challenges, such as severe currency depreciation, substantial equity market declines, and widening



bond spreads, indicative of heightened economic and financial instability. Other control variables include policy rates (monetary policy), GDP growth rate (economic growth), stock market returns (financial development), and house price index (real estate market). All the variables in the regression models are listed in detail in [Supplementary Appendix 2](#).

### 3.4. Estimation techniques

This study employs a dynamic panel data approach to examine the moderating effects of Economic Policy Uncertainty (EPU) and the Global Financial Crisis (GFC) on the relationship between excess liquidity and bank risk-taking. The decision to use a dynamic model is driven by the need to account for unobservable heterogeneity, as well as the constant nation-specific characteristics over time. As noted by Hsiao (1985), panel data provides additional data points, thereby improving the precision and efficiency of econometric estimates, making it a suitable choice for this analysis. However, including a lagged dependent variable as a regressor introduces endogeneity due to the correlation between this variable and the error term.

To address endogeneity, this study utilizes the System Generalized Method of Moments (SGMM) approach developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). SGMM is particularly well-suited for dynamic panel models as it addresses the endogeneity issue by using lagged levels as instruments for the first-difference equation and vice versa. This method reduces bias and enhances the efficiency of the estimators, particularly in datasets where the time dimension is small relative to the number of cross-sectional units (Roodman, 2009).

The choice of SGMM over alternative methods is based on its distinct advantages in addressing the specific challenges posed by the dataset. SGMM effectively manages unobserved heterogeneity and the potential endogeneity of the regressors, issues often encountered in financial and economic research (Bond, 2002). Additionally, SGMM is designed for datasets with large cross-sectional dimensions and relatively small-time dimensions, making it more appropriate for this study than methods like Fixed Effects or Random Effects, which may not fully account for endogeneity (Blundell & Bond, 1998). As Windmeijer (2005) points out, SGMM provides consistent and efficient parameter estimates in the presence of endogenous variables, a common concern in financial studies.

Despite its strengths, SGMM is not without limitations. One potential drawback is the risk of overfitting due to the use of too many instruments, which can weaken the power of the tests for instrument validity and lead to biased estimates (Roodman, 2009). To mitigate this risk, we carefully restrict the number of instruments used in the model, following best practices from prior literature (Roodman, 2009; Windmeijer, 2005). Furthermore, while SGMM is robust to autocorrelation and heteroskedasticity, careful attention is required to prevent instrument proliferation, which could undermine the validity of the results (Bowsher, 2002). This study implements SGMM with these considerations in mind, ensuring the robustness and reliability of the findings.

To ensure the robustness of the estimation results, several techniques were employed. First, the study considered individual country characteristics, including geographical stratification, income levels, and development classifications, to account for the heterogeneity across nations. This approach helps to ensure that the results are not driven by specific regional or economic characteristics but are instead broadly applicable across different contexts. Second, the research tested alternative specifications of the regression models. Specifically, it presented estimated results for models without any interaction terms and with only a two-variable interaction between EPU and excess liquidity (see [Supplementary Appendices 3 and 4](#)). This step was crucial in verifying the consistency of the findings across different model specifications, ensuring that the results are robust to changes in the model structure. Additionally, the research employed various proxies for the dependent variable in the banking sector, such as the negative value of the Z-score and NPLs, to further validate the robustness of the results. Finally, diagnostic tests were conducted to confirm the appropriateness of the model. The Arellano-Bond test for serial correlation and the Augmented Dickey-Fuller test for unit roots were applied to the model residuals. The results confirmed that the model residuals were not subject to serial correlation or unit roots, indicating that the model is well-specified and the findings are reliable.

**Table 1.** Summary statistics for the regression variables.

Variable	Obs	Mean	SD	Min	Max	Skewness	Kurtosis
RISK 1	3165	−13.6703	8.6871	−63.4100	−0.0200	−1.4694	6.3003
RISK 2	1570	−3.1278	1.1029	−7.1301	.47641	−.09477	3.6576
Excess	1575	0.2908	0.4543	0.0000	1.0000	0.9214	1.8489
EPU	3940	0.6000	0.4899	0.0000	1.0000	−0.4082	1.1667
Crisis	4137	0.0508	0.2195	0.0000	1.0000	4.0931	17.7535
IR	2536	13.2286	9.9968	0.0000	118.3800	3.2815	21.6570
GDP	3746	1.8672	5.5110	−62.3781	121.7797	1.9709	79.7911
SMR	3137	4.8490	23.4101	−86.7300	402.4600	5.9724	80.9727
RED	971	5.3269	8.9987	−36.9762	62.9767	0.9313	8.5416

**Table 2.** Estimation results for main regression with the two and three-variable interactions.

Variable	RISK 1				RISK 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag risk	0.852*** (0.107)	0.948*** (0.0778)	0.832*** (0.0996)	0.832*** (0.0930)	0.141*** (0.0415)	0.145*** (0.0341)	0.137*** (0.0437)	0.114*** (0.0436)
Excess	7.231*** (0.592)	7.367*** (0.532)	7.286*** (0.591)	7.391*** (0.457)	0.155*** (0.0325)	0.119*** (0.0370)	0.151*** (0.0354)	0.125*** (0.0388)
Excess × EPU	−1.382** (0.542)	−1.459*** (0.546)	−1.448*** (0.544)	−1.455*** (0.537)	−0.0294*** (0.00846)	−0.0125** (0.00620)	−0.0264*** (0.00889)	−0.0197** (0.00877)
Excess × EPU × Crisis	−5.821* (3.022)	−4.886* (2.510)	−4.925** (2.317)	−5.418** (2.713)	−0.114* (0.0592)	−0.109** (0.0533)	−0.123** (0.0603)	−0.123** (0.0593)
IR	0.540*** (0.0901)	0.518*** (0.0630)	0.517*** (0.0782)	0.516*** (0.0623)	0.0136*** (0.00201)	0.00964*** (0.00114)	0.0127*** (0.00201)	0.0116*** (0.00185)
GDP	0.860*** (0.142)	0.895*** (0.124)	0.863*** (0.141)	0.877*** (0.138)	0.0149*** (0.00272)	0.0231*** (0.00178)	0.0174*** (0.00281)	0.0187*** (0.00269)
SMR	−0.00608 (0.0105)	−0.00796 (0.00878)	−0.00349 (0.00917)	−0.00513 (0.0101)	−0.000363 (0.000235)	−0.00084*** (0.000232)	−0.000436* (0.000260)	−0.000478* (0.000264)
RED	0.0778*** (0.0292)	0.0636*** (0.0244)	0.0831*** (0.0268)	0.0827*** (0.0250)	0.00974*** (0.00180)	0.00931*** (0.00153)	0.00926*** (0.00180)	0.0103*** (0.00177)
Control by country effect								
Geographical stratification	No	Yes	No	No	No	Yes	No	No
Income level	No	No	Yes	No	No	No	Yes	No
Development classification	No	No	No	Yes	No	No	No	Yes
Observations	445	445	445	445	315	315	315	315
Number of groups	33	33	33	33	29	29	29	29
Number of instruments	22	26	23	23	22	25	22	22
Chi-squared test	1085.4	2130.5	1090.2	1272.4	987.9	1467.8	1471.2	872
Prob.	5.36E-229	0.00E+00	4.92E-230	2.21E-269	6.25E-208	1.26E-311	2.31E-312	6.12E-183
Hansen test of overid.	13.15	18.44	13.29	13.17	12.58	18.01	13.8	14.25
Prob.	0.514	0.427	0.58	0.589	0.56	0.388	0.465	0.431
Arellano-Bond test for AR(1)	−3.382	−3.48	−3.459	−3.456	−2.103	−1.871	−2.007	−1.841
Prob.	0.000719	0.000501	0.000542	0.000549	0.0355	0.0613	0.0447	0.0656
Arellano-Bond test for AR(2)	−1.389	−1.198	−1.427	−1.446	0.609	0.965	0.709	0.92
Prob.	0.165	0.231	0.154	0.148	0.542	0.334	0.479	0.357

Standard errors in parentheses: \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

The descriptive statistics for all dependent and independent variables are presented in Table 1. The mean values of RISK 1 (the negative value of the z-score) and RISK 2 (non-performing loans) are respectively −13.6703 and 0.1996. In addition, because the mean value of excess liquidity is lower than 0.5 (0.2908), most countries in the data sample were probably not confronting serious excess liquidity in their banking system. In contrast, EPU had a mean value above 0.5 (0.6), meaning that a majority of countries witnessed an increase in the EPU index compared to the previous period. With regard to the Crisis variable, only ten nations are classified in the sample as the most GFC-affected, so its mean value is at a low level of 0.0508 with a relatively high standard deviation of 0.2195. In terms of skewness<sup>2</sup> and kurtosis, all variables in the regression were not normally distributed.

#### 4. Estimation results and discussion

Table 2 provides robust empirical evidence supporting the key theoretical foundations outlined in the literature review. As hypothesized, excess liquidity exerts a significant positive impact on bank risk-taking behaviors, a finding that is consistent across all regressions. This outcome aligns with the Excess Liquidity Theory proposed by Acharya and Naqvi (2012), which posits that banks with surplus liquidity

are more likely to engage in riskier activities due to the ease of concealing credit risks and the increased incentives for aggressive lending strategies. This result echoes the conclusions of previous studies, such as those by Boateng et al. (2022), Khan et al. (2017), and Nguyen and Boateng (2013), which consistently demonstrated that banks with excess reserves are more prone to take higher risks, potentially compromising financial stability. These findings affirm the theoretical understanding of how excess liquidity fuels risk-taking behaviors in banking systems, particularly in periods of economic expansion or monetary easing.

Crucially, this study extends the literature by examining the moderating role of EPU on the relationship between excess liquidity and bank risk-taking. The negative and statistically significant coefficient for the interaction term between excess liquidity and EPU indicates that heightened policy uncertainty tempers the positive impact of excess liquidity on risk-taking behaviors. This finding is in line with the theoretical framework that high levels of uncertainty prompt banks to adopt more cautious risk strategies, as suggested by Caballero and Krishnamurthy (2008) and Gozgor et al. (2019). The result confirms that, under conditions of increased EPU, the risk-taking incentives associated with excess liquidity are mitigated. This insight adds a critical dimension to the Excess Liquidity Theory, illustrating that economic uncertainty disrupts the otherwise predictable relationship between liquidity surpluses and bank risk-taking. By incorporating EPU as a moderating factor, the study advances the understanding of how macroeconomic instability shapes bank behavior, particularly in periods of uncertainty.

The role of the Global Financial Crisis (GFC) as a key contextual factor is also explored in this study. The significant negative coefficient for the three-variable interaction term ( $\text{Excess} \times \text{EPU} \times \text{Crisis}$ ) underscores the amplifying effect of past crisis experiences on the moderating role of EPU. This finding supports our hypothesis that banks in these countries, having been deeply affected by the crisis, are more risk-averse in the face of economic uncertainty and excess liquidity. The literature, particularly Guiso et al. (2013, 2018), has shown that past economic shocks can lead to lasting changes in risk aversion and financial behavior, a phenomenon reinforced by the present study. Our work extends this theoretical framework by demonstrating that the legacy of the GFC continues to influence how banks in crisis-hit countries manage liquidity and risk, particularly when faced with high EPU. This insight underscores the importance of historical crises in moderating the relationship between liquidity and risk, contributing to the behavioral finance literature by integrating concepts from Prospect Theory (Tversky & Kahneman, 1992) and Heuristics Theory (Osman & Kelly, 1997).

Our findings carry important implications for policymakers and bank managers. The evidence suggests that excess liquidity can exacerbate financial instability by encouraging banks to engage in riskier activities. However, this risk can be mitigated through careful management of economic policy uncertainty. Therefore, policymakers should consider implementing stricter regulations to limit the number of excess reserves that banks can hold, such as by raising reserve requirements or restricting leverage. Such measures would help reduce the risks associated with surplus liquidity, thereby promoting greater financial stability. Moreover, in environments of high economic uncertainty, policymakers might strategically take advantage of the situation to curb excessive risk-taking by banks. Particularly, by carefully managing the timing and transparency of policy announcements, policymakers can create a controlled environment of uncertainty that encourages banks to be more cautious in their decision-making. Although this approach may seem counterintuitive, it has the potential to reduce moral hazard by discouraging banks from assuming that they will be bailed out during crises. However, such a strategy must be balanced carefully to avoid undermining public confidence in economic policy and causing excessive market volatility.

Ultimately, in countries severely affected by the GFC, the findings suggest that banks have developed a heightened sense of caution, which is further reinforced by economic policy uncertainty. Regarding these countries, policymakers may not need to impose overly stringent regulations, as banks' inherent prudence, shaped by their GFC experiences, already serves as a mitigating factor against excessive risk-taking. In contrast, in countries less affected by the GFC, it is crucial for policymakers to maintain vigilant regulatory oversight to prevent banks from engaging in risky behaviors, particularly in the absence of ingrained caution stemming from past crises.

With respect to the marginal effect of excess liquidity on bank risk-taking behaviours, the coefficients of EPU and  $\text{EPU} \times \text{Crisis}$  in Equation (2) were both negative. Based on these results, our explanation is

that when a country's EPU in the current year is higher than the previous year ( $EPU = 1$ ), the positive impact of excess liquidity on bank risk-taking behaviours will be attenuated. Additionally, in cases where countries with higher EPU were heavily affected by the GFC ( $EPU = 1$ ;  $Crisis = 1$ ), the attenuation will become stronger when the initial positive impact of excess liquidity is strongly reduced by the two negative coefficients. With regard to the control variables, all variables showed a significant and positive impact on bank risk-taking behaviours, except for SMR, which was not statistically significant.

The application of the SGMM estimator in this study was validated through rigorous diagnostic testing. The Arellano-Bond tests—AR (1) and AR (2)—confirmed that the residuals of the dynamic panel data model exhibited first-order but not second-order serial correlation, thereby ensuring the reliability of the estimation process (Arellano & Bond, 1991). The Hansen test for over-identifying restrictions was statistically insignificant, indicating that the instruments used in the model were valid and not overfitted (Roodman, 2009). Furthermore, the number of instruments was carefully managed to avoid overfitting, with the number of groups exceeding the number of instruments, further supporting the robustness of the model. To enhance the robustness of the findings, the study conducted a series of additional tests. These included alternative model specifications, such as regressions without interaction terms and those with only a two-variable interaction between EPU and excess liquidity. The study also tested different proxies for bank risk-taking, including the negative value of the Z-score and NPLs, across various regressions. The consistency of the results across these different models and specifications provides strong evidence that the SGMM estimator is appropriate for this dataset and that the findings are robust (Supplementary Appendices 3 and 4).

## 5. Conclusion

This study makes a significant contribution to the literature by exploring the intricate relationship between excess liquidity, economic policy uncertainty (EPU), and the Global Financial Crisis (GFC) in shaping bank risk-taking behaviors. Our findings reveal that while excess liquidity generally encourages greater risk-taking within the banking sector, this effect is significantly moderated by heightened economic uncertainty and the lasting impact of the GFC. Specifically, in environments of increased EPU, banks adopt more cautious risk management practices, mitigating the risks traditionally associated with surplus liquidity. Additionally, banks in countries most severely affected by the GFC demonstrate a higher degree of prudence, suggesting that past financial crises continue to exert a stabilizing influence on current risk-taking behaviors.

The originality of the research lies in the integration of EPU as a moderating factor within the Excess Liquidity Theory, as initially proposed by Acharya and Naqvi (2012). By illustrating how EPU serves as an automatic stabilizer that reduces risk-taking behaviors in the presence of excess liquidity, this study extends the theory's applicability. Furthermore, the research highlights that this moderating effect of EPU is amplified in countries that experienced more severe repercussions from the GFC, offering fresh insights into how historical crises influence banking behavior in contemporary financial environments.

The policy implications stemming from these findings are both clear and actionable. In countries less severely impacted by the GFC, there is a pressing need to enhance regulatory frameworks to better monitor and address the risks associated with excess liquidity. Policymakers could achieve this by strengthening capital adequacy requirements, refining stress testing protocols, and promoting greater transparency in banks' risk management practices. For countries already adopting a cautious approach due to their GFC experiences, maintaining robust regulatory oversight remains essential, while also exploring the strategic use of EPU as a further stabilizing mechanism. Central banks, in particular, could play a more proactive role by managing market expectations through careful policy announcements, using EPU to temper excessive risk-taking without disrupting financial stability. This approach could complement traditional monetary policies, offering an additional tool for safeguarding financial systems in times of excess liquidity.

Despite the contributions of this study, certain limitations warrant attention and provide pathways for future research. The reliance on the widely accepted EPU index, while valuable, restricts the geographical scope of analysis, potentially omitting regional variations in the interplay between excess liquidity and economic uncertainty. Future research should aim to incorporate more diverse datasets and consider

alternative measures of uncertainty to capture a broader range of economic environments. Furthermore, the study's timeframe, centered around the years leading up to and following the GFC, does not account for the significant economic shifts triggered by the COVID-19 pandemic. Expanding the analysis to include post-pandemic data would offer a deeper understanding of how recent global events have reshaped the dynamics between liquidity, uncertainty, and risk-taking in the banking sector.

## Notes

1. Thirty-three countries and territories in the final sample respectively include Australia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czechia, Hong Kong, Hungary, Iceland, India, Israel, Italy, Japan, Malaysia, Malta, Mexico, Netherlands, New Zealand, North Macedonia, Peru, Philippines, Romania, Russia, Serbia, Singapore, South Africa, South Korea, Sweden, Switzerland, and Thailand.
2. In a normal distribution, the value of skewness should be closer to zero, and the value for kurtosis should fluctuate around three.

## Author contributions

Thanh Cong Nguyen: formal analysis, resources, software, writing original draft, data curation. Thai Nguyen Vu Hong: conceptualization, project administration, supervision, writing–review and editing. Christophe Schinckus: methodology, data curation, writing–review and editing. Thanh Tuan Chu: supervision, validation, writing–review and editing.

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## About the authors

**Dr. Thanh Cong Nguyen (Nathan)** is a dedicated lecturer, researcher, and writer who is passionate about acquiring greater knowledge. After completing his BA in Finance, he pursued further expertise, obtaining an MA in Economics from Erasmus University Rotterdam and an MSc in Finance from HCMC University of Economics and Finance. He was honored with a full scholarship from the Fulbright School of Public Policy and Management & Harvard Kennedy School (Harvard University), becoming one of its distinguished students. To adapt to the program's demands, Nathan enhanced his English skills and earned a BA in Language & Literature from Ha Noi Open University. He earned his PhD in International Business (Economics and Finance Specialization) from RMIT University. His research interests encompass economics, finance, and business, leading to 40 publications, including over 10 notable works in SCOPUS indexed journals.

**Professor Thai Vu Hong Nguyen** currently serves as the Deputy Dean for Learning and Teaching at The Business School, RMIT Vietnam. His research focuses on monetary policies, banking performance, and blockchain technology.

**Professor Christophe Schinckus** is an administrator and researcher who is currently the Dean of the Faculty of Business and Computing at the University of the Fraser Valley (UFV) in Abbotsford, Canada. He has been recognized among the top 2% of scientists in business and economics from 2020 to 2022. Schinckus is a multidisciplinary academic with PhDs from both the University of Cambridge and Sorbonne in Paris. His educational background includes advanced degrees in physics, financial risk management, and philosophy of science. Over the course of his career, he has held teaching and managerial roles at international institutions such as the University of Quebec at Montreal, University of Leicester, Taylor's University in Malaysia, and RMIT Vietnam. Since joining UFV in 2021, he has made significant contributions to the academic community, publishing over 120 peer-reviewed papers and authoring two books on econophysics. His research encompasses a broad range of topics, including econophysics, FinTech, cryptocurrencies, energy economics, and the epistemology of finance.

**Dr. Thanh Tuan Chu** holds the position of Associate Program Manager of the Undergraduate Business Programs at The Business School, RMIT Vietnam. Prior to joining RMIT, Dr. Tuan amassed over eight years of teaching experience at institutions such as the New College of the Humanities in London, Bournemouth University, and the University of Winchester (UK). Since 2018, he has been recognized as a Fellow of the Higher Education Academy (UK). Dr. Tuan



earned his PhD in Economics from Bournemouth University and an MSc in Accounting and Finance from the University of Bath (UK). His primary research interests lie in Macroeconomics, particularly Fiscal Policy, alongside additional interests in Blockchain, Corruption, Technology in Accounting, and Sustainable Development.

## ORCID

Thanh Cong Nguyen  <http://orcid.org/0000-0001-6392-4030>

Thai Vu Hong Nguyen  <http://orcid.org/0000-0003-1750-593X>

## Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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