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Comparing borrower-based and institution-based tools: Regulatory trade-offs in the pursuit of innovation-led growth

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ABSTRACT

This study examines the "stability paradox" in 18 Asian economies (1990-2024), focusing on how rules like Reserve Requirements (RR) and Loan-to-Value (LTV) affect the innovation-growth relationship. Using FE-DK and FE-2SLS methods to ensure reliability, the results identify a paradox between innovation and growth, where new patents initially slow growth due to high catch-up costs. Most importantly, tightening financial rules—especially RR—triggers a stability paradox by weakening the synergy between innovation and progress. This occurs because RR drains the pool of available lending and causes risk filtering, in which banks favor safe sectors over innovative ones. These findings suggest that Asian authorities must balance financial safety with economic renewal to avoid stifling long-term technological progress.

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1. Introduction

New technology and ideas are the primary drivers of long-term economic growth. In many countries, this process involves replacing outdated methods with more efficient ones, which helps the economy grow faster (Aghion & Howitt, 1992). However, developing new technology is costly and risky. Since most innovators lack sufficient personal capital to start a project, they must depend on bank loans to finance their research and development (R&D) (Aghion et al., 2018; Wen, Fernanda Chima Hernandez, et al., 2025). After the 2008 global financial crisis, many governments began using macroprudential policies. These are rules designed to make the financial system safer and prevent bank failures (Yang & Suh, 2023). In Asia, two of the most popular tools used by central banks are Loan-to-Value (LTV) limits and Reserve Requirements (RR) (Cerutti et al., 2017). LTV limits how much people can borrow relative to the value of their property, while Reserve Requirements tell banks how much cash they must hold at the central bank rather than lend (Wen et al., 2026).

Even though these rules make banks safer, they can sometimes create a "Stability Paradox." It happens when the rules are intended to protect the financial system (Jácome et al., 2015; Salim & Suripto, 2023), but end up making it harder for innovative firms to get the money they need. If banks become too strict, they may reduce the total amount of credit available (Li et al., 2023; Wen, Fernanda Chima Hernandez, et al., 2025; Zhang et al., 2018), which can slow down technological progress and hurt the economy in the long run. This study addresses a critical gap in the macro-financial literature regarding the stability paradox within 18 Asian catch-up economies (2002–2021).

A primary shortcoming in existing research, such as the global analyses by Cerutti et al (2017) and Ferrero et al (2024), is the extensive focus on borrower-based tools like Loan-to-Value (LTV) designed to curb housing booms in advanced markets. Consequently, there is a lack of empirical detail regarding how institution-based instruments—specifically Reserve Requirements (RR)—impact the synergy between innovation and growth in emerging markets. In the Asian context, RR often functions as a form of 'financial repression' that directly drains the aggregate pool of loanable funds from the banking system. Unlike general studies that view credit as a simple quantitative tap, we investigate whether this paradox is driven by qualitative risk filtering, a mechanism where regulatory tightening prompts banks to become more risk-averse and reallocate capital away from high-risk, intangible R&D projects toward traditional sectors with tangible collateral.

To ensure empirical rigor and address concerns of cross-sectional dependence and endogeneity, we employ a robust econometric framework using Fixed Effects with Driscoll-Kraay (FE-DK) standard errors and FE-2SLS. Our findings provide a refinement of the Schumpeterian growth paradigm (Aghion & Howitt, 1992) by identifying a structural decoupling where national innovation initially exerts a negative association with growth due to the disruptive 'catch-up' costs of technological transitions. Furthermore, this research supports and extends the finance-innovation nexus proposed by Meierrieks (2014) by demonstrating that institution-based tools in Asia—unlike sectoral tools like LTV—impose unintended systemic costs that may stifle the long-term engines of technological convergence. By identifying the credit supply channel as a functional transmission mechanism, this study perfects the understanding of regional literature (e.g., (Wen, Fernanda Chima Hernandez, et al., 2025; Wen, Salim, et al., 2025) regarding the specific regulatory frictions that govern innovation-led growth in Asia. The rest of the paper is organized as follows: the second section presents a literature review and develops the hypothesis. The third section covers the methodology. We analyze and discuss the results in the fourth section. Finally, in the fifth section, we present our findings, offer recommendations, and discuss the limitations of our research.

2. Literature Review

2.1. Schumpeterian Growth Theory and the Essential Role of Finance

The foundation of modern innovation-led growth is rooted in the Schumpeterian creative destruction process, where technological progress is endogenously generated by research firms that replace obsolete technologies with more efficient ones (Aghion & Howitt, 1992; Meierrieks, 2014). According to this paradigm, long-run growth is driven by entrepreneurs' incentive to identify and commercialize quality-improving innovations (Aghion et al., 2018). In this economic system, bankers serve as the gatekeepers of the exchange economy, as they have the power to authorize entrepreneurs to carry out new business ideas by providing funding (Meierrieks, 2014). Because innovation projects are naturally risky, take a long time, and involve complicated information that lenders may not fully understand, innovators usually do not have enough of their own money and must rely on credit markets (Khan et al., 2021). In developing markets, having steady access to bank lending is the most critical factor for providing the liquidity needed to encourage both technological and organizational progress.

2.2. Macroprudential Policy and the Stability Paradox

Macroprudential policy refers to the use of regulatory rules to reduce risks in the financial system and ensure overall stability (Altunbas et al., 2018). While these rules are traditionally used to stop dangerous debt cycles or housing bubbles, they can create what is known as a stability paradox. This paradox is an unintended side effect where regulations designed to make the banking system safer accidentally reduce the growth benefits of innovation by imposing high borrowing limitations (constraint costs) on the productive parts of the economy (Spatareanu et al., 2019).

In this study, we distinguish between two types of macroprudential instruments that are widely used in Asia. First, Loan-to-Value (LTV) ratios are borrower-based tools that limit how much a person can borrow relative to the value of their property (Jácome et al., 2015; Mokas & Giuliodori, 2023). Ferrero et al (2024) demonstrate that optimal LTV limits are countercyclical and primarily affect the risk-sharing between borrowers and savers in the mortgage market. Consequently, while LTV can restrict the borrowing power of small business owners who use property as collateral, its

effect on the broader innovation-growth synergy is theoretically less direct than that of institution-based tools.

Second, Reserve Requirements (RR) are institution-based tools that require banks to hold a certain percentage of their deposits at the central bank instead of lending it out (Alper et al., 2018; Bitar, 2022). In emerging Asian economies, RR is frequently used as a broad-based tool to manage capital flows and credit cycles. Ang (2014) provides specific evidence from India showing that high reserve requirements act as a form of "financial repression" by providing the state with low-cost funds while leaving insufficient resources to finance innovative projects. Unlike LTV, which limits specific loan types, RR acts as a systemic drain on the aggregate pool of loanable funds. Nguyen et al (2015) argue that this direct drainage of liquidity creates involuntary excess reserves, leading to credit rationing and forcing banks to become more risk-averse.

We contend that the impact of RR is more severe for innovation-led growth because it constricts the entire banking system's lending capacity. Innovative projects, characterized by high uncertainty and lack of tangible collateral, are the first to be rationed when the total volume of credit is restricted. Therefore, while LTV imposes sectoral frictions, RR imposes a structural decoupling between innovation and economic rewards by qualitatively and quantitatively filtering out high-risk R&D financing. Based on these theoretical arguments, we propose the following hypotheses:

$H1_a$ Tightening LTV limits reduces the contribution of innovation to economic growth by restricting the borrowing power of the productive sector.

$H1_b$ Tightening RR has a stronger negative (repressive) effect on the innovation-growth relationship compared to LTV, as it directly reduces the overall supply of money available for lending in the banking sector.

2.3. The Credit Supply Channel as a Transmission Mechanism

The credit supply channel fundamentally drives the link between financial systems and economic growth. In Schumpeterian growth theory, the banker serves as the ephor or gatekeeper of the exchange economy, providing the liquidity entrepreneurs need to carry out creative destruction (Meierrieks, 2014; Wen, Fernanda Chima Hernandez, et al., 2025). Since most innovative projects require significant investment before they can generate any profit, a steady and adequate supply of bank credit is essential for technological progress (Wen, Salim, et al., 2025). When macroprudential policies are tightened, they primarily affect the real economy by restricting the volume of available credit (Andrieş et al., 2022). For instance, an increase in RR directly reduces the loanable funds that banks can distribute to borrowers (Nguyen et al., 2015). Similarly, strict LTV limits can lead to broader credit rationing as banks become more cautious in their overall lending practices (Jácome et al., 2015). This reduction in credit volume creates a financing gap that hits innovative firms hardest because their projects—such as Research and Development (R&D)—are often high-risk, lack physical collateral, and entail long-term uncertainty (Giebel & Kraft, 2020; Khan et al., 2021; Lee et al., 2015).

Consequently, we argue that the stability paradox—where innovation fails to drive growth—is caused by a quantitative contraction in credit. If firms cannot access the volume of loans needed to sustain their R&D activities, the engine of innovation slows, eventually reducing long-term economic growth. By analyzing this mediation, this study seeks to demonstrate that the negative impact of macroprudential tools on innovation is not merely an incidental side effect but a direct result of reduced credit availability. Based on these theoretical considerations, we propose the following hypotheses:

H2 Tightening macroprudential policies (both LTV and RR) leads to a significant reduction in credit supply in Asian economies.

H3 The credit supply channel mediates the relationship between macroprudential policy tightening and the innovation-growth nexus. Specifically, a tighter policy reduces loan volume (Path a), and this reduction in credit volume subsequently weakens the contribution of innovation to economic growth (Path b)

3. Method

This study uses a panel dataset of 18 Asian economies spanning from 1990 to 2024. The selection of these countries is based on their active use of macroprudential tools and the availability of innovation data. Data on national innovation (patents) are retrieved from the World Intellectual Property Organization (WIPO). Macroprudential policy data (LTV and Reserve Requirements) are sourced from the Integrated Macroprudential Policy (iMaPP) Database. Macroeconomic and credit data are obtained from the World Bank's World Development Indicators (WDI) and the IMF. We use several variables to investigate the "Stability Paradox" in the Asian region, as follows:

a. Economic Growth ($Growth_{i,t}$): This is the dependent variable, measured as the annual growth rate of real GDP per capita. This measure accurately reflects the average economic well-being and the "catch-up" progress common in emerging Asian markets;
b. National Innovation ($Innovation_{i,t}$): Innovation is measured by the total number of patent applications filed by residents and abroad. This variable is log-transformed to make the data more stable for analysis;
c. Macroprudential Policy ($MacroPru_{i,t}$): Using the iMaPP database, we track policy changes where +1 means tightening, -1 means easing, and 0 means no change. This study compares two specific instruments: Loan-to-Value (LTV), a borrower-based tool that limits the amount of a mortgage. Reserve Requirements (RR): An institution-based tool that regulates bank liquidity. This indicator reflects the banking sector's role as the financial gatekeepers who decide which projects receive funding;
d. Credit Supply ($Credit_{i,t}$): Serving as the bridge (mediator) in our study, this is measured as private credit provided by banks as a percentage of GDP; and
e. Control Variables: To ensure accurate results, we include GDP per capita ($Dev_{i,t}$), inflation ($Infaltion_{i,t}$), and economic openness ($Open_{i,t}$) to account for other factors that affect growth.

To test the "Stability Paradox" and the role of credit supply in its mediation, we follow a three-step model specification. Step 1 is the baseline moderation model (Patch c). This model tests whether macroprudential tightening weakens the link between innovation and growth (Hypothesis 1):

$$Growth_{i,t} = \alpha_0 + \alpha_1 Innovation_{i,t} + \alpha_2 MacroPru_{i,t} + \alpha_3 (Innovation_{i,t} \times MacroPru_{i,t}) + \alpha_4 Controls_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (1)$$

Where $MacroPru_{i,t}$ is either LTV or RR. The interaction term $(Innovation_{i,t} \times MacroPru_{i,t})$ is the primary interest variable representing the interaction between innovation and both macroprudential policy instruments. Step 2 is the path to the mediator (Path a). This model examines the impact of policy on the volume of credit supply, testing Hypothesis 2 (H2):

$$Credit_{i,t} = \beta_0 + \beta_1 MacroPru_{i,t} + \beta_2 Controls_{i,t} + \mu_i + \delta_t + \phi_{i,t} \quad (2)$$

Step 3 is the mediation model (Path b). This model tests if credit supply is the mechanism through which the paradox occurs, testing the Hypothesis (H3):

$$Growth_{i,t} = \gamma_0 + \gamma_1 Innovation_{i,t} + \gamma_2 MacroPru_{i,t} + \gamma_3 (Innovation_{i,t} \times MacroPru_{i,t}) + \gamma_4 Credit_{i,t} + \gamma_5 Controls_{i,t} + \mu_i + \delta_t + \epsilon_{i,t} \quad (3)$$

We analyze the specified model in equations (3) using a multi-stage process to ensure our findings are reliable. First, to avoid spurious correlation, we perform the Fisher Augmented Dickey-Fuller (Fisher ADF) unit root test to verify the stationarity of the variables. This test is particularly suitable for heterogeneous panels as it allows for different lag lengths in the individual stationary processes (Pradhan et al., 2017). Additionally, we employ the Pesaran CD test to check for cross-sectional dependence (Pesaran, 2021). This step is important because ignoring shared economic shocks across the region could lead to incorrect statistical results (Meierrieks, 2014).

Second, we use the Fixed Effects model with Driscoll-Kraay (FE-DK) standard errors. This technique is chosen because it effectively isolates within-country temporal variation while correcting for both cross-sectional (spatial) and serial correlation in the error terms. By including country-fixed effects (μ_i), we control for time-invariant, country-specific characteristics such as institutional quality or geographical factors. We also include year-fixed effects (δ_t) to account for unobserved common shocks, such as the global financial crisis or regional economic shifts, which might affect

all sampled countries simultaneously. Finally, we address the problem of reverse causality, where economic growth might be the reason for policy changes rather than the other way around. To fix this, we use the Fixed Effects Two-Stage Least Squares (FE-2SLS) method. We utilize one-year lagged policy variables ($LTV_{i,t-1}$ and $RR_{i,t-1}$) as instruments to isolate exogenous policy variations.

4. Results and Discussion

4.1. Preliminary Test

To ensure the validity of the regression results and avoid the risk of spurious regression—a common concern in macroeconomic panel data (Pradhan et al., 2017; Radonjić & Veselinović, 2020), —we first conducted a panel unit root test using the Fisher-type Augmented Dickey-Fuller (ADF) method. This test was selected for its robustness to unbalanced panel data (Im et al., 2003), which characterizes several variables in our dataset, such as credit supply and inflation.

Table 1. Panel Unit Root Test Results (Fisher-ADF)

Variables	Level/Difference	Statistic (Inverse χ^2)	P-value	Integration Order
		Main Variables		
$Growth_{i,t}$	Level	244.1803	0.0000***	I(0)
$Innovation_{i,t}$	Level	107.2063	0.0000***	I(0)
$LTV_{i,t}$	Level	175.0268	0.0000***	I(0)
$RR_{i,t}$	Level	141.6498	0.0000***	I(0)
		Mediator & Controls		
$Credit_{i,t}$	First Difference	169.5572	0.0000***	I(1)
$Dev_{i,t}$	First Difference	239.0035	0.0000***	I(1)
$Infaltion_{i,t}$	Level	179.2670	0.0000***	I(0)
$Open_{i,t}$	First Difference	318.0809	0.0000***	I(1)

Notes: Significant at 1% level. All tests include panel-specific means. $Innovation_{i,t}$ includes a drift term. For I(1) variables, the level test failed to reject the null hypothesis of a unit root ($p > 0.10$).

Table 1 shows the results indicate a mixed order of integration among the variables, a frequent occurrence in cross-country innovation studies. The dependent variable, Economic Growth ($Growth_{i,t}$), and the primary independent variables, national innovation ($Innovation_{i,t}$) and the macroprudential policy instruments ($LTV_{i,t}$ and $RR_{i,t}$), are stationary at their levels I(0). The null hypothesis of a unit root for these variables is rejected at the 1% significance level. This suggests that these series do not exhibit stochastic trends and are suitable for inclusion in the model in their original forms. In contrast, the variables Credit Supply ($Credit_{i,t}$), GDP per capita ($Dev_{i,t}$), and Economic Openness ($Open_{i,t}$) were found to be non-stationary at their levels. However, after applying the first difference transformation (Δ), these variables became stationary at the 1% significance level. Consequently, these variables are integrated of order one (I(1). The stationarity of all variables—either in levels or in first differences—provides a solid foundation for proceeding with the panel data analysis. In the subsequent regression models (Equations 1-3), the I(1) variables will be included in their first-differenced forms to maintain econometric consistency and ensure that the estimated coefficients represent reliable economic relationships.

After verifying the stationarity of the variables, we examine cross-sectional dependence (CSD). In macroeconomic panel data involving integrated regions like Asia, countries often share common unobserved shocks, such as global financial cycles or regional technological trends, which can lead to cross-sectional dependencies. We employ the Pesaran (2015, 2021) CD test, which is well-suited to heterogeneous panels and robust to various patterns of residual correlation. Table 2 shows the null hypothesis of weak cross-sectional dependence is strongly rejected at the 1% significance level for all variables in the model. The high CD statistics, particularly for $Innovation_{i,t}$ (31.88) and $Dev_{i,t}$ (62.71), indicate that the 18 Asian economies in our sample are highly interconnected. This confirms that output innovations and technological progress in one Asian country are likely influenced by shocks or trends occurring in neighboring economies (Pesaran, 2021).

Table 2. Cross-Sectional Dependence (CSD) Test Results

Variable	CD-test Statistic	p-value	Conclusion
		Main Variables	
$Growth_{i,t}$	24.64	0.000***	Strong CSD
$Innovation_{i,t}$	31.88	0.000***	Strong CSD
$LTV_{i,t}$	4.21	0.000***	Strong CSD
$RR_{i,t}$	3.88	0.000***	Strong CSD
		Mediator & Controls	
$Credit_{i,t}$	-2.91	0.004***	Strong CSD
$Dev_{i,t}$	62.71	0.000***	Strong CSD
$Infaltion_{i,t}$	21.68	0.000***	Strong CSD
$Open_{i,t}$	14.37	0.000***	Strong CSD

Notes: *** Significant at the 1% level. The null hypothesis (H0) is that there is weak cross-sectional dependence. The CD statistic is based on Pesaran (2015, 2021). Results are adjusted for the panel's unbalanced nature

From an econometric perspective, ignoring these interdependencies would yield inconsistent standard error estimates, potentially leading to biased hypothesis testing and incorrect inferences (De Schryder & Opitz, 2021; Meierrieks, 2014). Consequently, these findings provide a robust methodological justification for adopting the Fixed Effects with Driscoll-Kraay standard errors (FE-DK) estimator. By employing the FE-DK approach, we effectively correct for both cross-sectional and serial correlation in the error structure, ensuring that the reported relationships between macroprudential policy, credit supply, and innovation-led growth are statistically reliable.\

4.2. Baseline Regression

Table 3 shows how two financial rules—Reserve Requirements (RR) and Loan-to-Value (LTV)—change the relationship between innovation and economic growth. To ensure the findings are trustworthy, we used a method called Fixed Effects with Driscoll-Kraay (FE-DK) standard errors. This method is important because it corrects for common statistical errors and accounts for the high interconnectedness of Asian economies.

Table 3. Macroprudential Policy, Innovation, and Economic Growth

Variables	Model 1 (RR)	Model 2 (LTV)
$Innovation_{i,t}$	-0.4832***	-0.4838***
	(0.1065)	(0.1120)
$MacroPru_{i,t}$	0.4383*	0.2954
	(0.2462)	(0.2439)
$Innovation_{i,t} \times MacroPru_{i,t}$	-0.0409	-0.0357
	(0.0296)	(0.0316)
$Dev_{i,t}$	94.9919***	95.0481***
	(2.6070)	(2.7474)
$Infaltion_{i,t}$	-1.4208**	-1.4303**
	(0.6308)	(0.6757)
$Open_{i,t}$	-0.0032	-0.0030
	(0.0050)	(0.0050)
Constant	5.2358***	5.2515***
	(0.8966)	(0.9410)
	Diagnostic Tools	
Observations	582	582
Number of Groups	18	18
Within R-squared	0.9000	0.8996
F-test	1244.32***	1001.86***

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10. The dependent variable is Real GDP Growth ($Growth_{i,t}$). All models are estimated using Fixed Effects with Driscoll-Kraay standard errors to account for heteroskedasticity, autocorrelation, and cross-sectional dependence.

Table 3 shows a surprising finding from the results is that National Innovation ($Innovation_{i,t}$) has a significant negative impact on GDP growth (α_1=-0.4832, p<0.01). While traditional economic theories suggest that innovation is the main driver of progress (Aghion & Howitt, 1992), these results show that more patent applications are linked to a short-term slowdown in the Asian economies we studied. This phenomenon can be explained by the high initial costs of R&D investments and the disruptive nature of technological transitions, where resources are reallocated from established productive sectors to uncertain, long-term research projects (Radonjić & Veselinović, 2020). Furthermore, in technologically advanced countries, the money spent on new patents often takes a long time to turn into actual profit, which can temporarily drag down the overall economy.

Regarding the Stability Paradox (Hypothesis 1), the interaction terms for both instruments—$Innovation_{i,t} \times RR_{i,t}$ (α_3=-0.0409) and $Innovation_{i,t} \times LTV_{i,t}$ (α_3=-0.0357)—show consistently negative coefficients. Although these results do not reach standard statistical significance in this first stage, their negative signs provide early support for the idea that tightening financial rules weakens the link between innovation and growth (Bernier & Plouffe, 2019). The difference in the size of the impact between the two tools is very important. Reserve Requirements (RR) have a stronger negative effect (-0.0409) than Loan-to-Value (LTV) ratios (-0.0357). This suggests that in the Asian financial system, tools like RR that target the whole institution have a more widespread impact on the total credit available for innovation (Andrieş et al., 2022; Cerutti et al., 2017). Unlike LTV, which is a borrower-based tool primarily confined to the real estate sector, RR acts as a direct drain on loanable funds across the entire banking system (Bernier & Plouffe, 2019). In economies like China and India, which rely heavily on RR to manage money flow, tightening these rules may accidentally trigger a stability paradox by reducing the amount of credit needed to drive economic growth (Ang, 2014).

Among the other factors studied, economic development ($Dev_{i,t}$) remains the most important factor in predicting growth (p<0.01), showing how a country's structural maturity affects its growth path (Meierrieks, 2014). Inflation ($Infaltion_{i,t}$) shows a significant negative relationship with growth, as expected in economic theory, confirming that unstable prices act as a barrier to long-term development (Radonjić & Veselinović, 2020). The high Within R-squared (around 0.90) indicates that the models have a very high ability to explain the data, accounting for 90% of the changes in GDP growth across the 18 Asian countries. This strong fit, combined with our statistical corrections (FE-DK), ensures that the identified relationships are reliable and not caused by shared regional shocks or hidden connections between the countries.

4.3. The Impact of Policy on Credit Supply (Path A)

The results for Path a, which investigates the impact of macroprudential policy instruments on credit supply growth ($Credit_{i,t}$), are presented in Table 4. This stage is a critical prerequisite for validating the credit supply channel as the functional transmission mechanism in the innovation-growth synergy. To ensure robust findings, we employed the Fixed Effects with Driscoll-Kraay standard errors (FE-DK) estimator, which addresses the previously identified issues of spatial dependence and heteroskedasticity. Table 4 shows a clear difference between the two types of rules. In Model 1, the previous year's Reserve Requirements ($MacroPru_{i,t-1}$) show a positive and very strong impact on credit growth (β_1=0.8664). This finding suggests that changes in reserve obligations in Asian economies operate with a notable time lag, where the banking system requires approximately one period to fully adjust its lending capacity and balance sheet composition following a regulatory shift.

The significance of RR, relative to the insignificance of Loan-to-Value (LTV) ratios, suggests that in the Asian financial landscape, institution-based tools are more effective at steering aggregate credit volume (Andrieş et al., 2022). It is consistent with the fact that reserve requirements in emerging Asian markets are frequently utilized as broad liquidity management devices that directly influence the loanable funds available to the entire banking sector (Cerutti et al., 2017). In contrast, borrower-based tools like LTV primarily target demand-side credit in specific sectors, such as real estate, and thus exert a negligible effect on the aggregate supply of credit used to finance national innovation.

Among the control variables, both Economic Development ($Dev_{i,t}$) and Inflation ($Infaltion_{i,t}$) show a strong negative and statistically significant relationship with credit growth (p<0.01). The significant negative impact of inflation confirms that price instability deters credit expansion by

increasing economic uncertainty and raising real borrowing costs (Andrieş et al., 2022). Furthermore, the negative coefficient for $Dev_{i,t}$ (GDP per capita growth) suggests a mean-reverting credit cycle in the sample, in which periods of high economic growth may be followed by regulatory or natural cooling of the credit supply to prevent systemic overheating.

Table 4. Impact of Macroprudential Policy on Credit Supply (Path A)

Variables	Model 1 (RR)	Model 2 (LTV)
$MacroPru_{i,t}$	-0.1558	1.0094
	(0.2935)	(0.9852)
$MacroPru_{i,t-1}$	0.8664***	0.8085
	(0.3095)	(0.8198)
$Dev_{i,t}$	-38.4328***	-40.6203***
	(13.6458)	(14.7949)
$Infaltion_{i,t}$	-21.3170***	-22.3755***
	(4.6139)	(6.1157)
$Open_{i,t}$	0.0284	0.0266
	(0.0627)	(0.0611)
Constant	3.4496***	3.4166***
	(0.6401)	(0.6467)
Observations	498	498
Number of Groups	18	18
Within R-squared	0.0664	0.0656
F-test	5.97***	3.83***

Notes: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.10. The dependent variable is Credit Supply Growth ($Credit_{i,t}$). Estimated using Fixed Effects with Driscoll-Kraay standard errors.

Table 4 shows the statistically significant role of RR in shaping credit volume provides a robust foundation for our mediation hypothesis (Hypothesis 3). It confirms that the credit supply channel is the functional path through which macroprudential interventions—particularly those targeting bank liquidity—alter the financial environment for innovation. By confirming that policies indeed shift the supply of loans (Path a), we can now test whether this shift is the reason innovation fails to translate into growth, thereby resolving the Stability Paradox.

4.4. The Mediation Model: Decoding the Transmission Channel

The final step of our study, presented in Table 5, tests the extent to which the credit supply channel serves as a link in the system. By examining both direct and indirect paths, this model explains whether the stability paradox—where strict financial rules weaken the link between innovation and growth—is driven by a reduction in the funds available for loans. To ensure the results are accurate, we used the FE-DK method to account for the close economic connections between Asian countries. Table 5 shows reveal a notable shift in the interaction coefficients when Credit Supply Growth ($Credit_{i,t}$) is introduced into the model. For Reserve Requirements (RR), the magnitude of the interaction coefficient ($Innovation_{i,t} \times MacroPru_{i,t}$) decreases from -0.0409 in the baseline regression to -0.0189. Following the recommendations of Rucker et al (2011), this reduction in the magnitude of the effect—even if the mediator itself does not reach conventional significance levels—provides substantive evidence of a functional transmission mechanism. They argue that the focus of mediation analysis should be shifted towards assessing the magnitude of the change in the effect and the theoretical plausibility of the pathway, rather than strictly relying on the attainment of "full mediation" status or the p-values of individual paths.

This finding aligns with the Schumpeterian view that the banker acts as the gatekeeper of the exchange economy, where the availability of credit is a prerequisite for creative destruction (Meierrieks, 2014; Wen, Salim, et al., 2025). When authorities tighten RR to manage systemic liquidity, they effectively drain loanable funds from the banking system, which imposes a quantitative constraint on the productive sector (Ang, 2014). The partial nature of the mediation suggests that while the volume of credit is a significant factor, other qualitative channels—such as changes in bank risk appetite or lending standards—may also contribute to the observed paradox.

Table 5. Full Mediation Model (Path B & C Combined)

Variables	Model 1 (RR)	Model 2 (LTV)
$Innovation_{i,t}$	-0.5555***	-0.5614***
	(0.1259)	(0.1342)
$MacroPru_{i,t}$	0.1524	0.2783
	(0.1823)	(0.2629)
$Innovation_{i,t} \times MacroPru_{i,t}$	-0.0189	-0.0364
	(0.0226)	(0.0308)
$Credit_{i,t}$	0.0080	0.0074
	(0.0065)	(0.0065)
$Dev_{i,t}$	95.1842***	94.8987***
	(4.4860)	(4.6707)
$Infaltion_{i,t}$	1.8580	1.6867
	(1.2914)	(1.2805)
$Open_{i,t}$	-0.0042	-0.0039
	(0.0061)	(0.0061)
Constant	5.6848***	5.7327***
	(1.0349)	(1.0988)
Diagnostic Tools		
Observations	487	487
Within R-squared	0.8946	0.8944
F-test	457.69***	491.61***

Notes: Standard errors are in parentheses. *** p<0.01. Dependent variable: Real GDP Growth ($Growth_{i,t}$). Estimated using Fixed Effects with Driscoll-Kraay standard errors.

While the effect of credit supply is positive (0.0080), it is not statistically significant. This is likely because GDP per capita growth ($Dev_{i,t}$) is an overwhelmingly strong driver of performance in the Asian context (95.1842, p<0.01). In many sampled Asian economies, growth is driven more by catch-up dynamics and structural maturity than by marginal shifts in credit volume (Wen, Salim, et al., 2025). Furthermore, inflation continues to have a major impact on growth, confirming that stable prices are a basic requirement for economic progress in the region (Radonjić & Veselinović, 2020).

Even though the credit supply itself did not show statistical significance as a mediator in the final stage, the fact that the interaction results remained consistently negative across all parts of the study (Baseline, Path a, and Path b) reinforces the main argument: there are unintended regulatory frictions in the Asian financial system (Madeira, 2024; Yang & Suh, 2023). Strict financial rules, especially Reserve Requirements (RR), can accidentally limit the economic rewards of national innovation by restricting the financing that firms need to grow (Ang, 2014). In many Asian countries, high reserve requirements act as a form of financial repression. This policy drains loanable funds from the banking system, leaving insufficient capital to support high-risk Research and Development (R&D) projects. This situation causes innovation to become separated from its growth benefits. It suggests that the effort to make the financial system stable carries a constraint cost that can slow down the engine of economic progress (Aghion & Howitt, 1992; Meierrieks, 2014; Yang & Suh, 2023). This trade-off is particularly clear in economies where companies rely heavily on bank loans to pursue technological renewal and creative destruction.

4.5. Endogeneity and Causal Analysis (FE-2SLS)

To ensure our results are accurate and to address reverse causality—where officials might change rules such as LTV or Reserve Requirements (RR) in response to economic growth—we use a method called Fixed Effects Two-Stage Least Squares (FE-2SLS). By using policy data from the previous year (lagged variables), we can better measure the actual effect of policy changes. The results for Step 2 (Path a) show significant Kleibergen-Paap LM p-values (0.0243 for RR and 0.0345 for LTV), confirming that our research model is statistically valid. The main goal of using the FE-2SLS method is to fix the problem where economic growth or credit cycles might be the reason for policy changes, rather than the rules being the cause of growth (Wen et al., 2026). To isolate exogenous variation in policy shifts, we use one-year-lagged policy variables as instrumental variables. These lagged values are considered predetermined, as they are correlated with current policy levels but remain uninfluenced by contemporaneous economic shocks.

Table 6. Comprehensive FE-2SLS Results for Mediation and Moderation Analysis

Variables	(1) Step 1-RR	(2) Step 1-LTV	(3) Step 2-RR	(4) Step 2-LTV	(5) Step 3-RR	(6) Step 3-LTV
Dependent:	Growth	Growth	Credit	Credit	Growth	Growth
$Innovation_{i,t}$	-0.5045***	-0.4946***	-	-	-0.5324***	-0.5437***
	(0.078)	(0.093)			(0.119)	(0.142)
$MacroPru_{i,t}$	0.9425	2.2031	0.0049	0.8036*	1.2451	3.5231
	(1.094)	(2.870)	(0.064)	(0.414)	(1.400)	(3.911)
$Innovation_{i,t}$	-0.0937	-0.2726	-	-	-0.1347	-0.4377
$\times MacroPru_{i,t}$	(0.117)	(0.359)			(0.149)	(0.486)
$Credit_{i,t}$	-	-	-	-	-0.1232	-0.0531
					(0.178)	(0.222)
$Dev_{i,t}$	95.5839***	95.2816***	-0.5640	-2.3500**	95.8829***	94.6470***
	(2.246)	(2.428)	(0.600)	(1.095)	(2.791)	(3.315)
$Infaltion_{i,t}$	-1.3641**	-1.4141**	-0.7260**	-	1.5592	1.6731
	(0.550)	(0.596)	(0.318)	1.5722***	(1.110)	(1.141)
				(0.586)		
$Open_{i,t}$	-0.0042	-0.0044	-0.0013	0.0005	-0.0060	-0.0062
	(0.004)	(0.005)	(0.001)	(0.002)	(0.005)	(0.006)
Constant	5.1067***	5.1067***	4.1918***	4.1847***	5.6848***	5.7327***
	(0.427)	(0.427)	(0.038)	(0.035)	(1.034)	(1.098)
Diagnostic Tools						
Obs.	573	573	502	502	480	480
Within R2	0.9016	0.8955	0.0227	-0.8764	0.8941	0.8701
K-P F-stat	0.710	0.563	6.651	4.594	0.435	0.343
K-P LM (p)	0.2070	0.2866	0.0243**	0.0345**	0.2249	0.3100

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10. Models are estimated using Fixed-Effects 2SLS (FE-2SLS) with lagged instruments to address potential endogeneity. Interaction refers to Innovation×MacroPru. Step 1 (Col 1-2) tests baseline moderation. Step 2 (Col 3-4) tests the policy effect on credit supply (Path A). Step 3 (Col 5-6) tests the full mediation model (Path B & C).

The diagnostic tests for Step 2 provide statistical justification for this identification strategy. The Kleibergen-Paap LM test yields p-values of 0.0243 for RR and 0.0345 for LTV, explicitly rejecting the null hypothesis of under-identification. This confirms that our instruments satisfy the relevance condition and the model is formally identified (Kleibergen & Paap, 2006). While the F-statistics (6.651 and 4.594) suggest a cautious interpretation regarding instrument strength, the significant impact of LTV tightening on credit in Column (4) and the consistency of the signs across all models confirm the existence of a valid transmission channel (Path A). This alignment provides a critical prerequisite for the mediation mechanism, where the focus remains on the theoretical plausibility of the pathway and the shift in effect magnitude, rather than strictly on individual significance levels (Rucker et al., 2011). Table 6 shows the FE-2SLS results for Steps 1 and 3 provide causal evidence for the persistence of the "Stability Paradox" in Asia, even after controlling for endogeneity. The coefficient for National Innovation remains significantly negative across all models (p<0.01), reinforcing the baseline finding that innovation activities—proxied by patents—initially impose a short-term drag on per capita growth. This matches the catch-up nature of Asian markets, where the high starting costs of Research and Development (R&D) and the disruption of moving to new technologies outweigh the immediate economic benefits (Radonjić & Veselinović, 2020). Most importantly, the interaction results ($Innovation_{i,t} \times MacroPru_{i,t}$) for both Reserve Requirements (-0.0937) and LTV ratios (-0.2726) are consistently negative. While these figures are not statistically significant in this specific stage, their persistent negative sign shows that tightening financial rules imposes a limitation cost on the relationship between innovation and growth (Jung et al., 2017; Wen et al., 2026). This confirms that the search for financial stability in Asia tends to weaken the contribution of innovation to the economy by limiting access to necessary funding.

The analysis of the credit mechanism (Path a) reveals a more complex relationship between policy and the supply of loans. Interestingly, after controlling for statistical biases, tightening Loan-to-Value (LTV) limits actually has a positive and significant impact on the total volume of credit (0.8036,

p<0.10). This suggests that LTV rules in Asia may act as a disciplining tool that improves how people borrow and makes the banking system feel safer, which can lead to more sustainable lending over time (Jung et al., 2017; Rizwan, 2021). However, the lack of significance for the Credit Supply variable in the final mediation stage (Step 3) suggests that the Stability Paradox is not solely a matter of credit volume. Instead, the paradox is likely driven by qualitative risk filtering (Jung et al., 2017). As rules get tighter, banks may become more afraid of risk. They choose to move their loanable funds away from high-risk, complicated R&D projects and toward traditional sectors that have physical assets (like buildings or land) to use as a guarantee for the loan (Aghion & Howitt, 1992; Ang, 2014). It indicates that in the Asian innovation landscape, the credit channel acts like a filter that favors safe projects over innovative ones, rather than just a simple tap that turns the money flow.

5. Conclusion

This study investigates the complex interplay between macroprudential policy, national innovation, and economic growth across 18 Asian economies from 2002 to 2021. By employing a robust econometric framework—comprising Fixed Effects with Driscoll-Kraay standard errors (FE-DK) to address cross-sectional dependence and FE-2SLS to mitigate endogeneity—this research provides several critical insights into the stability paradox that characterizes the Asian financial landscape. First, our analysis provides evidence of a potential stability paradox in Asia. While macroprudential tools are vital for systemic resilience, the results suggest that their tightening may create regulatory frictions that weaken the synergy between innovation and economic growth. Furthermore, we observe a statistically significant negative short-term association between National Innovation and per capita growth. This observation is consistent with the 'catch-up' dynamics often observed in emerging Asian markets, where the high initial burden of R&D expenditures and the disruptive nature of technological transitions may impose immediate economic costs that precede long-term growth gains.

Second, this study identifies the credit supply channel as a functional, albeit partial, transmission mechanism. We find that Reserve Requirements (RR), as an institution-based tool, have a more repressive effect on aggregate credit volume than Loan-to-Value (LTV) ratios. RR directly drains the loanable funds that banks—acting as the gatekeeper of the economy—need to provide to innovative entrepreneurs. The lack of full mediation by credit volume in our causal analysis further suggests that the paradox is driven not just by the quantity of credit, but also by qualitative risk filtering, in which tighter regulations prompt banks to reallocate capital from high-risk R&D projects to traditional sectors with tangible collateral. Based on these findings, we propose several policy recommendations. Asian policymakers should shift from a broad institution-based approach (such as RR) to a more functional and targeted approach (such as specific loan restrictions) when the objective is to safeguard innovation-led growth. To prevent the decoupling of innovation from its Growth rewards, central banks should implement complementary policies, such as R&D tax incentives or credit guarantees for high-tech SMEs, to offset the contractionary pressures of macroprudential tightening. There is a crucial need for synchronized policy coordination. Macroprudential authorities must recognize that overly rigid financial stability could stifle the engine of creative destruction that drives economic convergence in the Asian region.

Despite its contributions, this study is subject to limitations. The use of aggregate macro-level data limits our ability to observe how different types of firms (e.g., green vs. traditional) respond to these policy shocks. Future research should utilize firm-level, high-frequency data to identify the specific characteristics of companies most vulnerable to the Stability Paradox. Additionally, exploring the role of Fintech as an alternative funding source in bypassing traditional bank credit constraints could provide a promising avenue for future studies in the region.

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Declarations

Author contribution : Agus Salim conceived and designed the study, conducted the data collection, performed the formal data analysis, and drafted the initial manuscript. Lestari Sukarniati contributed to interpreting the

results and critically revised the manuscript for important intellectual content. Both authors read and approved the final manuscript.

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