

Financial Stability, Impossible Trinity, and Macroprudential Policy

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According to the monetary policy trilemma, countries cannot simultaneously achieve the three goals of exchange rate stability, monetary independence, and capital openness. In this study, we offer empirical evidence on the monetary and financial quadrilemma regarding the trade-off relationship between financial stability and the traditional trilemma variables. Further, we investigate whether macroprudential policy can mitigate this trade-off relationship of four objective variables. Using a data set from 116 countries for the period 2000-2013, we find that macroprudential policy has the potential to relax the traditional trilemma and quadrilemma constraints.

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1. Introduction

What is the relationship between financial stability and the Mundell–Fleming trilemma? For the last few decades, the global economy has witnessed increasing financial integration alongside large international financial flows. Emerging and developing countries as well as advanced economies have continued to liberalize their financial markets but have become increasingly vulnerable to changes in the global financial environment. Consequently, the recent global financial crisis and its aftermath have highlighted the need for financial regulation to prevent systemic risk. In this study, we investigate the link between financial market stability, macroprudential policy, and the open-economy “trilemma” or “impossible trinity.”

According to Mundell (1963) and Fleming (1962), a country may simultaneously accomplish at most two but not all of the three policy goals of exchange rate stability, monetary policy independence, and financial integration. This monetary trilemma has been a standard macroeconomic framework through which academic researchers and policy makers investigate the intertwined nature of the globalized economy. Furthermore, this traditional trilemma has been empirically supported in the international finance literature.

Financial stability is closely related to this traditional trilemma. For example, consider the case of a small open economy trying to maintain financial integration without losing its monetary independence at the cost of exchange rate stability. This may render it more vulnerable to the domestic financial market under large volumes of capital inflows and outflows. Another example is that of a small open economy such as Hong Kong that has to abandon its monetary autonomy in order to maintain a fixed exchange rate

system and perfect capital mobility. In this case, monetary policy cannot stabilize the domestic financial market.

In this vein, the first purpose of this study is to investigate whether the policy objective space of small open economies is constrained by the quadrilemma, implying a trade-off between exchange rate stability, monetary independence, capital openness, and financial stability. In other words, we investigate whether financial stability has a trade-off relationship with the traditional trilemma variables. In particular, following Aizenmen, Chinn, and Ito (2009, 2013), we empirically test the linearity of the quadrilemma and investigate whether the traditional trilemma variables are constrained by the changes in financial stability.

From our findings based on data from 116 countries for the period 2000-2013, the abovementioned four variables are significantly and positively weighted to a constant. In other words, an increase in the relative weight of one of the four variables lowers the weighted sum of the other three. Furthermore, as a robustness check, we sort the countries by degree of openness and income. We find that this quadrilemma holds in open as well as closed economies, and emerging markets and developing countries. However, for advanced economies, we find only the traditional trilemma.

The second purpose of this study is to investigate the link between macroprudential policy and the quadrilemma constraint. The global financial crisis in the late 2000s highlighted the need to maintain financial stability and prevent a systemic banking crisis. The role of macroprudential policies has been investigated as an alternative of the traditional macroeconomic policy to stabilize the financial market and hence prevent systemic banking crises. However, existing studies focus only on the effectiveness of macroprudential policies on financial stability, such as by examining credit growth and housing inflation.

This study examines the effect of macroprudential policy from the perspective of four policy goals. Macroprudential policy can affect the traditional trilemma and quadrilemma through two channels. The first channel is intervention on the link between residents and non-residents. The uncovered interest rate parity implies that, given the interest rate of a base country, an increase in the domestic interest rate induces capital inflows, and vice versa, since there is no arbitrage condition. Hence, under full capital mobility, an independent domestic monetary policy induces volatile exchange rate movements.

However, Steiner (2015) asserts that interest rate may not be the only instrument a central bank uses to pursue two goals: stabilization of exchange rate and independent monetary policy. Foreign exchange market intervention with voluminous foreign reserves can be one reason keeping the interest rate parity from holding. Obstfeld, Shambaugh, and Taylor (2010) find that financially open countries with pegged or quasi-pegged exchange rates tend to hold more reserves in order to manage their financial stability as well as exchange rates with increasing financial openness.

Another option is macroprudential policy. The monetary authority often raises the interest rate when the economy is overheated, which entices abrupt capital inflows into the domestic credit market. In this case, countercyclical regulation can enhance the resilience of the financial system and insulate the domestic economy from overborrowing and sudden stops. For example, when domestic banks seem to take too much risk, the central bank can increase the interest rate and cool down the credit boom. However, the increase in the domestic interest rate could lure international creditors to invest in the domestic economy. In this case, macroprudential regulation can be coordinated with monetary policy to impose prudent requirements on financial institutions. If macroprudential

regulation to lower financial volatility can mitigate capital inflows and outflows, it would allow for independent monetary policy to actively respond to domestic credit booms and busts.

Even when the interest rate hardly moves, a low short-term interest rate may render riskless assets less attractive. Following the global recession, advanced economies kept their interest rates at the lowest level, but housing prices steadily increased. Macroprudential policy can be considered to play an alternative role to that of traditional monetary policy even when the economy falls into the effective lower bound. For example, Zhang and Zoli (2016) find that advanced East Asian economies such as Hong Kong and Singapore have relied more heavily on macroprudential policies since the recent financial recession.

This study sheds new light on the link between macroprudential policy and the quadrilemma. In particular, following Steiner (2015), we adopt a two-step approach to examine whether macroprudential policy can relax the estimated trilemma and quadrilemma. We first construct the realized weighted sum of the trilemma and quadrilemma around a constant and then investigate whether the deviations in the estimated weighted sum of the trilemma and quadrilemma variables in each period can be explained by macroprudential policy.

We find that macroprudential policies are associated with the trilemma and quadrilemma in the short run. In other words, macroprudential policies are more active when the weighted sums of the trilemma and quadrilemma variables are larger. Sorting countries by income and openness, we find that macroprudential policy is very effective in emerging markets, advanced economies, and open economies. Furthermore, if we divide macroprudential policy into sub-categories, we find that financial institutions-based macroprudential policy is more effective than borrowers-lenders-based measures.

The contribution of this study is twofold. First, this study contributes

to the literature on the traditional monetary trilemma providing another trade-off relationship with financial stability and suggesting a new tool to relax the trade-off between policy goals. Aizenman, Chinn, and Ito (2013) test the linearity of the trilemma to find that a rise in one of the three trilemma variables should be traded-off with a drop in the weighted sum of the remaining two. Ito and Kawai (2014) apply the seemingly unrelated regression estimation method and show how trilemma policy combinations are related to economic fundamentals. Obstfeld, Shambaugh, and Taylor (2005) investigate the coherence of international interest rates over more than 130 years. Bleaney, Lee, and Lloyd (2013) find that credibly pegging countries without capital controls closely follow foreign interest rates. Our work suggests that policy makers have another goal, financial stability, and this has a trade-off relationship with the existing trilemma goals. Our work is related to that of Steiner (2015), which shows that foreign exchange interventions provide an effective instrument to relax the trilemma. Our results suggest that macroprudential policy plays a more important role than foreign exchange intervention in relaxing the trilemma and the quadrilemma.

We also contribute to the literature on macroprudential policy suggesting that this macroeconomic policy in the financial sector can play an additional role in pursuing other policy goals. Existing studies focus on the effectiveness of macroprudential policy in stabilizing the financial market. Lee, Asuncion, and Kim (2015) find that macroprudential policies promote financial stability in Asia. Using a new index of the macroprudential policies of 57 advanced and emerging economies constructed for the 2000–2013 period, Akinci and Olmstead-Rumsey (2015) find that macroprudential tightening is negatively associated with bank credit growth, housing credit growth, and housing inflation. Using data from 13 Asian countries and 33 economies for the 2000–2013 period, Zhang and Zoli (2016) find that housing-related measures are associated with reductions in the credit

growth rate in Asia. Using the macroprudential instruments of 119 countries for the period 2000–2013, Cerutti, Claessens, and Laeven (2017) find that macroprudential policies reduced the credit growth rate. Tillmann (2015) finds that lowering the maximum loan-to-value (LTV) ratios could dampen the credit growth and reduce the appreciation of house prices in Korea. Using Norwegian data, Akram (2014) finds that the increases in capital requirements under Basel III have significant effects, especially on house prices and credit. Using bank-level capital inflows data from Turkey, Baskaya, Giovanni, Kalemli-Ozcan, Peydro, and Ulu (2017) find that larger and more capitalized banks with higher non-core liabilities increase their credit supply when capital inflows are higher. None of these works examine the role of macroprudential policy mitigating the traditional monetary trilemma and quadrilemma captured in this study.

The remainder of the paper is organized as follows. Section 2 briefly explains the data. Section 3 describes our empirical methodology. Section 4 presents our main results. Section 5 concludes the paper.

2. Data

Our data comprise the annual observations of 116 countries during the period 2000–2013.¹⁾ Tables 1 and 2 provide our groupings of these countries. We classify the countries into three groups by income following Cerutti, Claessens, and Laeven (2017). Accordingly, 30, 62, and 24 countries are classified as advanced, emerging, and developing economies, respectively. Furthermore, we classify the countries into two groups by the degree of de facto capital account openness and obtain 48 open economies and 67 closed economies.

1) The data covers the period when the macroprudential policy measures are widely used across a spread of countries but has a limitation not covering the recent periods.

(Table 1) Country subgroup classifications based on the income group (IMF WEO April 2014): advanced economies, emerging markets, and developing economies. Advanced economies include the Group of Seven (G7)—the United States, Japan, Germany, France, Italy, the United Kingdom, and Canada. The members of the euro area are also distinguished as a subgroup of advanced economies. The group of emerging market and developing economies includes all those that are not classified as advanced economies.

Advanced	Emerging		Developing
Australia	Albania	Kazakhstan	Bangladesh
Austria	Algeria	Kuwait	Bhutan
Belgium	Angola	Lebanon	Burundi
Canada	Argentina	Lithuania	Cambodia
Cyprus	Armenia	Macedonia, FYR	Congo, Dem. Rep.
Czech Republic	Azerbaijan	Malaysia	Ethiopia
Estonia	Bahamas, The	Mauritius	Gambia, The
Finland	Bahrain	Mexico	Ghana
France	Belarus	Montenegro	Haiti
Germany	Belize	Morocco	Honduras
Hong Kong, China	Bosnia and Herzegovina	Pakistan	Kenya
Iceland	Botswana	Paraguay	Kyrgyz Republic
Ireland	Brazil	Peru	Lao PDR
Israel	Brunei	Philippines	Lesotho
Italy	Bulgaria	Poland	Malawi
Japan	Cape Verde	Romania	Moldova
Korea, Rep.	Chile	Russian Federation	Mongolia
Latvia	China	Saudi Arabia	Mozambique
Malta	Colombia	Serbia, Rep. of	Nepal
Netherlands	Costa Rica	South Africa	Solomon Islands
New Zealand	Croatia	Sri Lanka	Sudan
Norway	Dominican Republic	St. Kitts and Nevis	Tajikistan
Portugal	Ecuador	Thailand	Uganda
Singapore	El Salvador	Timor-Leste	Zambia
Slovak Republic	Fiji	Tonga	24 countries
Slovenia	Georgia	Trinidad and Tobago	
Spain	Guyana	Tunisia	
Sweden	Hungary	Turkey	
Switzerland	India	Ukraine	
United Kingdom	Indonesia	United Arab Emirates	
30 countries	Jamaica Jordan	62 countries	

〈Table 2〉 Country subgroup classifications based on the de facto financial openness.

Open economics		Closed economics		Not classified
Australia	Norway	Albania	Korea, Rep.	Bahamas, The
Austria	Paraguay	Algeria	Kyrgyz Republic	1 country
Bahrain	Portugal	Angola	Lao PDR	
Belgium	Saudi Arabia	Argentina	Lesotho	
Belize	Singapore	Armenia	Lithuania	
Brunei	Slovak Republic	Azerbaijan	Macedonia, FYR	
Bulgaria	Slovenia	Bangladesh	Malawi	
Canada	Spain	Belarus	Mexico	
Cape Verde	St. Kitts and Nevis	Bhutan	Moldova	
Chile	Sweden	Bosnia and Herzegovina	Mongolia	
Cyprus	Switzerland	Botswana	Morocco	
Estonia	Trinidad and Tobago	Brazil	Mozambique	
Finland	United Arab Emirates	Burundi	Nepal	
France	United Kingdom	Cambodia	Pakistan	
Germany	48 countries	China	Peru	
Guyana		Colombia	Philippines	
Hong Kong, China		Congo, Dem. Rep.	Poland	
Hungary		Costa Rica	Romania	
Iceland		Croatia	Russian Federation	
Ireland		Czech Republic	Serbia, Rep. of	
Israel		Dominican Republic	Solomon Islands	
Italy		Ecuador	South Africa	
Jamaica		El Salvador	Sri Lanka	
Japan		Ethiopia	Sudan	
Jordan		Fiji	Tajikistan	
Kuwait		Gambia, The	Thailand	
Latvia		Georgia	Timor-Leste	
Lebanon		Ghana	Tonga	
Malaysia		Haiti	Tunisia	
Malta		Honduras	Turkey	
Mauritius		India	Uganda	
Montenegro		Indonesia	Ukraine	
Netherlands		Kazakhstan	Zambia	
New Zealand		Kenya	67 countries	

Note: Financial openness is calculated based on the dataset constructed by Lane and MilesiFerretti (2007).

Trilemma indexes are taken from Aizenman, Chinn, and Ito (2013). As a monetary independence measure, the reciprocal of the interest correlation between the home and base countries is calculated:

$$MI = 1 - \frac{\text{corr}(R_i, R_j)}{2},$$

where R , i , and j are interest rates, home countries, and the base countries, respectively. The exchange rate stability index is calculated based on the inverse of the standard deviation of bilateral monthly exchange rates as follows:

$$ERS = \frac{0.01}{0.01 + \text{stdev}(\Delta(\log(\text{exchangerate}))}).$$

Capital mobility is based on the IMF de jure openness of capital accounts data. All these indexes are normalized between zero and one. Higher values indicate higher monetary policy independence, more stable exchange rate, and more open cross-border capital transactions, and vice versa.

To measure financial stability, we construct an index for financial stability, defined as

$$FS = \frac{0.01}{0.01 + \text{dev}(cr)}, \quad (1)$$

where FS and $\text{dev}(cr)$ denote the financial stability index and the absolute value of the credit growth deviation from its average value, respectively. Hence, if the credit growth during a certain period equals its average value, the financial stability index becomes one. However, if the deviation is large, the financial stability index will be lowered. As an alternative measure of financial stability, we use credit-to-GDP gaps.

We briefly examine our quadrilemma index moves in each country group; this combines the monetary trilemma and financial stability indexes. Fig.1 displays the changing patterns of our quadrilemma indexes. For the full sample, Panel (A) shows that each index hovers around a certain value. The capital openness index in dotted lines shows an increasing pattern until 2008, after which it slightly

decreases. The exchange rate stability index in dashed lines stays around the value 0.6, but then decreases following the global financial crisis. The monetary independence index in dash-dotted lines falls to 0.32 in 2002, and then gradually increases to around 0.47, to thereafter fall again. The financial stability index in dark lines fluctuates around the value 0.2.

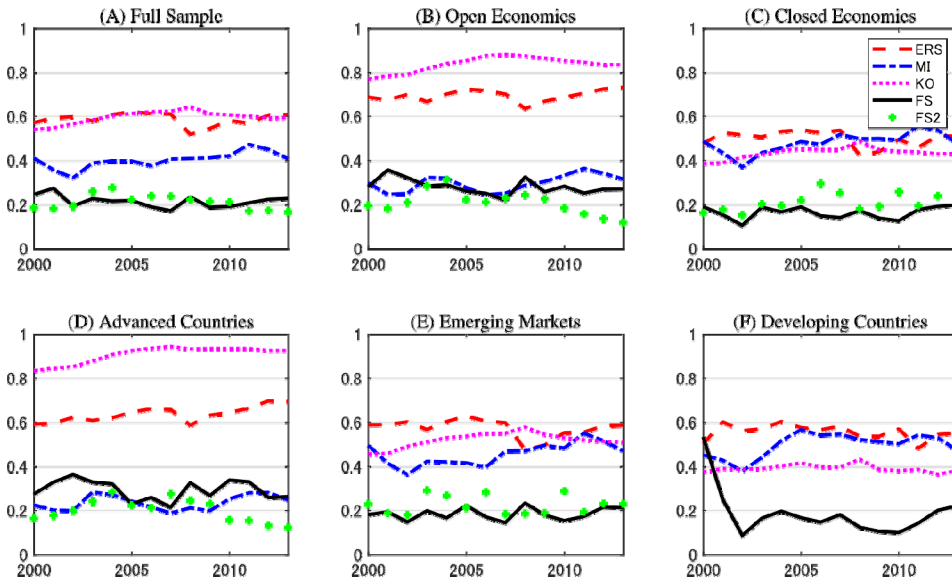
Panels (B) and (C) present the subgroup data of open and closed economies, respectively. Open economies show high levels of capital openness and exchange rate stability by definition, whereas closed economies show a low degree of capital openness. However, the latter group has higher monetary independence than that of open economies. This group also has lower financial and exchange rate stability.

Panel (D) shows that advanced economies have the highest capital openness and exchange rate stability but the lowest monetary independence. This might reflect the Euro zone's importance in this group. Of the three income subgroups, advanced economies show the highest financial stability. For the emerging economies, Panel (F) shows the trilemma indexes moving between 0.4 and 0.6, financial stability hovering around 0.2, indicating no specific increasing or decreasing trend. As regarding developing countries in Panel (F), we find higher monetary independence and lower capital openness compared to the emerging economies.²⁾ The three subgroups show very low financial stability except for during the initial period, which is because a few high-value data are present in this period.

2) Credit-to-GDP gap data is unavailable for developing countries.

(Figure 1)

Quadrilemma Indexes.



Notes: *ERS*, *MI*, *KO*, *FS*, and *FS2* denote exchange rate stability, monetary independence, capital openness, financial stability, and an alternative measure of financial stability, respectively. All these indexes are normalized between zero and one. Higher values indicate higher monetary policy independence, more stable exchange rate, more open cross-border capital transactions, and more stable financial markets, and vice versa.

The macroprudential indexes we use here are taken from Cerutti, Claessens, and Laeven (2017). A variety of macroprudential policy tools exist, such as borrower- and financial institution-based measures.³⁾ The quantitative restrictions on borrowers and lenders include the caps on loan-to-value (LTV) and debt-to-income (DTI) ratios. This reflects collateral constraints in the theoretical models such as Kiyotaki and Moore (1997). Financial institution-based policies include the limits on leverage and dynamic provisioning, general countercyclical capital buffer, capital surcharges on systemically important financial institutions (SIFI), limits on interbank exposures, concentration, foreign currency loans, domestic currency loans, reserve requirement ratios, and tax on financial institutions.⁴⁾

3) For an overview of macroprudential policy, see Engel (2016) and Tomuleasa (2015).

4) For details on the usage and choices of macroprudential policy instruments, see Cerutti,

Lim, Columba, Costa, Kongsamut, Otani, Saiyid, Wezel, and Wu (2011) explain that the choice and usage of instruments of macroprudential policy considerably depend on the countries' characteristics. For example, the stage of economic and financial development is one of the important determinants of usage. Emerging markets and developing economies have applied macroprudential policies more broadly than advanced economies. Moreover, countries with fixed or managed exchange rates are more inclined to adopt macroprudential policy.

For credit data, we use the Bank for International Settlements (BIS)-adjusted domestic bank credit to private non-financial sector if available, and otherwise, the International Monetary Fund International Financial Statistics (IMF IFS), that is, the depository corporations' domestic claims on the private sector. Credit data are deflated by the IMF IFS consumer price index (CPI). The credit-to-GDP gap data is also taken from BIS.

We use the currency and banking crisis data taken from Reinhart and Rogoff (2009). For comparison, we use the systemic banking crises data taken from Laeven and Valencia (2013). The real GDP growth rates and CPI data are taken from World Bank World Development Indicators (WB WDI) and IMF IFS, respectively. As a measure of governance, the Worldwide Governance Indicator (WGI) are taken from the World Bank.⁵⁾The trade openness index measured as the sum of a country's exports and imports as a share of that country's GDP is obtained from Our World in Data. To consider the impact of fiscal health and financial development, we employ the government debt-to-GDP ratio and the Financial Development Index collected from the IMF.

Claessens, and Laeven (2017).

5) We take an average of six indexes: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption.

3. Estimation Methodology

This section presents our estimation methodology. The empirical model is based on Aizenman, Chinn, and Ito (2009, 2013) and Steiner (2015).

3.1 Linearity of the quadrilemma index variables

Exchange rate stability, monetary policy independence, and capital mobility are three traditional trilemma variables. To test whether these three macroeconomic policy goals are binding in the context of the monetary trilemma, Aizenman, Chinn, and Ito (2009, 2013) conceptualize the linear hypothesis of the trilemma by placing a simplex on a plane in a third-dimensional domain constructed by the three indexes, meaning the weighted sum of the three policy variables adds up to a constant. We include financial stability as another policy objective variable to the estimation equation. Following Aizenman, Chinn, and Ito (2009, 2013), we regress the constraint of one of these four objective variables to investigate the quadrilemma constraint. More specifically, we estimate the augmented quadrilemma equation as

$$1 = \beta_1 ERS + \beta_2 MI_{it} + \beta_3 KO_{it} + \beta_4 FS_{it} + e_{it} \quad (2)$$

where *ERS*, *MI*, *KO*, and *FS* stand for exchange rate stability, monetary independence, capital openness, and financial stability, respectively. Aizenman, Chinn, and Ito (2013) find the estimated coefficients of the first three variables to be significantly positive; this implies that a trade-off exists between the three variables. In other words, if one of the coefficients is not significant or significantly negative, the trilemma does not exist.

The main difference between our approach and that taken in the

literature is that we include financial stability in the equation. We therefore check whether the estimated coefficient of financial stability as well as the traditional trilemma variables are significantly positive.

3.2 Two-step regression

Next, if the first step of the estimation indicates the existence of a quadrilemma, we estimate how it is affected by macroprudential policy. To this end, we investigate what determines the short-run trilemma and the quadrilemma index deviations estimated in equation (2).⁶⁾ In particular, we examine whether the deviations of the fitted trilemma and quadrilemma variables from its expected value can be explained by the macroprudential policy variables.

Following Steiner (2015), we regress the fitted the trilemma and quadrilemma index values as

$$\hat{Y} = \delta Y + \theta MPP + \mu_i + u, \quad (3)$$

where \hat{Y} captures our dependent variable, the predicted value of the aggregated trilemma or quadrilemma obtained at the first-step regression. X , MPP , and μ_i denote a vector of control variables, the aggregate index of macroprudential policy, and a country fixed effect to capture any non-time varying country specific conditions, respectively.

X includes the dummy variables for banking and currency crises, real GDP per capita, the foreign reserve-to-GDP ratio, governance, trade openness, the government debt-to-GDP ratio, and financial development.⁷⁾ When a country faces a currency crisis, the trilemma

⁶⁾ Another way to estimate the effect of the macroprudential policy involves including the policy tool measure in equation (2). This estimation method is simple and clear, but we proceed with the two-step regression method because it allows us to control for the fixed effect and easily distinguish policy tool variables from the policy-goal variables.

⁷⁾ We are grateful for the anonymous referee for referring to many important candidate variables.

or quadrilemma goals become harder to achieve than in normal times. In a financially globalized economy, banking crises can affect the trilemma throughout the financial market. Hence, we include the systemic banking crisis dummy. We expect these two crises to have a negative impact on \hat{Y} . As another possible determinant, we include the real GDP per capita as a measure of economic development, as discussed by Steiner (2015). We include the foreign reserve divided by GDP because the foreign reserves are often emphasized as a hidden policy tool in studies such as those by Obstfeld, Shambaugh, and Taylor (2010), Aizenman, Chinn, and Ito (2013), and Mendoza (2010). We include government-related variables such as governance and government debt-toGDP ratio. Trade openness and financial development are likely to have a positive impact like the real GDP per capita.

2. Main results

4.1 Existence of the quadrilemma

Financial stability requirements constrain the weighted sum of the monetary trilemma variables. A country trying to stabilize the domestic financial market would further tighten the traditional trilemma constraint. Additionally, a country putting more weight on one of the traditional trilemma objectives would raise the cost of financial stability as well as the remaining two trilemma variables. In this subsection, we present our benchmark results for the quadrilemma. For comparison, we also display the results of the traditional trilemma specification without financial stability.

Table 3 reports the estimation results of equation (2). Table 3 Column 1 shows that the estimated coefficients of the trilemma variables are significantly positive for all countries in our sample.

Thus, the trilemma constraint is binding as in Aizenman, Chinn, and Ito (2013). Further, in Column 2, when we include the financial stability index, its coefficient becomes significantly positive. Thus, we can conclude that a trade-off exists between the four objective variables, indicating a quadrilemma.

If we divide the full sample into three subgroups by income level, as in Columns 3-8, we would find the trilemma constraint binding in all cases. If we include our financial stability measure, we find that the coefficients of all four policy-goal variables are significantly positive in the emerging markets and the developing economies, strongly indicating that the quadrilemma holds for these groups. However, for the advanced economies, the coefficient of financial stability shows no statistically significant association with the quadrilemma. One possible reason is that the domestic financial market in the emerging markets and the developing markets is immature with a low level of financial stability, whereas the advanced economies maintain relatively stable financial markets.

Next, differentiating by capital account openness level, as shown in Columns 9-12, we find strong evidence of the quadrilemma in both open and closed economies. We find that financial stability constrains the traditional trilemma more severely in closed than open economies. The coefficient of financial stability in closed economies is more than twice as large as that in open economies. Our conjecture is that as in the advanced economy case, open economies have accomplished a higher degree of financial development compared to the closed economies.

The inclusion of financial stability in regressions increases in their goodness of fit. Thus, equation (2) can model the quadrilemma including financial stability.

(Table 3) Estimation results of the trilemma and quadrilemma.

	Full sample		Developing countries		Emerging markets		Advanced countries		Open economies		Closed economies	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ERS	0.544*** (35.89)	0.537*** (29.72)	0.610*** (16.23)	0.604*** (14.18)	0.474*** (19.94)	0.483*** (15.37)	0.359*** (12.46)	0.220*** (7.549)	0.439*** (25.29)	0.402*** (21.02)	0.570*** (22.14)	0.593*** (18.96)
MI	0.948*** (50.20)	0.926*** (45.29)	0.940*** (16.59)	0.808*** (12.83)	1.100*** (34.51)	1.085*** (29.28)	0.652*** (18.03)	0.526*** (14.26)	0.675*** (26.90)	0.648*** (23.39)	1.051*** (31.57)	0.943*** (25.16)
KO	0.415*** (30.08)	0.382*** (23.17)	0.341*** (8.501)	0.348*** (8.123)	0.337*** (14.40)	0.292*** (9.914)	0.652*** (24.68)	0.772*** (26.76)	0.562*** (34.34)	0.564*** (29.76)	0.341*** (13.88)	0.333*** (11.86)
FS		0.247*** (7.316)		0.335*** (3.941)		0.313*** (5.494)		-0.00105 (-0.0296)		0.144*** (4.434)		0.397*** (7.041)
Observations	1,483	1,066	305	224	758	510	420	332	627	458	842	608
Countries	108	85	23	19	55	42	30	24	45	35	62	50
R ² adjusted	0.947	0.953	0.941	0.946	0.941	0.947	0.974	0.982	0.971	0.976	0.936	0.945

Notes: *ERS*, *MI*, *KO*, and *FS* denote exchange rate stability, monetary policy independence, capital openness, and financial stability, respectively. All these indexes are normalized between zero and one. *t*-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

(Table 4) Estimation results of the quadrilemma with BIS credit gap data.

	Full sample	Emerging markets	Advanced countries	Open economies	Closed economies
	(1)	(3)	(5)	(7)	(9)
ERS	0.469*** (17.10)	0.558*** (10.51)	0.105*** (4.054)	0.247*** (10.78)	0.711*** (10.80)
MI	0.928*** (30.87)	0.994*** (16.03)	0.307*** (8.459)	0.468*** (14.65)	0.920*** (13.04)
KO	0.486*** (20.76)	0.453*** (8.096)	0.879*** (35.69)	0.743*** (35.01)	0.511*** (8.424)
FS	0.229*** (5.390)	0.264*** (3.311)	0.0513 (1.581)	0.104*** (3.075)	0.274*** (3.253)
Observations	518	200	318	346	172
Countries	39	16	23	25	14
R ² adjusted	0.960	0.943	0.987	0.984	0.949

Notes: *ERS*, *MI*, *KO*, and *FS2* denote exchange rate stability, monetary policy independence, capital openness, and alternative measure of financial stability, respectively. *FS2* is established using BIS credit-to-GDP gap data. All these indexes are normalized between zero and one. *t*-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

As an alternative measure of financial stability, we use the BIS credit-to-GDP gap data. Table 4 reports the results and we still find the quadrilemma in all cases except that of advanced economies. We have a limited number of countries compared to the main estimation, when we use the BIS credit-to-GDP gap data. Therefore, we proceed with our analysis using the financial stability index measured by credit growth deviations.

4.2 Mitigation effect of macroprudential policy

Several types of channels exist through which macroprudential policy may interact with the quadrilemma variables. If macroprudential policy offers more room to the monetary authority, the domestic monetary policy can become more independent of the base country policy. For example, assuming that the domestic economy is heated and the monetary authority wants to cool down the economy, the traditional contractionary monetary policy would use the interest rate channel. If the economy is growing through overborrowing, contractionary macroprudential policy can present another option. Macroprudential regulation coupled with a strong monetary policy can limit the excessive borrowing from non-residents even in the event of free capital mobility. Here, macroprudential policy plays a supplementary role to lessen the monetary trilemma constraint.

Furthermore, macroprudential policy can ease several problems emerging markets face. These markets often overborrow from international creditors, which is sometimes associated with sudden stops and accompanying currency crises. Furthermore, the recent currency crises, including that of the East Asian region in the late 1990s, have often interacted with the banking and financial system.⁸⁾ Korinek (2011) points out that capital controls should protect inflows

8) See Chang and Velasco (2000), for example.

from the distortions arising from overborrowing. Engel (2016) insists that capital flows should target assets that contribute more to systemic risk.⁹⁾

Tables 5 and 6 present the two-step regression results of equation (3) for the trilemma and quadrilemma, respectively. For the full sample, Column 1 presents the bivariate regression results of the fitted sums of the trilemma and the quadrilemma on the macroprudential policy measures. In both cases, we find that macroprudential policy has a significantly positive effect on the fitted variables of the trilemma and the quadrilemma. In other words, the macroprudential policy a country adopts to stabilize the domestic financial market has a positive spillover effect on relaxing the quadrilemma as well as trilemma constraints.

In Column 2, we control for other possible variables. Following Steiner (2015) and Obstfeld, Shambaugh, and Taylor (2010), we include the foreign reserve-to-GDP ratio as another promising tool to relax the trilemma and quadrilemma constraints as well as some control variables. We find that the foreign reserve-to-GDP ratio significantly relaxes the weighted sum of two constraints. However, if we compare the magnitude of the estimated coefficients of these two macroeconomic policy tools, the macroprudential policy appears to play a considerably more important role in relaxing the constraints. Different from Steiner (2015), which finds that the currency crisis has a significantly detrimental effect, we find that systemic banking crisis has a more tightening effect on the constraints. We also find that trade openness has a significant but minor effect in relaxing the weighted sum of the trilemma and quadrilemma variables.

9) *KO* is based on the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*, which includes multiple exchange rates, restrictions on current account transactions, on capital account transactions, and the requirement of the surrender of export proceeds. The *MPP* also includes two capital-control related indices: limits on foreign currency loans in order to reduce vulnerability to foreigncurrency risks, and FX and/or countercyclical reserve requirements.

We divide the full sample into three subgroups by income level, as in Columns 3-8, and by capital account openness level in Columns 9 and 10, respectively. For income subgroups, we find that macroprudential policy plays a very important role in relaxing the trilemma and the quadrilemma constraints in many cases. There are some exceptions: compared to the other income groups, macroprudential policy seems to play a limited role in developing countries. In particular, we find that the coefficient of macroprudential policy index is insignificant both in

<Table 5> Estimation results of the trilemma on macroprudential policy.

	Full sample		Developing countries		Emerging markets		Advanced countries		Open economies		Closed economies	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Macroprudential policy	0.0876*** (6.431)	0.0536** (2.299)	0.0536 (1.473)	0.164* (1.896)	0.0870*** (4.283)	0.0496 (1.267)	0.120*** (6.624)	0.0640*** (2.627)	0.0966*** (6.295)	0.0838*** (2.956)	0.0882*** (4.218)	0.0261 (0.762)
Banking crisis, dummy		-0.0553** (-2.312)				-0.0663 (-1.285)		-0.0423** (-2.378)		-0.0486** (-2.188)		-0.101* (-1.863)
Currency crisis, dummy		-0.0829 (-1.537)		-0.0596 (-0.567)		-0.00951 (-0.105)		-0.239*** (-2.809)		-0.0717 (-0.898)		-0.0623 (-0.849)
Real GDP per capita		1.74e-06 (0.917)		-0.000522*** (-3.029)		2.38e-06 (0.413)		2.08e-06* (1.730)		5.45e-07 (0.371)		1.22e-05 (1.389)
Foreign reserve-GDP ratio		0.00310*** (3.218)		0.000989 (0.230)		0.000353 (0.188)		0.00221*** (3.008)		0.000727 (0.801)		0.00294* (1.650)
Governance		-0.0157 (-0.256)		0.0735 (0.411)		-0.124 (-1.302)		0.201*** (2.817)		0.0354 (0.426)		-0.0913 (-1.059)
Trade openness		0.000943* (1.892)		0.00298* (1.798)		-2.67e-05 (-0.0262)		0.000433 (1.083)		0.00114** (2.420)		0.000856 (0.943)
Government debt-GDP ratio		-0.000732 (-1.552)		-0.000408 (-0.402)		-0.00370*** (-3.719)		0.000714 (1.373)		-0.000101 (-0.168)		-0.00169** (-2.507)
Financial development		-0.123 (-0.777)		2.593* (1.827)		-0.0144 (-0.0526)		-0.110 (-0.816)		-0.0648 (-0.418)		-0.158 (-0.510)
Constant	0.906*** (118.3)	0.851*** (11.67)	0.915*** (43.16)	0.685*** (2.795)	0.897*** (73.92)	1.025*** (9.566)	0.927*** (106.3)	0.611*** (5.490)	0.928*** (114.6)	0.799*** (6.552)	0.893*** (73.29)	0.855*** (8.811)
Observations	1,483	795	305	104	758	402	420	289	627	357	842	438
Countries	108	80	23	13	55	40	30	27	45	34	62	46
R ² adjusted	-0.047	-0.063	-0.074	-0.060	-0.051	-0.055	0.032	0.048	-0.009	-0.054	-0.055	-0.063

Notes: The second-step results of the two-step regression are presented. The results of the first step are shown in Table 3. Dependent variables in the second step are the predicted values of the aggregated trilemma obtained at the first-step regression. Macroprudential policy, our first independent variable, stands for the aggregate index of macroprudential policy. *t*-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

(Table 6) Estimation results of the quadrilemma on macroprudential policy.

	Full sample		Developing countries		Emerging markets		Advanced countries		Open economies		Closed economies	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Macroprudential policy	0.0943*** (6.031)	0.0946*** (3.834)	0.00241 (0.0620)	0.122 (1.444)	0.114*** (4.797)	0.0956** (2.276)	0.0926*** (6.386)	0.0727*** (3.297)	0.0957*** (5.905)	0.125*** (4.195)	0.0768*** (3.302)	0.0614* (1.703)
Banking crisis, dummy		-0.0467* (-1.930)				-0.0526 (-1.009)		-0.0264* (-1.673)		-0.0340 (-1.520)		-0.0824 (-1.489)
Currency crisis, dummy		-0.0661 (-1.150)		-0.125 (-1.349)		-0.00485 (-0.0445)		-0.253*** (-3.637)		-0.0486 (-0.655)		-0.0960 (-1.198)
Real GDP per capita		-1.24e-06 (-0.670)		-0.000429*** (-2.742)		-5.66e-06 (-0.945)		1.66e-06* (1.675)		-9.19e-07 (-0.658)		1.57e-05* (1.684)
Foreign reserve-GDP ratio		0.00251** (2.328)		0.00225 (0.587)		-0.00148 (-0.636)		0.00129* (1.838)		0.00125 (1.240)		0.000979 (0.488)
Governance		-0.0458 (-0.709)		-0.124 (-0.685)		-0.164 (-1.541)		0.210*** (3.383)		0.125 (1.450)		-0.223** (-2.450)
Trade openness		0.00165*** (3.108)		0.00195 (1.307)		0.00154 (1.231)		0.000526 (1.481)		0.00136*** (2.775)		0.00174* (1.759)
Government debt-GDP ratio		0.000340 (0.669)		-0.000335 (-0.370)		-0.00319** (-2.235)		0.000179 (0.416)		-6.32e-05 (-0.102)		-0.000243 (-0.323)
Financial development		-0.230 (-1.406)		1.581 (1.205)		0.182 (0.595)		-0.161 (-1.427)		-0.329** (-2.118)		-0.0700 (-0.214)
Constant	0.907*** (101.3)	0.842*** (10.18)	0.946*** (38.20)	0.696*** (2.859)	0.886*** (60.22)	0.875*** (6.657)	0.948*** (141.3)	0.652*** (6.223)	0.935*** (111.8)	0.860*** (6.112)	0.904*** (63.23)	0.690*** (6.397)
Observations	1,066	631	224	98	510	285	332	248	458	286	608	345
Countries	85	66	19	13	42	30	24	23	35	28	50	38
R ² adjusted	-0.048	-0.053	-0.093	-0.074	-0.039	-0.074	0.048	0.094	-0.000	0.004	-0.069	-0.069

Notes: The second-step results of the two-step regression are presented. The results of the first step are shown in Table 3. Dependent variables in the second step are the predicted values of the aggregated quadrilemma obtained at the first-step regression. Macroprudential policy, our first independent variable, stands for the aggregate index of macroprudential policy. Dependent variables are the predicted values of the aggregated quadrilemma obtained at the first-step regression. t-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

the bivariate and multivariate regressions for the quadrilemma case. We also find that macroprudential policy becomes more effective in open economies than in closed economies in achieving the mixed policy goals.

Akinci and Olmstead-Rumsey (2015) find that borrower-based measures are more effective in reducing credit growth in advanced economies, whereas capital inflow restrictions on the banking sector are associated with reductions in credit growth. Cerutti, Claessens, and Laeven (2017) show that emerging markets use macroprudential

policies more frequently, whereas advanced economies tend to use borrower-based policies. Hence, we investigate whether borrower- and financial institution-based measures differ in mitigating the quadrilemma.

Tables 7 and 8 present the results obtained for the borrower- and financial institution-based macroprudential policy measures, respectively. For the full sample, if we compare Columns 1 and 7, each macroprudential policy measure has a different effect. Financial institution-based measures are positively related to the fitted values of the trilemma and the quadrilemma index values at the one percent significance level. However, the borrower-based measure is insignificant in relaxing the trilemma constraint and significant at the ten percent level.

Regarding the subgroups, borrower-based macroprudential policies are mostly effective in open economies. However, the estimated coefficients are insignificant in many other cases. In contrast, in most cases, financial institution-based macroprudential policies are very efficient in relaxing the trilemma and the quadrilemma constraints. In line with the results in Tables 4 and 5, both borrower-based and financial institution-based macroprudential policies have a limited effect in developing countries. This implies that the effectiveness of macroprudential policy may depend on which macroprudential measure policymakers use. As apparent from Tables 7 and 8, the macroprudential policy measure play a different role in different country groups.

Overall, we find that the financial institution-based macroprudential policy is more effective than borrower-based macroprudential policy in stabilizing credit growth volatility, and hence relaxing the weighted sum of the trilemma and quadrilemma variables.

(Table 7) Estimation results of Borrower and Financial institution-based macroprudential policy on the trilemma.

	BORROWER						FINANCIAL INSTITUTION					
	All	Developing Countries	Emerging Markets	Advanced Countries	Open Economies	Closed Economies	All	Developing Countries	Emerging Markets	Advanced Countries	Open Economies	Closed Economies
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Borrower	0.0343 (1.181)	-0.0744 (-0.604)	-0.0150 (-0.315)	0.0499* (1.778)	0.112*** (3.680)	-0.0386 (-0.825)						
Financial institution							0.0754*** (2.994)	0.164* (1.896)	0.0998** (2.451)	0.0777*** (2.670)	0.0941*** (2.699)	0.0658* (1.887)
Banking crisis, dummy	-0.0494** (-2.071)		-0.0675 (-1.305)	-0.0353** (-2.008)	-0.0419* (-1.943)	-0.106* (-1.950)	-0.0580** (-2.427)		-0.0701 (-1.367)	-0.0410** (-2.319)	-0.0480** (-2.150)	-0.100* (-1.860)
Currency crisis, dummy	-0.0856 (-1.582)	-0.0493 (-0.461)	-0.00751 (-0.0830)	-0.240*** (-2.797)	-0.0737 (-0.929)	-0.0603 (-0.821)	-0.0827 (-1.536)	-0.0596 (-0.567)	-0.00875 (-0.0975)	-0.240*** (-2.825)	-0.0709 (-0.886)	-0.0616 (-0.842)
Real GDP per capita	1.99e-06 (1.044)	-0.000295** (-2.103)	4.27e-06 (0.739)	2.34e-06* (1.940)	6.92e-07 (0.477)	1.50e-05* (1.688)	2.09e-06 (1.112)	-0.000522*** (-3.029)	3.48e-06 (0.620)	2.23e-06* (1.870)	9.74e-07 (0.667)	1.18e-05 (1.372)
Foreign reserve-GDP ratio	0.00335*** (3.493)	0.00466 (1.159)	0.000778 (0.417)	0.00226*** (3.041)	0.000683 (0.758)	0.00336* (1.918)	0.00302*** (3.141)	0.000989 (0.230)	9.95e-05 (0.0536)	0.00231*** (3.149)	0.000762 (0.838)	0.00266 (1.508)
Governance	-0.00947 (-0.154)	-0.0295 (-0.167)	-0.123 (-1.276)	0.189*** (2.608)	0.0235 (0.286)	-0.0953 (-1.101)	-0.0227 (-0.372)	0.0735 (0.411)	-0.143 (-1.500)	0.212*** (2.985)	0.0417 (0.499)	-0.103 (-1.201)
Trade openness	0.00100** (2.008)	0.00212 (1.304)	0.000361 (0.355)	0.000499 (1.229)	0.00124*** (2.648)	0.00104 (1.144)	0.000877* (1.760)	0.00298* (1.798)	-0.000192 (-0.191)	0.000266 (0.660)	0.00100** (2.093)	0.000774 (0.858)
Government debt-GDP ratio	-0.000826* (-1.754)	-0.000789 (-0.777)	-0.00383*** (-3.826)	0.000748 (1.428)	-0.000110 (-0.184)	-0.00173** (-2.584)	-0.000668 (-1.415)	-0.000408 (-0.402)	-0.00353*** (-3.555)	0.000728 (1.403)	-7.11e-05 (-0.117)	-0.00159** (-2.370)
Financial Development	-0.101 (-0.639)	1.096 (0.803)	0.0193 (0.0706)	-0.112 (-0.815)	-0.146 (-0.923)	-0.171 (-0.549)	-0.111 (-0.709)	2.593* (1.827)	-0.0602 (-0.221)	-0.0580 (-0.435)	0.00895 (0.0586)	-0.186 (-0.601)
Constant	0.838*** (11.51)	0.817*** (3.146)	1.002*** (9.414)	0.609*** (5.368)	0.831*** (6.824)	0.859*** (8.835)	0.838*** (11.59)	0.685*** (2.795)	1.020*** (9.676)	0.566*** (5.154)	0.746*** (6.096)	0.848*** (8.777)
Observations	795	104	402	289	357	438	795	104	402	289	357	438
Countries	80	13	40	27	34	46	80	13	40	27	34	46
R ² adjusted	-0.069	-0.101	-0.059	0.034	-0.038	-0.063	-0.058	-0.060	-0.042	0.049	-0.059	-0.055

Notes: The second-step results of the two-step regression are presented. Dependent variables in the second step are the predicted values of the aggregated trilemma obtained at the first-step regression. Borrower stands for the aggregate index of borrower-based macroprudential policy including the loan-to-value ratio and the debt-to-value ratio. Financial for the aggregate index of financial institution-based macroprudential policy. t-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

(Table 8) Estimation results of Borrower and Financial institution-based macroprudential policy on the quadrilemma.

	BORROWER						FINANCIAL INSTITUTION					
	All	Developing Countries	Emerging Markets	Advanced Countries	Open Economies	Closed Economies	All	Developing Countries	Emerging Markets	Advanced Countries	Open Economies	Closed Economies
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Borrower	0.0692** (2.253)	0.0621 (0.508)	0.0193 (0.380)	0.0357 (1.340)	0.131*** (4.145)	0.0183 (0.371)						
Financial institution							0.113*** (4.225)	0.122 (1.444)	0.130*** (3.042)	0.120*** (4.332)	0.173*** (4.363)	0.0852** (2.363)
Banking crisis, dummy	-0.0342 (-1.410)		-0.0573 (-1.089)	-0.0139 (-0.891)	-0.0155 (-0.710)	-0.0875 (-1.571)	-0.0499** (-2.060)		-0.0579 (-1.121)	-0.0313** (-2.009)	-0.0400* (-1.770)	-0.0827 (-1.503)
Currency crisis, dummy	-0.0696 (-1.201)	-0.121 (-1.291)	0.00303 (0.0275)	-0.262*** (-3.691)	-0.0568 (-0.764)	-0.0948 (-1.178)	-0.0658 (-1.150)	-0.125 (-1.349)	-0.00470 (-0.0435)	-0.249*** (-3.631)	-0.0444 (-0.599)	-0.0958 (-1.201)
Real GDP per capita	-8.95e-07 (-0.479)	-0.000302** (-2.375)	-2.95e-06 (-0.490)	1.97e-06* (1.944)	-6.72e-07 (-0.483)	1.78e-05* (1.886)	-6.19e-07 (-0.338)	-0.000425*** (-2.742)	-3.46e-06 (-0.599)	1.77e-06* (1.831)	-2.96e-07 (-0.214)	1.61e-05* (1.748)
Foreign reserve-GDP ratio	0.00290*** (2.693)	0.00412 (1.136)	-0.000757 (-0.325)	0.00138* (1.920)	0.00122 (1.210)	0.00159 (0.798)	0.00244** (2.269)	0.00225 (0.587)	-0.00166 (-0.721)	0.00135* (1.960)	0.00118 (1.177)	0.000900 (0.454)
Governance	-0.0175 (-0.269)	-0.146 (-0.801)	-0.131 (-1.217)	0.215*** (3.372)	0.127 (1.466)	-0.201** (-2.213)	-0.0591 (-0.913)	-0.124 (-0.685)	-0.192* (-1.801)	0.218*** (3.591)	0.141 (1.638)	-0.241*** (-2.640)
Trade openness	0.00163*** (3.047)	0.00125 (0.870)	0.00205 (1.615)	0.000538 (1.472)	0.00140*** (2.852)	0.00180* (1.797)	0.00158*** (2.980)	0.00195 (1.307)	0.00149 (1.211)	0.000311 (0.884)	0.00115** (2.327)	0.00171* (1.737)
Government debt-GDP ratio	0.000255 (0.498)	-0.000520 (-0.574)	-0.00319** (-2.190)	0.000182 (0.413)	-4.46e-05 (-0.0722)	-0.000319 (-0.422)	0.000378 (0.746)	-0.000335 (-0.370)	-0.00314** (-2.218)	0.000216 (0.510)	2.93e-05 (0.0475)	-0.000199 (-0.265)
Financial Development	-0.194 (-1.170)	1.004 (0.795)	0.243 (0.787)	-0.140 (-1.202)	-0.375** (-2.368)	-0.0547 (-0.166)	-0.190 (-1.173)	1.581 (1.205)	0.154 (0.506)	-0.104 (-0.950)	-0.217 (-1.441)	-0.0895 (-0.275)
Constant	0.815*** (9.823)	0.740*** (2.939)	0.823*** (6.282)	0.625*** (5.794)	0.865*** (6.137)	0.691*** (6.369)	0.817*** (9.972)	0.696*** (2.859)	0.861*** (6.688)	0.597*** (5.876)	0.749*** (5.357)	0.680*** (6.328)
Observations	795	104	402	289	357	438	795	104	402	289	357	438
Countries	80	13	40	27	34	46	80	13	40	27	34	46
R ² adjusted	-0.069	-0.101	-0.059	0.034	-0.038	-0.063	-0.058	-0.060	-0.042	0.049	-0.059	-0.055

Notes: The second-step results of the two-step regression are presented. Dependent variables in the second step are the predicted values of the aggregated quadrilemma obtained at the first-step regression. Borrower stands for the aggregate index of borrower-based macroprudential policy including the loan-to-value ratio and the debt-to-value ratio. Financial for the aggregate index of financial institution based macroprudential policy. t-statistics are reported in parentheses. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

5. Conclusion

In this study, we investigate the link between financial stability and the Mundell-Fleming trilemma. We show that a trade-off exists between four policy-goal variables, exchange rate stability, monetary independence, capital openness, and financial stability.

Furthermore, we investigate whether macroprudential policy can mitigate the policy trilemma and quadrilemma. Our main findings are as follows. First, we find that macroprudential policy is a promising tool to relax both the trilemma and the quadrilemma constraints. Second, macroprudential policy is very effective in many income subgroups but plays a limited role in developing countries. Third, financial institution-based macroprudential policy is more significant than borrower-based macroprudential policy.

This study has a limitation regarding the investigation of several channels that enable macroprudential policy to stabilize the financial market and economy. Future research should present a structural interpretation using a theoretical model.

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(Appendix 1) The Home Country and the Base Country

Advanced Country Name	Base Country	Emerging Country Name	Base Country	Developing Country Name	Base Country
Australia	U.S.	Albania	U.S.	Bangladesh	U.S.
Austria	Germany	Algeria	France	Bhutan	India
Belgium	Germany	Angola	U.S.	Burundi	U.S.
Canada	U.S.	Argentina	U.S.	Cambodia	U.S.
Cyprus	Germany	Armenia	U.S.	Congo, Dem. Rep.	U.S.
Czech Republic	Germany	Azerbaijan	U.S.	Ethiopia	U.S.
Estonia	Germany	Bahamas, The	U.S.	Gambia, The	U.K.
Finland	Germany	Bahrain	U.S.	Ghana	U.S.
France	Germany	Belarus	U.S.	Haiti	U.S.
Germany	U.S.	Belize	U.S.	Honduras	U.S.
Hong Kong, China	U.S.	Bosnia and Herzegovina	Germany	Kenya	U.S.
Iceland	Germany	Botswana	South Africa	Kyrgyz Republic	U.S.
Ireland	Germany	Brazil	U.S.	Lao PDR	South Africa
Israel	U.S.	Brunei	Singapore	Lesotho	U.S.
Italy	Germany	Bulgaria	Germany	Malawi	U.S.
Japan	U.S.	Cape Verde	Germany	Moldova	U.S.
Korea, Rep.	U.S.	Chile	U.S.	Mongolia	U.S.
Latvia	Germany	China	U.S.	Mozambique	U.S.
Malta	France	Colombia	U.S.	Nepal	India
Netherlands	Germany	Costa Rica	U.S.	Solomon Islands	U.S.
New Zealand	Australia	Croatia	U.S.	Sudan	U.S.
Norway	Germany	Dominican Republic	Germany	Tajikistan	U.S.
Portugal	Germany	Ecuador	U.S.	Uganda	U.S.
Singapore	Malaysia	El Salvador	U.S.	Zambia	U.S.
Slovak Republic	Germany	Fiji	U.S.		
Slovenia	Germany	Georgia	U.S.		
Spain	Germany	Guyana	U.S.		
Sweden	Germany	Hungary	Germany		
Switzerland	Germany	India	U.S.		
United Kingdom	Germany	Indonesia	U.S.		
		Jamaica	U.S.		
		Jordan	U.S.		
		Kazakhstan	U.S.		
		Kuwait	U.S.		
		Lebanon	U.S.		
		Lithuania	Germany		
		Macedonia, FYR	Germany		
		Malaysia	U.S.		
		Mauritius	U.K.		
		Mexico	U.S.		
		Montenegro	Germany		
		Morocco	France		
		Pakistan	U.S.		
		Paraguay	U.S.		
		Peru	U.S.		
		Philippines	U.S.		
		Poland	Germany		
		Romania	U.S.		
		Russian Federation	U.S.		
		Saudi Arabia	U.S.		
		Serbia Rep. of	U.S.		
		South Africa	U.S.		
		Sri Lanka	India		
		St. Kitts and Nevis	U.S.		
		Thailand	U.S.		
		Timor-Leste	U.S.		
		Tonga	Australia		
		Trinidad Tobago	U.S.		
		Tunisia	France		
		Turkey	U.S.		
		Ukraine	U.S.		
		United Arab Emirates	U.S.		

Notes: The base countries are primarily based on Aizenman, Chinn, and Ito (2009) and complemented by information from IMF's *Annual Report on Exchange Arrangement and Exchange Restrictions 2013*. The classification system for the exchange rate system is based on the countries' actual, de facto arrangements as identified by IMF staff, which may differ from their officially announced, de jure arrangements. The anchor currencies of the base countries during our sample period are the Australian dollar for Australia, the Euro for Germany and France, the Rand for South Africa, the Ringgit for Malaysia, the Rupee for India, the Singapore dollar for Singapore, and the U.S. dollar for the U.S., respectively. Note that Euro-zone members have been maintaining the exchange-rate stability since the adoption of the Euro.

금융의 안정성, 불가능한 삼위일체, 그리고 거시건전성 정책

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본고는 전통적인 먼델-플레밍(Mundell-Fleming)의 Trilemma에 금융안정성이 포함된 Quadrilemma가 실제 국제금융에서 작동하는지를 실증적으로 분석하였다. 먼델-플레밍에 따르면 한 국가가 금융정책 자율성(Monetary independence), 환율 안정성(Exchange rate stability), 금융시장 개방(Capital openness)의 세가지는 동시에 달성하기 불가능한 경제정책목표라 할 수 있다. 본고에서는 이에 더하여 금융시장의 안정성(financial stability)도 이 세가지 목표와 트레이드오프(Trade-off)의 관계에 있다는 것을 확인하였다. 또한 금융시장의 안정을 위한 거시건전성 정책(Macro Prudential Policy)이 Quadrilemma를 완화하는데 효과가 있다는 것으로 나타났다.

JEL Classification Number: E58, F34, F41

핵심 주제어: 불가능한 삼위일체, 금융 안정, 쿼드릴레마, 거시건전성 정책

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