"Impossible Trinity" Hypothesis: The causal Relation between Trilemma and Macro Policy Performance

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Abstract:
This paper investigates how trilemma policy and economic performance mutually affected each other in developing and emerging countries between 1990 and 2017. We find that higher capital openness lowers output volatility and the inflation rate. However, trilemma policy decisions are also affected by economic performance. Under a high inflation regime, a country is pressured to reduce its financial integration by restricting its capital openness. During periods of heightened global risk and financial crisis, a country is pressured to reduce its exchange rate stability.

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1. Introduction

The trilemma hypothesis in international economics states that a country can only achieve two but not all three policy goals: monetary independence, exchange rate stability, and free capital movement. Obstfeld et al. (2005) examined the movements of interest rates over more than 130 years (covering the gold standard, Bretton Woods, and post-Bretton Woods periods) and concluded that the constraints implied by the trilemma are largely borne out by history.

As a typical example, euro countries have chosen a pattern of exchange rate stability and free capital movement by giving up their monetary independence. Unfortunately, the euro crisis has demonstrated the fragility of this structure. Featherstone (2016) is suspicious of the extent to which a member country of the Eurozone can respond to domestic monetary issues. Hereafter, we use the term 'trilemma policy' to indicate a given combination of the three policy goals. How countries determine their trilemma policy is an issue that needs to be clarified to achieve sound and stable economic growth.

Several works have examined the relationship between trilemma policy and macroeconomic performance. Aizenman et al. (2010) find that greater monetary independence lowers output volatility while greater exchange rate stability is associated with greater output volatility. They also find that greater exchange rate stability and greater financial openness are linked with a lower inflation rate. Developing countries' trilemma policy variables such as exchange rate stability and financial openness are influenced by the core economies—the US, Japan and the Eurozone (Aizenman et al. 2016). Since 1990, the trilemma variables in developing countries have converged toward intermediate levels, characterized by managed flexible exchange rates and the use of sizable international reserves as a buffer with retention of some degree of monetary autonomy (Aizenman et al., 2013).

A question follows: Are policy-makers indeed forced to choose only two policy goals out of monetary independence, exchange rate stability, and free capital movement, in line with the impossible trinity hypothesis, or can they choose an optimal mixture of all three? How can a government set its trilemma policy at the optimal level?

By using the trilemma index, Aizenman and Ito (2014) found that countries respond to financial crisis experiences by adjusting their mixture of the three policy goals. We expect that financial crises and macroeconomic performance pressure may lead countries to reduce their trilemma policy integration from the optimal level.

To make the framework easier to understand, Figure 1 presents two extreme examples

among our sample countries[1]. Panel (a) shows El Salvador, which experienced the most remarkable trilemma policy change among these countries during the sample period. As the most extreme case, El Salvador increased its exchange rate stability and capital openness from 0 to almost 1 in nearly ten years. The following specific features of El Salvador may be a reason for this drastic change. The smallest country in Central America, El Salvador has high exposure to natural disasters. As a result, El Salvador has suffered from a low level of economic growth during the past twenty years, despite its advantages for potential economic growth, such as its strategic location to access other markets and growing labor force.

As the other extreme case, Congo is one of the countries with the most stable trilemma policies, as depicted in Panel (b) of Figure 1. There was no change in its exchange rate stability and capital openness and only a moderate change in its monetary independence (from 0.1 to 0.7). Congo is richly endowed with natural resources and has had a stable economic growth rate since the 1990s. It is also a member of the Economic and Monetary Community of Central Africa (CEMAC, Communauté Économique et Monétaire de l'Afrique Centrale). Even when the region experiences economic deteriorations, such as during region-wide economic crises, to restore confidence in the common currency, Congo, along with other CEMAC partners, can make only fiscal policy adjustments. This is the reason for their relatively low level of monetary independence.

Following the studies described above in the literature, this paper first examines how trilemma policy affects economic performance, namely, output volatility and inflation, in developing and emerging countries. However, trilemma policy may, in turn, need to be reconsidered when changes in macroeconomic performance impose pressure on policy-makers. We thus also estimate reverse causality in this relationship. This feedback raises an endogeneity problem in our first regression, and we address it with instrumental variable estimation. To the best of our knowledge, this is the first paper to systematically investigate the direction of the causal relationship between trilemma policy and macroeconomic performance in general.

Our main objective is to clarify whether and how trilemma policy and macroeconomic performance affect each other. To clarify the effects of trilemma policy on economic performance, we apply robust OLS models[2]: We regress economic performance variables

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[1] We explain the specific calculation methods of the three trilemma policy variables in Section 2.

[2] As emphasized by Cameron and Miller (2015), a failure to control for within-cluster error correlation can misleadingly lead to small standard errors and consequently narrow confidence intervals. Our regression models group sample countries into

on three trilemma policy variables and a set of other control variables for 42 developing and emerging countries for the period of 1990-2017. Next, as an extension of Aizenman et al. (2013), we also focus on a possible causal effect of underlying macroeconomic conditions on a trilemma policy decision. This second regression has a trilemma index on the left-hand side and variables that potentially express home and foreign economic performance on the right-hand side.

Our empirical results can be summarized as follows. First, with our sample countries between 1990 and 2017, we find that only one trilemma policy variable out of the three affects macroeconomic performance: higher capital openness lowers output volatility and the inflation rate. Second, underlying economic conditions affect policy-makers' trilemma policy decisions. Among local economic variables, a high inflation rate and the occurrence of financial crises pressure a country to reduce the scope of its trilemma policy, leaving some space around the imposed limits. For global economic variables, a higher global risk in stock market pressure leads a country to reduce its financial integration with the rest of the world. Third, after we address the endogeneity problem with GMM estimation, we find that policy-makers tend to adjust the exchange rate stability and capital openness when faced with domestic and global volatility shocks. Moreover, we find that less democratic countries pursue more flexible exchange rates and more control over capital flows.

The remainder of this paper is organized as follows. Section 2 describes our data and explains our construction of the trilemma policy variables. Section 3 examines the link between trilemma policy and economic performance. Section 4 presents the results robust to reverse causality problems. Section 5 concludes.

2. Data

In this study, we examine how trilemma policy variables and economic performance interact in developing and emerging countries. Our sample period covers 1990 to 2017 and 42 developing and emerging countries[3]. Table 1 lists the sample countries.

2.1 Trilemma policy indices

For the trilemma variables, we use the Aizenman, Chinn and Ito database of trilemma

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clusters, with errors uncorrelated across clusters but correlated within clusters (cluster-robust standard errors).

[3] We refer to the definition of developing and emerging countries of the World Bank and choose the countries for which full datasets for our sample period are available.

indices. We briefly explain the definition of three trilemma variables in this subsection; one can refer for more details to Aizenman et al. (2008) and Aizenman et al. (2010). First, monetary independence is defined as the transformation of the annual correlation of the monthly interest rate in the domestic (i) and base (j) countries[4], where the base country is defined as the country with which a home country's monetary policy is most closely linked. The index for monetary independence is calculated as[5]:

$$MI = 1 - \frac{corr(i_i, i_j) - (-1)}{1 - (-1)}$$

The indicator takes values between 0 and 1. Higher values of the MI index mean a more independent monetary policy. MI takes the value of zero when there is a perfect positive correlation between a country's interest rate and the base country's interest rate. In this case, a country literally pegs its interest rate to that of the base country. Note that MI is only 0.5 when there is no correlation between the interest rates of two countries.

Next, exchange rate stability is defined as the transformation of the annual standard deviation of the 12 monthly exchange rates between the domestic (i) and base (j) countries. The index of exchange rate stability is defined as follows:

$$ERS = \frac{0.01}{0.01 + sd(\Delta log(exch\_rate)}$$

The values are also normalized to between 0 and 1, and higher values mean a more stable exchange rate. To avoid a downward bias, whereby even a small monthly change in the exchange rate would make the standard deviation large and the exchange rate stability value small, the method applies a threshold to the exchange rate movement such that the exchange rate is defined as fixed and the exchange rate stability index takes value one if the rate of monthly change in the exchange rate stays within plus or minus 0.33%.

Last, for the financial openness variable, we use Chinn and Ito's (2008) capital account openness index, which is based on binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. The Chinn and Ito index is normalized to between 0 and 1. Higher values of the index mean a more open capital account.

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[4] Base countries are defined based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions and the CIA Factbook; details can be confirmed in Aizenman, Chinn and Ito (2008).

[5] The correlation of domestic and base countries' monetary policies can be negative. To solve this problem, MI is defined to take the value of 1 in the case of a perfect negative correlation.

2.2 Other economic variables

Following Aizenman et al. (2010), we choose output volatility and the inflation rate as the main indicators to represent economic performance. Output volatility is measured as the five-year standard deviation of real per capita GDP growth.

Other macro control variables are defined as follows: inflation volatility, measured as the five-year standard deviation of the yearly rate of inflation; trade openness, calculated by dividing the aggregate value of imports and exports by GDP; terms of trade (TOT) shocks, defined as five-year standard deviation of TOT growth times trade openness; fiscal procyclicality, measured as the correlation between HP-filtered government spending and HP-filtered real GDP; broad money growth volatility, measured as the five-year standard deviation of broad money growth; private credit, measured as the ratio of private credit by deposit money banks to GDP; reserves, defined as total official reserves excluding gold to GDP; and the change in the US real interest rate.

In Section 4, we also investigate the trilemma policy responses of policy-makers to global risk, measured by the VIX, a proxy variable expressing global uncertainty. We expect financial market volatility to be negatively correlated with the trilemma policy index.

For financial crises, we use Laeven and Valencia's (2018) financial crisis database, which includes both a banking crisis index and a currency crisis index. They define banking crises as events satisfying the following two conditions: (1) significant financial distress in the banking system and (2) significant banking policy intervention measures in response to significant losses in the banking system. Currency crises need to meet two conditions: (1) a depreciation of the currency vis-à-vis the US dollar of at least 30% relative to the previous year and (2) at least a 10% higher rate of depreciation than that observed in the previous year. We expect that both kinds of country-specific financial crisis events force policy-makers to abandon their pursuit of a restrictive trilemma policy.

For the democracy level of a country, Polity, data are taken from the Polity IV dataset. The variable is computed by subtracting the institutionalized autocracy score from the institutionalized democracy score. We expect the democracy score to affect the trilemma policy decision.

2.3 Summary statistics

Table 2 provides the unconditional correlations between variables. As expected, the correlations between output volatility and inflation (as well as inflation volatility) are lower than 0.1, and we think that these two indicators represent completely different

aspects of economic performance. At a matter of course, broad money growth and the inflation rate have a strong correlation, whereas broad money growth and inflation volatility have a correlation of over 0.9. Notably, the correlation of monetary independence and exchange rate stability is nearly -0.2. As defined by the impossible trinity hypothesis, stability in one component may be accompanied by instability in another. Similarly, the correlations between exchange rate stability and the Polity index are nearly -0.3. As expected, the democracy score can affect the exchange rate policy decision. From these results, we confirm that a collinearity problem does not exist in our analysis.

3. Empirical results on the effect of trilemma policy on economic performance

3.1 Empirical model

In this section, we use the same methodology as that in Aizenman et al. (2010) to confirm the relationship between trilemma policy variables and macroeconomic performance during our sample periods. In the preceding section, we demonstrated that the trilemma policy choice may be quite different for each country. Addressing this with an individual country dummy, our analysis focuses mainly on the fixed effects model. From the finding of Aizenman and Ito (2014), it is obvious that trilemma variables have autocorrelation properties. To address this issue, we also revisit the results with an instrumental variable estimation in a later section. We estimate the following panel robust OLS regression equation as the base model:

$$y_{it} = a_0 + \alpha_1 MI_{it} + \alpha_2 ERS_{it} + \alpha_3 KAO_{it} + \boldsymbol{\beta X_{it}} + \varepsilon_{it} \quad (1)$$

where y_{it} is the macro policy performance (output volatility or inflation rate) for country i and year t. MI_{it} is a country's monetary independence, where a higher value of MI means a more independent monetary policy. ERS_{it} is a country's exchange rate stability, where a higher value means a more stable exchange rate. KAO_{it} is the value of the Chinn-Ito capital openness index, for which a higher value means a more open capital account. Considering the impossible trinity hypothesis, according to which the policy space is restricted to two of the three trilemma variables when the trilemma is binding, we include only two of the three variables in each estimation model.

$\boldsymbol{X_{it}}$ is a vector of control variables that includes inflation volatility, TOT shocks, fiscal procyclicality, private credit, reserves and the change in the US real interest rate when output volatility is the dependent variable in a regression. The control variables are trade openness, TOT shocks, fiscal procyclicality, broad money growth volatility, private credit,

reserves and the change in the US real interest rate when the inflation rate is the dependent variable[6].

3.2 Output volatility regression

Table 3 shows the estimated coefficient of regression Equation (1) with output volatility as the dependent variable. The left panel from Columns 1 to 3 summarizes the fixed effect estimation results.

From these results in column 1 to 3, we can observe a positive relationship of TOT shocks and output volatility, which means that a greater TOT shock leads to higher output volatility. This finding is consistent with results from Rodrik (1998) and Aizenman et al. (2010), who claim that volatility in world commodities measured as trade openness can raise output volatility. For inflation volatility, we also find a significant positive effect on output volatility, which means that among developing and emerging countries, an unstable inflation rate also deteriorates output stability. For the three trilemma variables, we observe only a negative association between capital openness and output volatility at the ten percent statistical significance level, which suggests that a more open capital account can subdue output volatility. However, in contrast, we find no statistically significant effect of monetary independence and capital openness.

3.3 Inflation rate regression

The results of the estimated coefficients for Equation (1) with the inflation rate as the dependent variable are shown in Table 4. The three columns differ by the pair of variables selected from the three trilemma policy variables for inclusion in the regression. From Column 1, we find that a country with higher private credit experiences a lower inflation rate, consistent with the findings of Ostry et al. (1995) and Aizenman et al. (2010). When capital openness is included as a trilemma policy variable, however, the results change substantially. Columns 2 and 3 in Table 4 show that higher trade openness is associated with a higher inflation rate. In contrast, a higher foreign exchange reserve rate has a moderating effect on rising inflation. Similarly, consistent with Aizenman et al. (2010), we find a negative relationship between capital openness and inflation: the more open capital flow is allowed, the lower is the inflation rate. As in the case of the result of the

[6] As a robustness check, we estimate the same regression while excluding control variables that show no significant influence in the baseline regression. The results are almost consistent with the baseline, except for a slight change in the statistical significance level of exchange rate stability and capital openness with respect to the inflation rate.

output volatility regression, we cannot observe a statistically significant effect of monetary independence and capital openness on the inflation rate. For the instrumental variable analysis, the results (from Columns 4 to 6) are almost consistent with the fixed effect results.

We find no robust results in the inflation rate analysis. An important reason for this may be that many developing countries (especially some Latin American and African countries, such as Argentina, Bolivia, Brazil, Mexico, Peru, Uruguay, and Uganda) experienced high inflation (over 100 percent annually) from the 1990s to the 2000s. This may introduce some bias in the results[7].

3.4 Regional subsample regression

We have investigated the relationship between trilemma policy variables and macroeconomic performance; however, we have found only weak evidence of an effect of trilemma policy variables on output volatility and the inflation rate. One of the possible reasons for the weak link may be that countries in different regions have dissimilar economic characteristics, which may differently influence government policy decisions. In this subsection, we address this issue by dividing our sample countries into three regional subsamples as follows: Asia, Africa, and Latin America[8].

Table 5 shows the output volatility regression results separately for the three subsamples. For Asian (Panel 1) and Latin American (Panel 3) countries, we can observe a positive relationship of inflation volatility with output volatility. This finding is consistent with the aggregate regression results in Table 3. In addition, for Latin American countries, greater TOT shocks lead to higher output volatility, but this effect does not appear in Asia and Africa (Panel 2). For trilemma policy variables, we can observe a negative relationship between capital openness and output volatility only in Asian countries, consistent with the aggregate regression result. This finding can be explained as follows. Capital openness significantly boosts capital accumulation and productivity (Guru and Yadav, 2021) but also heightens the risk of experiencing a financial crisis. If a

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[7] As shown in Appendix Table A1, our sample includes several countries that have experienced hyperinflation. Some may worry that this generates bias in the regression. Therefore, we confirm our results by excluding countries that experienced an annual inflation rate over 200 percent (including the following four countries: Bolivia, Peru, Argentina, and Brazil) from the regression. Except for M2 growth volatility becoming positive and statistically significant, the qualitative results remain almost unchanged. It is noteworthy that these four removed countries all belong to the Latin American region.

[8] For this subsample analysis, we have not included Middle Eastern countries.

developing country wants to benefit from capital openness and yet reduces output volatility at the same time, high economic integration is a prerequisite. In contrast to countries in other regions, Asian countries are helped in managing the adverse impacts of financial crises by solid financial institutions, swift policy responses, and stable macroeconomic environments with adequate reserves (Ito et al., 2009). Regarding African countries, we find a negative association between exchange rate stability and output volatility at the five percent statistical significance level. In contrast, we find a positive relationship of monetary independence and output volatility in the instrumental variable regression, which implies that for African countries, greater monetary independence leads to higher output volatility.

The inflation rate regression results for the regional subsamples are reported in Table 6. From Panel 1, we can confirm the statistically significant effect of trade openness on the inflation rate, which means that among Asian countries, a country with greater trade openness experiences a higher inflation rate. In the case of Africa, the influence of trade openness is relatively indecisive, but the relationship of money supply growth volatility with the inflation rate is clear. In addition, we confirm a negative influence of reserves in both regions. For Latin America, we observe almost no effects with statistical significance among the explanatory variables. This may be due to the extremely high inflation rate of Latin American countries (e.g., Argentina and Brazil) during the beginning of the 1990s biasing the results. For the three trilemma policy variables, we also observe markedly different results among the three regions. For Asian countries, consistent with previous studies in the literature, e.g., Devereux et al. (2006), a stable exchange rate can help a country maintain a lower inflation rate. However, simultaneously, higher monetary independence raises the inflation rate. As indicated by Aizenman et al. (2010), a possible reason is that countries with higher monetary independence are more likely to engage in debt monetization. Similar to the Asian case, for Africa, we confirm a negative influence of exchange rate stability on the inflation rate, but monetary independence is not statistically significant; instead, we observe a negative relationship of capital openness with the inflation rate.

In this subsection, we checked how regions' distinct economic characteristics may have affected the results in the previous section. As we expected, we find evidence that the link between trilemma policy variables and macroeconomic performance for the entire sample countries is weakened by different government policy decisions in different regions with dissimilar economic characteristics.

3.5 Resource curse problem

The resource curse is a phenomenon whereby countries with more abundant natural resources have less economic growth and worse development than those with relatively fewer resources. This phenomenon has been investigated by many studies. After summarizing and extending previous research, Sachs and Warner (2001) claimed that countries with great natural resource wealth tend to grow more slowly than resource-poor countries. In addition, this negative association of resource dependence and economic growth is more evident in developing countries (Badeeb et al., 2017). Since this issue may also influence our results, in this subsection, we address it by dividing our sample countries into two subsamples based on their total natural resource rents, a data series provided by the World Development Indicators (WDI)[9].

Table 6 shows the output volatility regression results separately for the two groups. For countries with both high (Panel 1) and low (Panel 2) rates of rents, we can observe a positive relationship of inflation volatility with output volatility. This finding is consistent with the aggregate regression results in Table 3. In addition, only for countries with high rents do greater TOT shocks lead to higher output volatility. This finding is consistent with the argument of Papyrakis and Gerlagh (2004), who propose that terms of trade are especially important to economic growth in countries with abundant natural resources. For trilemma policy variables, from the fixed effect regression results in Panel 1, we can observe a negative relationship between capital openness and output volatility only in countries with high rents, consistent with the aggregate regression result.

The inflation rate regression results for the two resource level groups are reported in Table 8. From both Panels 1 and 2, we can confirm that the effect of M2 growth volatility on the inflation rate is statistically significant. Nonetheless, for countries with high rents, the coefficient of M2 growth volatility is lower than that for countries with low rents; the reason for this difference may be that resource-abundant countries have, on average, lower budget deficits and inflation (Polterovich et al., 2007). The inflation rate of countries with high rents is also more likely to be affected by other factors; appropriate macro policies and institutions seem particularly important in resource-abundant countries. More specifically, in Panel 1, higher fiscal procyclicality raises the inflation rate. The possible reason is that countries where the resource curse exists are those where the combination of natural resource and public expenditure policies leads to a low rate of genuine saving (Atkinson and Hamilton, 2003), and the decreases in net savings worsen the inflation rate (Lindh and Malmberg, 2000). We also confirm the negative effects of

[9] The countries in the two groups, along with the country's average total natural resources rents, are listed in Table A2.

reserves and exchange rate stability on the inflation rate. Generally, resource-abundant countries have higher foreign reserves but simultaneously are susceptible to an overvalued real exchange rate (Polterovich et al., 2007). Stable exchange rates are more important in resource-abundant countries than in resource-poor countries. Finally, we can also observe a negative relationship between capital openness and the inflation rate.

In this subsection, as a robustness check, we have divided our sample countries into two subsamples (resource-abundant and resource-poor). Our results support that this classification is meaningful: the economic performance of resource-abundant countries is sensitive to trilemma policy variables as well as to the external environment.

4 Causality problem

In the previous section, we investigated how each trilemma policy variable affects economic performance; however, we could not find a clear-cut relationship between them. One possible reason for the weak causal link from trilemma policy to economic performance is that as argued in Section 2, affected by regional economic characteristics and resources, countries have unique trilemma policies and adjustment paths. We also suspect that policy-makers are frequently forced to make adjustments to the trilemma policy when faced with economic turmoil at home or in the world, and it is hard for an economy to keep its trilemma policy stable. When faced with rising risk from both the domestic and global economic situations, policy-makers must temporarily give up the optimal or their targeted trilemma policy to weather the economic distress for the time being. As confirmed in Aizenman and Ito (2014), trilemma policy is affected by past crisis experiences. We also expect macroeconomic performance and global risk to affect the trilemma policy decision.

4.1 Trilemma index

In this section, we follow the methodology of Aizenman and Ito (2012) to measure a trilemma policy index as follows:

$$T_{it} = \sqrt{(MI_{it} - 1)^2 + (ERS_{it} - 1)^2 + (KAO_{it} - 1)^2} \quad (2)$$

T_{it} is an index to measure the scope of three trilemma variables together; T_{it} is greater if any one of the trilemma policy variables is lower. Figure 2 plots T_{it} for different geographical area groups. As Aizenman and Ito (2012) have shown, trilemma configurations converged toward a middle ground among developing and emerging countries, especially during the period after the 1990s. From Figure 2, we can find different variations among the four country groups. The trilemma index of Latin

American countries tended to decline gradually during the sample period. For Asian countries, a remarkable rise in the trilemma index can be observed for the period of the 1997 Asian financial crisis period, and in the postcrisis period, the trilemma index became relatively stable between 1.0 and 1.1. Similarly, the trilemma index of African countries is relatively stable. Among the four groups, the Middle East displays the most drastic fluctuations. A significant trilemma index hike can be observed in two occasions: after 1997 and 2011. It seems evident that policy adjustment was necessitated after the shock of the Asian financial crisis and the end of the fallout from the oil price shock[10]. To compare the trilemma policy changes by region, we also calculate the average ratio of T_{Max}/T_{Min} by different groups and obtain the comparatively high-fluctuation groups of Latin America (2.62) and the Middle East (2.93) and lower-fluctuation groups of Asia (1.70) and Africa (1.73).

These results may also be partial evidence of our hypothesis that it is difficult for a developing and emerging economy to maintain trilemma policy at the same level for a long period. Many factors both at home and abroad can affect trilemma policy decisions, and a changing policy in a relatively short period may be the reason for the muted effect of the trilemma policy mix on economic performance, which involves outcomes affected by relatively longer-run economic environments.

4.2 Trilemma policy decision

To test the hypothesis that domestic and global risk force a country to move away from its optimal trilemma policy, we estimate the impact of potential risk factors on trilemma variables in the following model:

$$T_{it} = \alpha_0 + \alpha T_{it-1} + \boldsymbol{\beta Dom_{it}} + \boldsymbol{\gamma Glob_{it}} + \varepsilon_{it} \quad (3)$$

where T_{it} is the trilemma policy index. $\boldsymbol{Dom_{it}}$ is a vector of control variables that include domestic economic performance, i.e., output volatility and the inflation rate, banking crises, currency crises, and the democracy level. $\boldsymbol{Glob_{it}}$ is a vector including the VIX that represents global risks. Because the trilemma index has a strong autocorrelation property (Aizenman and Ito, 2014), we also add T_{it-1} as an explanatory variable, and we apply the dynamic panel model of Arellano and Bond (1991).

The results are based on a GMM regression and are robust to heteroscedastic variances in the error terms. Column 1 of Table 9 reports the results for the estimated coefficient of Equation (3). The statistically significant coefficient of T_{it-1} certifies that our choice of

[10] In 2011, the oil market was broadly stable, having recovered from the Lehman shock (when the oil price fell to nearly 40 USD per barrel) to a well-balanced state (with the price at nearly 110 USD per barrel).

a dynamic panel framework is correct. The results for the trilemma index in Column 1 show that the estimated coefficient of the inflation rate is positive and statistically significant. This means that when a developing or emerging country experiences a rising inflation rate, it tends to reduce the overall trilemma policy integration[11]. Moreover, the estimated coefficients of both kinds of financial crisis are positive and statistically significant. This means that developing and emerging countries tend to reduce their trilemma policy integration to address financial crises. The result that financial crises are associated with lower trilemma integration is consistent with the findings of Aizenman and Ito (2014). As an indicator of global financial market volatility, the VIX also has a positive and statistically significant effect on the trilemma index. However, there appears to be no effect of the Polity index on trilemma integration.

From the above, we have confirmed that not only financial crisis events and global financial volatility but also the domestic economic performance indicators that we used in the previous section cause developing and emerging countries to reduce their trilemma integration. Thus, we confirm the hypothesis that when faced with high risks from both domestic and global economic conditions, policy-makers are forced to abandon the optimal trilemma policy.

4.3 Adjustment paths

Following the previous section, in this section, we investigate how a country adjusts each component of the trilemma policy index when faced with different calamities, which here we call the adjustment path. We expect there to be different routes to instantiating the reduction in the trilemma policy index when an economy experiences different economic hardships. Instead of using the integrated trilemma index, we revisit the analysis above with the three trilemma policy variables separately in this section. From Columns 2 to 4 in Table 9, we find unique and different results for each of the three trilemma policies.

The results for exchange rate stability in Column 2 are similar to the results for the trilemma index. Under pressure from either kind of financial crisis or a rising VIX index, countries tend to reduce their exchange rate stability. The inflation rate has a negative effect, but with a lower statistical significance level of ten percent. At the same time, countries with a higher democracy score seem to have less stable exchange rates, indicating that those with lower democracy scores adjust their exchange rate more freely. It should be noted that the evidence is weak; it is statistically significant only at the ten

[11] It should be recalled that a rise in the trilemma index indicates a reduction in the level of the trilemma policy variables.

percent level. This result is consistent with Bearce and Hallerberg (2011), who argue that more democratic regimes should be associated with a more flexible exchange rate because the median voter is likely to be a domestically oriented producer with a preference for domestic monetary policy autonomy, requiring a more flexible exchange rate regime. Column 3 reports the result for the monetary independence regression. Unlike the results for exchange rate stability and capital openness, monetary independence is not affected by any of the variables, regardless of domestic or global risk factors. From Column 4 of Table 9, we find that output volatility and the inflation rate have statistically significant impacts on capital openness. More precisely, higher output volatility and a higher inflation rate are associated with lower capital openness. This means that unstable domestic economic conditions can lead a country to reduce its capital openness. This result is also consistent with the finding of Bekaert et al. (2006) that financial liberalizations are associated with declines in the ratio of consumption growth volatility to GDP growth volatility. A negative and statistically significant Polity index effect implies that for less democratic regimes, capital openness can be adjusted more freely, similar to the results for exchange rate stability. Finally, only currency crises, not banking crises, influence capital openness.

From the results of the three individual trilemma variable regressions, we can draw the following conclusions[12]. First, developing and emerging countries tend to reduce their exchange rate stability and capital openness when facing a high inflation rate or a currency crisis, while countries with less democratic regimes can adjust these policies more freely. Second, the VIX and financial crises can influence exchange rate stability. Higher global financial volatility and the occurrence of financial crises may lead a country to reduce its exchange rate stability. Third, capital account openness is affected by output volatility. A freer capital account may eliminate the unstable production problem, consistent with the finding of Bekaert et al. (2006).

5 Conclusion

In this paper, we investigate the relationship between trilemma policy and

[12] As mentioned above, the possible levels of the three trilemma policy variables are theoretically constrained. Therefore, in Appendix Table A3, we introduce another two trilemma policy variables as explanatory variables in addition to these three individual trilemma variable regressions. From the results, the constraints among these three variables are not obvious. We confirmed only a negative effect of exchange rate stability on capital openness at the ten percent significance level.

macroeconomic performance. Our main results are summarized by the following points. First, higher capital openness is linked to lower output volatility and can suppress rises in the inflation rate. Second, trilemma policy decisions are also associated with domestic and global economic performance. Among domestic factors, a high inflation rate pressures a country to reduce its degree of financial integration. Among global factors, the occurrence of global crises and higher stock market volatility force a country to reduce its degree of financial integration. Third, by investigating the adjustment path for individual trilemma variables, we find that when faced with domestic and global volatility shocks, policy-makers tend to adjust the exchange rate stability and capital openness. These adjustments are also associated with a country's level of democracy: a country with a lower democracy score may adjust more freely.

These results have the following important implications. First, during the 1990s to 2010s, the trilemma policy of developing and emerging countries had only mild effects on economic performance. As shown by Aizenman et al. (2013), since 1990, the trilemma variables in developing and emerging countries have converged toward an intermediate level. The reason may be that developing and emerging countries targeted the trilemma policy mix at some controllable level and insulated the trilemma issue from improvements in domestic economic performance. Second, it is important for governments of developing countries and emerging economies to adjust their trilemma policy decisions under different macroeconomic conditions. Both domestic economic performance and global shocks can force the trilemma policy mix to drift away from the targeted level. These findings and discussions have important implications for trilemma policy. We should realize that the trilemma restrictions do not exist only among the three policy goals but are also affected by changes in the external macroeconomic environment.

Appendix Table.

Table A1. Descriptive Statistics

	Obs.	Mean	S.Dev	10 % Per	90 % Per	Min	Max
ERS	1,134	0.58	0.31	0.20	1.00	0.03	1.00
MI	1,134	0.45	0.18	0.20	0.68	0.00	0.97
KAO	1,134	0.47	0.33	0.17	1.00	0.00	1.00
output volatility	1,134	4.95	4.51	1.41	9.87	0.23	32.09
inflation volatility	1,134	24.36	196.08	0.73	12.59	0.20	2940.49
inflation rate	1,134	13.05	90.79	0.88	18.51	-29.69	2075.89
PC	1,129	37.85	30.69	8.41	81.03	1.97	163.21
totshock	1,134	0.05	0.05	0.01	0.10	0.00	0.53
fiscyc	1,134	0.53	0.57	-0.46	0.99	-0.99	1.00
m2gr	1,125	25.86	171.45	2.01	19.10	0.24	2512.05
polity2	1,080	3.49	5.88	-6.00	9.00	-9.00	10.00
res	1,134	0.19	0.20	0.04	0.39	0.00	1.24
dusi	1,134	-0.14	1.02	-1.58	1.38	-2.22	1.81
vix	1,134	19.23	5.94	12.69	27.29	11.09	32.69

Note: Calculated for the full sample period of 1990-2017. 10%Per and 90%Per are the 10th and 90th percentiles, respectively.

Table A2. Average total natural resource rents

Resource-rich country	Resources rents	Resource-poor country	Resources rents
Congo, Rep.	40.21	India	3.02
Gabon	29.32	Argentina	2.79
Algeria	21.88	Brazil	2.60
Uganda	14.76	Botswana	2.11
Malaysia	11.72	Thailand	1.80
Ecuador	10.63	Guatemala	1.76
Central African Republic	10.36	Comoros	1.54
Egypt	9.64	Pakistan	1.50
Cameroon	7.65	Morocco	1.50
Rwanda	7.43	Philippines	1.11
Chile	7.37	Jordan	0.93
Indonesia	7.00	Uruguay	0.92
Bolivia	6.90	Bangladesh	0.81
Peru	5.93	El Salvador	0.70
Colombia	5.10	Turkey	0.35
South Africa	4.82	Sri Lanka	0.23
Tunisia	4.25	Panama	0.17
Kenya	4.10	Seychelles	0.11
Mexico	4.01	Korea	0.03
China	3.93	Mauritius	0.01
Swaziland	3.55	Singapore	0.00

Note: Averages are calculated for the full sample period of 1990-2017. Total natural resource rents are taken from the World Development Indicators of the World Bank.

Table A3. Panel robust regression of trilemma index and variables

	Dependent variable:			
	Trilemma index	Exchange rate stability	Moneytary Independence	Capital Openness
T/ERS/MI/KAO t-1	0.616 ***	0.437 ***	0.691 ***	0.826 ***
	(0.029)	(0.068)	(0.026)	(0.031)
Output Volatility	-0.003	0.000	0.000	-0.002 *
	(0.002)	(0.003)	(0.002)	(0.001)
Inflation rate	$0.006X10^{-2}$ ***	$-0.002X10^{-2}$	$-0.002X10^{-2}$	$-0.002X10^{-2}$ ***
	($0.002X10^{-2}$)	($0.001X10^{-2}$)	($0.001X10^{-2}$)	($0.001X10^{-2}$)
VIX Index	0.002 ***	-0.003 ***	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Polity Index	0.001	-0.006 *	0.002	-0.005 **
	(0.002)	(0.003)	(0.003)	(0.002)
Currency Crisis Dummy	0.100 ***	-0.130 ***	-0.001	-0.053 ***
	(0.028)	(0.041)	(0.021)	(0.015)
Banking Crisis Dummy	0.132 ***	-0.140 **	-0.026	-0.032
	(0.034)	(0.057)	(0.028)	(0.022)
Exchange rate stability			-0.003	-0.057 *
			(0.029)	(0.032)
Moneytary Independence		-0.026		-0.005
		(0.043)		(0.019)
Capital Openness		0.034	0.036	
		(0.042)	(0.023)	
Obs	1080	1080	1080	1080
Wald test	543.47 ***	93.32 ***	825.63 ***	971.36 ***
Arellano-Bond test	-4.56 ***	-3.97 ***	-5.32 ***	-4.00 ***

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. Wald test reports the Wald statistic of the null hypothesis that all coefficients except the constant are zero. Arellano–Bond test for zero autocorrelation in first-differenced errors. Because of data restrictions on the Polity index, we exclude Congo, Rep., and Seychelles from the sample countries.

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Table 1. List of sample countries by geographical region

Africa	Asia	Latin America and Caribbean	Middle East
Algeria	Korea	Brazil	Egypt
Cameroon	Malaysia	Colombia	Turkey
Central African Republic	Philippines	Peru	Jordan
Congo, Rep.	Singapore	Ecuador	
Gabon	Bangladesh	Guatemala	
Kenya	India	Bolivia	
Morocco	Pakistan	Argentina	
Rwanda	Sri Lanka	Chile	
South Africa	China	El Salvador	
Tunisia	Indonesia	Mexico	
Botswana	Thailand	Panama	
Comoros		Uruguay	
Mauritius			
Seychelles			
Swaziland			
Uganda			

Table 2. Correlations between the variables

	outputvol	infvol	inf	pc	totshock	fiscyc	m2gr	polity2	res	dusi	vix	ers	mi	kao
outputvol	1.00													
infvol	0.09	1.00												
inflation	0.06	0.51	1.00											
pc	-0.03	-0.10	-0.06	1.00										
totshock	0.27	-0.05	-0.03	0.00	1.00									
fiscyc	-0.08	0.02	0.05	-0.06	-0.10	1.00								
m2gr	0.09	0.99	0.51	-0.09	-0.05	0.03	1.00							
polity2	-0.18	0.02	0.05	0.01	-0.08	0.07	0.03	1.00						
res	0.19	-0.08	-0.05	0.35	0.16	-0.16	-0.07	-0.07	1.00					
dusi	0.02	-0.01	-0.02	0.02	-0.06	-0.05	-0.01	0.01	0.00	1.00				
vix	0.09	-0.05	0.01	0.00	0.07	-0.10	-0.05	0.00	0.04	-0.62	1.00			
ers	0.10	-0.08	-0.11	-0.09	0.07	-0.10	-0.08	-0.32	-0.09	0.04	-0.05	1.00		
mi	-0.07	0.00	0.00	0.04	-0.02	0.04	0.00	0.11	-0.01	0.04	-0.01	-0.23	1.00	
kao	-0.03	-0.05	-0.09	0.17	0.10	-0.02	-0.06	0.21	0.23	0.02	0.03	-0.04	0.01	1.00

Note: Correlations are calculated for the full sample period of 1990-2017.

Table 3. Output volatility panel regression

	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	0.118	0.120	0.101	0.126	0.133	0.095
	(0.115)	(0.116)	(0.111)	(0.121)	(0.120)	(0.111)
Inflation Volatity	0.002 ***	0.001 ***	0.001 ***	0.002 ***	0.001 ***	0.001 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Credit	-0.015	-0.007	-0.006	-0.016	-0.010	-0.006
	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.015)
TOT Shock	13.735 ***	13.802 ***	14.095 ***	13.269 ***	13.515 ***	13.923 ***
	(4.792)	(4.707)	(4.792)	(4.628)	(4.670)	(4.709)
Fiscal Procyclicality	0.264	0.241	0.240	0.273	0.247	0.249
	(0.210)	(0.208)	(0.215)	(0.209)	(0.202)	(0.216)
Reserves/GDP	3.820	3.618	3.531	3.929	3.722	3.585
	(2.534)	(2.620)	(2.653)	(2.512)	(2.564)	(2.640)
Exchange Rate Stability	-1.587	-1.437		-2.714	-2.529	
	(1.151)	(1.141)		(1.911)	(1.939)	
Moneytary Independence	0.416		0.399	1.066		1.140
	(0.627)		(0.641)	(1.185)		(1.156)
Capital Openness		-1.433 *	-1.582 *		-1.146	-1.476
		(0.757)	(0.808)		(1.005)	(0.957)
Obs	1129	1129	1129	1129	1129	1129
Adjusted R^2	0.13	0.14	0.21	0.06	0.09	0.20

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

Table 4. Inflation rate panel regression

	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.177	0.172	0.171	0.177	0.172	0.173
	(0.137)	(0.134)	(0.132)	(0.136)	(0.133)	(0.134)
Trade openess	6.254	9.440 *	11.193 *	7.565	10.163 *	10.778 *
	(4.456)	(5.233)	(6.499)	(5.618)	(5.888)	(6.117)
Private Credit	-0.214 ***	-0.051	-0.017	-0.208 ***	-0.052	-0.062
	(0.074)	(0.086)	(0.100)	(0.076)	(0.092)	(0.083)
TOT Shock	15.234	15.017	21.997	17.535	21.010	19.518
	(21.698)	(21.976)	(26.613)	(25.627)	(28.112)	(25.122)
Fiscal Procyclicality	4.802	4.361	4.358	5.038	4.393	4.679
	(2.862)	(2.646)	(2.725)	(3.095)	(2.699)	(3.000)
Reserves/GDP	-9.820	-15.861 **	-18.521 ***	-10.447	-17.016 ***	-16.283 ***
	(6.995)	(6.205)	(5.791)	(6.584)	(5.746)	(5.411)
Exchange Rate Stability	-29.196	-25.345		-11.354	-6.510	
	(22.617)	(21.583)		(9.787)	(9.929)	
Moneytary Independence	4.896		3.915	26.211		23.992
	(7.389)		(7.797)	(29.159)		(28.348)
Capital Openness		-32.901 *	-35.858 *		-29.282 *	-28.219 **
		(17.048)	(18.668)		(15.136)	(12.617)
Obs	1119	1119	1119	1119	1119	1119
Adjusted R^2	0.14	0.15	0.14	0.14	0.14	0.14

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

Table 5. Output volatility panel regression by subsample region

Panel 1: Asia	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	-0.204	-0.182	-0.181	-0.213	-0.183	-0.177
	(0.124)	(0.127)	(0.132)	(0.135)	(0.127)	(0.139)
Inflation Volatity	0.308 ***	0.315 ***	0.319 ***	0.293 ***	0.310 ***	0.324 ***
	(0.061)	(0.054)	(0.052)	(0.076)	(0.061)	(0.054)
Private Credit	0.016	0.023	0.025	0.014	0.023	0.027
	(0.027)	(0.025)	(0.025)	(0.028)	(0.024)	(0.025)
TOT Shock	-2.846	-1.823	-1.930	-3.929	-1.954	-2.067
	(5.497)	(5.421)	(5.514)	(5.693)	(5.384)	(5.657)
Fiscal Procyclicality	0.307	0.442	0.448	0.316	0.454	0.474
	(0.403)	(0.466)	(0.467)	(0.373)	(0.459)	(0.468)
Reserves/GDP	4.458	3.640	3.617	4.101	3.485	3.446
	(4.790)	(5.139)	(5.042)	(5.156)	(5.408)	(5.210)
Exchange Rate Stability	-0.430	-0.075		-1.841	-0.420	
	(1.464)	(1.318)		(2.947)	(2.642)	
Moneytary Independence	-0.398		-0.448	-1.260		-1.115
	(1.189)		(0.822)	(1.555)		(1.052)
Capital Openness		-3.731 *	-3.765 *		-4.064 *	-4.275 *
		(1.793)	(1.760)		(2.180)	(2.210)
Obs	295	295	295	295	295	295
Adjusted R^2	0.42	0.09	0.08	0.40	-0.28	0.05

Panel 2 Africa	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	0.288	0.305	0.206	0.289	0.365	0.159
	(0.266)	(0.266)	(0.264)	(0.295)	(0.279)	(0.271)
Inflation Volatity	0.129	0.123	0.161	0.112	0.095	0.162
	(0.133)	(0.141)	(0.154)	(0.131)	(0.147)	(0.156)
Private Credit	-0.031	-0.029	-0.030	-0.032	-0.028	-0.031
	(0.032)	(0.031)	(0.032)	(0.034)	(0.034)	(0.036)
TOT Shock	13.730	13.843	14.659	12.760 *	13.123 *	14.203
	(8.210)	(8.248)	(8.902)	(7.326)	(7.775)	(8.654)
Fiscal Procyclicality	0.269	0.279	0.341	0.154	0.215	0.264
	(0.379)	(0.389)	(0.374)	(0.424)	(0.424)	(0.373)
Reserves/GDP	6.701	6.532	6.359	7.145 *	6.728 *	6.606 *
	(3.941)	(4.012)	(3.937)	(3.862)	(4.023)	(3.840)
Exchange Rate Stability	-7.223 **	-7.385 **		-11.347	-12.832 **	
	(3.171)	(3.156)		(7.346)	(6.337)	
Moneytary Independence	0.963		1.323	4.453 *		5.168 **
	(0.928)		(1.076)	(2.444)		(2.396)
Capital Openness		-0.565	0.080		-1.012	0.068
		(1.297)	(1.373)		(1.846)	(1.919)
Obs	428	428	428	428	428	428
Adjusted R^2	0.02	0.01	0.23	0.00	0.00	0.19

Panel 3 Latin America	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	0.113	0.113	0.124	0.115	0.124	0.119
	(0.097)	(0.097)	(0.094)	(0.100)	(0.097)	(0.093)
Inflation Volatity	0.001 ***	0.001 ***	0.001 ***	0.001 ***	0.001 ***	0.001 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Credit	-0.004	-0.005	-0.006	-0.005	-0.012	-0.013
	(0.013)	(0.013)	(0.014)	(0.015)	(0.017)	(0.018)
TOT Shock	15.869 **	15.392 **	16.270 **	17.729 ***	15.970 ***	18.130 ***
	(6.761)	(6.511)	(6.471)	(6.625)	(5.917)	(6.113)
Fiscal Procyclicality	0.062	0.109	0.087	-0.032	0.168	0.028
	(0.232)	(0.265)	(0.241)	(0.220)	(0.275)	(0.253)
Reserves/GDP	-3.362	-3.355	-3.454	-3.410	-3.434	-3.432
	(2.234)	(2.232)	(2.238)	(2.352)	(2.393)	(2.274)
Exchange Rate Stability	0.548	0.543		0.274	-0.027	
	(0.726)	(0.732)		(1.376)	(1.535)	
Moneytary Independence	-0.603		-0.625	-2.447		-2.399
	(1.140)		(1.156)	(1.669)		(1.667)
Capital Openness		0.212	0.279		0.948	0.765
		(0.678)	(0.693)		(1.283)	(1.078)
Obs	324	324	324	324	324	324
Adjusted R^2	0.04	0.04	0.04	0.05	-0.28	-0.26

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

Table 6. Inflation rate panel regression by subsample region

Panel 1: Asia	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.100	0.083	0.109	0.091	0.052	0.102
	(0.109)	(0.107)	(0.112)	(0.110)	(0.092)	(0.102)
Trade openess	5.661 **	5.032 *	5.439 **	5.743 ***	4.806 **	5.235 **
	(2.298)	(2.337)	(2.425)	(2.198)	(2.034)	(2.157)
Private Credit	-0.034	-0.032	-0.029	-0.038	-0.046	-0.031
	(0.026)	(0.025)	(0.026)	(0.031)	(0.031)	(0.024)
TOT Shock	-2.962	-4.169 **	-0.233	-4.745 **	-7.383 **	-0.343
	(1.652)	(1.799)	(2.835)	(2.415)	(3.439)	(3.017)
Fiscal Procyclicality	0.015	-0.002	-0.055	0.045	-0.041	-0.094
	(0.413)	(0.411)	(0.344)	(0.441)	(0.450)	(0.335)
Reserves/GDP	-14.598 ***	-13.931 ***	-13.516 ***	-15.108 ***	-13.723 ***	-13.006 ***
	(3.180)	(2.826)	(3.528)	(2.952)	(2.853)	(3.793)
Exchange Rate Stability	-3.061 **	-3.654 **		-5.043 **	-7.077 **	
	(1.150)	(1.229)		(2.508)	(3.236)	
Moneytary Independence	3.821 *		4.547 **	3.496		4.467 *
	(1.880)		(1.737)	(2.290)		(2.418)
Capital Openness		1.550	0.711		4.149	1.896
		(1.828)	(1.561)		(3.665)	(2.573)
Obs	295	295	295	295	295	295
Adjusted R^2	0.02	0.03	0.01	0.03	0.04	0.01

Panel 2 Africa	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.294 ***	0.254 ***	0.307 ***	0.287 ***	0.228 ***	0.306 ***
	(0.072)	(0.063)	(0.064)	(0.056)	(0.057)	(0.059)
Trade openess	3.610	4.899 *	4.653	3.224	4.900 *	4.532
	(2.760)	(2.761)	(3.311)	(2.673)	(2.707)	(3.526)
Private Credit	-0.076	-0.056	-0.055	-0.075	-0.051	-0.048
	(0.051)	(0.048)	(0.054)	(0.050)	(0.047)	(0.055)
TOT Shock	-16.309 *	-15.719 *	-14.201	-17.332 **	-16.762 *	-14.553 *
	(8.147)	(8.154)	(8.343)	(8.730)	(9.093)	(8.254)
Fiscal Procyclicality	0.246	0.254	0.321	0.159	0.169	0.253
	(0.433)	(0.531)	(0.602)	(0.457)	(0.585)	(0.630)
Reserves/GDP	-9.301 *	-10.711 **	-11.461 ***	-8.695 *	-10.345 ***	-11.524 ***
	(4.644)	(3.768)	(3.122)	(4.829)	(3.848)	(3.017)
Exchange Rate Stability	-13.109 ***	-13.796 ***		-17.795 *	-20.728 *	
	(3.170)	(3.035)		(9.708)	(11.601)	
Moneytary Independence	3.316		3.210	4.968		5.253
	(3.191)		(3.340)	(5.106)		(5.634)
Capital Openness		-6.061 *	-5.259		-7.491 ***	-6.825 **
		(2.890)	(3.268)		(2.610)	(2.963)
Obs	428	428	428	428	428	428
Adjusted R^2	0.15	0.13	0.02	0.14	0.12	0.02

Panel 3 Latin America	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.174	0.163	0.162	0.175	0.164	0.166
	(0.149)	(0.141)	(0.135)	(0.149)	(0.137)	(0.142)
Trade openess	14.359	28.910	43.240	36.302	35.218	55.007
	(24.469)	(26.611)	(42.201)	(40.865)	(31.542)	(51.372)
Private Credit	-0.414	0.444	0.467	-0.419 *	0.314	0.335
	(0.251)	(0.428)	(0.398)	(0.253)	(0.371)	(0.338)
TOT Shock	405.436	353.297	307.062	367.460	323.069	305.527
	(397.656)	(374.601)	(340.012)	(352.570)	(344.871)	(333.437)
Fiscal Procyclicality	15.930	8.506	8.378	20.127	8.338	13.998
	(12.425)	(9.470)	(10.378)	(16.525)	(9.820)	(15.794)
Reserves/GDP	-65.397	-78.259	-79.275	-78.014	-72.890	-90.640 *
	(57.900)	(53.733)	(52.332)	(53.991)	(45.568)	(52.410)
Exchange Rate Stability	-73.087	-61.417		-31.304 *	-7.845	
	(62.340)	(62.155)		(16.227)	(20.771)	
Moneytary Independence	18.433		20.095	97.626		94.341
	(29.132)		(29.254)	(106.495)		(109.138)
Capital Openness		-89.571	-99.458		-84.333 *	-80.861 **
		(52.033)	(55.792)		(49.290)	(39.372)
Obs	324	324	324	324	324	324
Adjusted R^2	0.05	0.17	0.16	0.13	0.16	0.17

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

Table 7. Output volatility panel regression by resource rent group

Panel 1: High rents rate	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	0.272	0.284	0.274	0.255	0.289	0.249
	(0.196)	(0.201)	(0.199)	(0.202)	(0.202)	(0.201)
Inflation Volatity	0.001 ***	0.001 ***	0.001 ***	0.001 ***	0.001 ***	0.001 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Credit	-0.026	-0.015	-0.013	-0.030	-0.020	-0.017
	(0.029)	(0.028)	(0.026)	(0.030)	(0.032)	(0.029)
TOT Shock	22.341 ***	21.972 ***	22.543 ***	21.337 ***	21.398 ***	22.359 ***
	(6.379)	(6.108)	(6.542)	(6.131)	(5.868)	(6.696)
Fiscal Procyclicality	0.111	0.065	0.083	0.131	0.059	0.128
	(0.261)	(0.255)	(0.273)	(0.276)	(0.243)	(0.293)
Reserves/GDP	4.893	4.669	4.583	5.053	4.807	4.712
	(4.104)	(4.131)	(4.129)	(4.042)	(4.117)	(4.095)
Exchange Rate Stability	-1.944	-1.763		-3.696	-3.590	
	(1.883)	(1.876)		(2.993)	(3.085)	
Moneytary Independence	0.669		0.458	2.783 *		2.640 *
	(0.681)		(0.667)	(1.553)		(1.445)
Capital Openness		-1.813 *	-1.946 *		-1.369	-1.436
		(1.006)	(1.056)		(1.226)	(1.187)
Obs	564	564	564	564	564	564
Adjusted R^2	0.25	0.28	0.36	0.12	0.17	0.34
Panel 2: Low rents rate	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
Changes in US Real interest Rate	-0.010	-0.013	-0.036	0.009	-0.001	-0.034
	(0.093)	(0.091)	(0.093)	(0.100)	(0.092)	(0.096)
Inflation Volatity	0.002 **	0.002 **	0.001 **	0.002 **	0.002 ***	0.001 **
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Private Credit	-0.003	0.000	0.002	-0.004	0.000	0.003
	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.018)
TOT Shock	1.698	2.034	2.202	1.815	1.885	2.536
	(8.409)	(8.522)	(8.675)	(8.610)	(8.288)	(8.864)
Fiscal Procyclicality	0.505	0.494	0.471	0.518	0.507	0.465
	(0.347)	(0.350)	(0.351)	(0.341)	(0.338)	(0.349)
Reserves/GDP	1.381	1.251	1.149	1.389	1.320	1.048
	(2.520)	(2.682)	(2.781)	(2.511)	(2.539)	(2.861)
Exchange Rate Stability	-1.162	-1.069		-1.967	-1.664	
	(1.302)	(1.281)		(2.284)	(2.131)	
Moneytary Independence	0.221		0.318	-0.597		-0.361
	(1.078)		(1.137)	(1.672)		(1.746)
Capital Openness		-0.762	-0.916		-0.705	-1.209
		(1.133)	(1.240)		(1.357)	(1.496)
Obs	565	565	565	565	565	565
Adjusted R^2	0.03	0.01	0.01	0.02	0.01	0.00

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

Table 8. Inflation rate panel regression by resource rent group

Panel 1: High rents rate	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.052 ***	0.050 ***	0.051 ***	0.050 ***	0.049 ***	0.051 ***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Trade openess	3.999	7.852	6.923	5.181	8.944	7.273
	(4.057)	(4.639)	(4.534)	(5.474)	(5.724)	(4.873)
Private Credit	-0.204 **	-0.088 *	-0.067	-0.219 ***	-0.100 *	-0.056
	(0.075)	(0.049)	(0.052)	(0.086)	(0.057)	(0.061)
TOT Shock	-12.588	-18.029 *	-12.950	-18.103 *	-23.245 *	-13.094
	(7.304)	(9.721)	(8.272)	(10.661)	(12.716)	(8.386)
Fiscal Procyclicality	2.277 **	1.902 **	2.000 **	2.154 **	1.820 **	1.920 **
	(0.900)	(0.730)	(0.753)	(0.949)	(0.773)	(0.758)
Reserves/GDP	-11.625 ***	-15.564 ***	-15.886 ***	-11.535 ***	-15.472 ***	-16.312 ***
	(3.292)	(3.963)	(4.202)	(4.265)	(4.586)	(4.722)
Exchange Rate Stability	-15.557 **	-13.709 **		-29.444 *	-25.998 *	
	(6.759)	(5.436)		(15.486)	(13.451)	
Moneytary Independence	4.255		1.948	1.999		-1.484
	(3.371)		(3.984)	(8.650)		(9.709)
Capital Openness		-19.003 *	-20.130 *		-19.320 **	-21.631 *
		(9.239)	(10.076)		(9.837)	(11.523)
Obs	564	564	564	564	564	564
Adjusted R^2	0.31	0.31	0.26	0.27	0.29	0.25

Panel 2: Low rents rate	Fixed robust			Instrumental variable		
	[1]	[2]	[3]	[4]	[5]	[6]
M2 Growth volatility	0.521 ***	0.513 ***	0.489 ***	0.511 ***	0.504 ***	0.496 ***
	(0.169)	(0.166)	(0.148)	(0.167)	(0.165)	(0.155)
Trade openess	8.776	9.659	22.094 *	16.394	14.953	22.484
	(9.546)	(10.333)	(12.431)	(10.572)	(10.004)	(13.289)
Private Credit	-0.257 *	-0.142	-0.036	-0.243 *	-0.160	-0.132 *
	(0.127)	(0.115)	(0.113)	(0.146)	(0.117)	-(0.132)
TOT Shock	-2.692	9.071	31.299	1.700	16.946	17.502
	(20.033)	(21.551)	(39.897)	(23.271)	(24.233)	(33.904)
Fiscal Procyclicality	15.613	15.216	13.899	15.178	14.606	14.403
	(10.223)	(9.841)	(9.762)	(10.385)	(9.793)	(10.257)
Reserves/GDP	1.973	-3.601	-18.787	-3.074	-9.547	-12.651
	(29.423)	(25.148)	(11.459)	(27.508)	(20.048)	(17.246)
Exchange Rate Stability	-93.239	-90.658		-41.338	-44.351	
	(84.602)	(86.896)		(52.738)	(62.925)	
Moneytary Independence	15.827		24.692	60.165		66.021
	(25.289)		(32.924)	(63.581)		(72.175)
Capital Openness		-24.883	-39.035 *		-14.261	-20.646 *
		(15.852)	(22.042)		(14.194)	(12.480)
Obs	555	555	555	555	555	555
Adjusted R^2	0.31	0.31	0.31	0.31	0.32	0.30

Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. For the instrumental variable estimation, we add an additional instrument for the three trilemma variables.

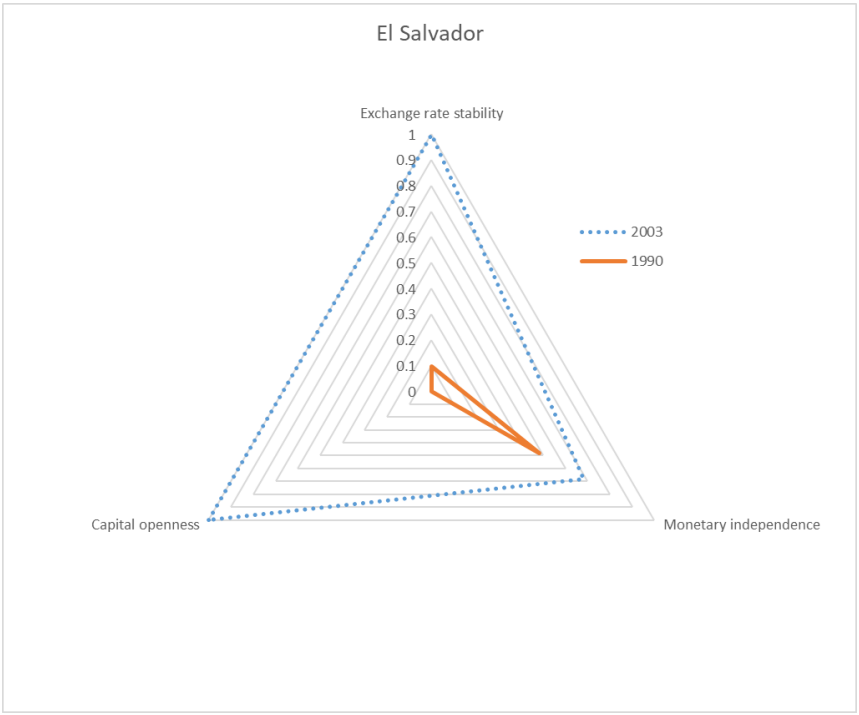
Table 9. Panel robust regression of trilemma index and variables

	Dependent variable:			
	Trilemma index	Exchange rate stability	Moneytary Independence	Capital Openness
T/ERS/MI/KAO t-1	0.616 ***	0.446 ***	0.688 ***	0.821 ***
	(0.029)	(0.068)	(0.026)	(0.033)
Output Volatility	-0.003	0.000	0.000	-0.002 *
	(0.002)	(0.003)	(0.002)	(0.001)
Inflation rate	$0.006X10^{-2}$ ***	$-0.002X10^{-2}$ *	$-0.002X10^{-2}$	$-0.002X10^{-2}$ **
	($0.002X10^{-2}$)	($0.001X10^{-2}$)	($0.001X10^{-2}$)	($0.001X10^{-2}$)
VIX Index	0.002 ***	-0.003 ***	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
Polity Index	0.001	-0.005 *	0.003	-0.004 **
	(0.002)	(0.003)	(0.002)	(0.002)
Currency Crisis Dummy	0.100 ***	-0.130 ***	-0.003	-0.044 ***
	(0.028)	(0.041)	(0.022)	(0.015)
Banking Crisis Dummy	0.132 ***	-0.141 **	-0.027	-0.028
	(0.034)	(0.057)	(0.028)	(0.023)
Obs	1080	1080	1080	1080
Wald test	543.47 ***	86.41 ***	851.61 ***	849.80 ***
Arellano-Bond test	-4.56 ***	-3.96 ***	-5.32 ***	-3.98 ***

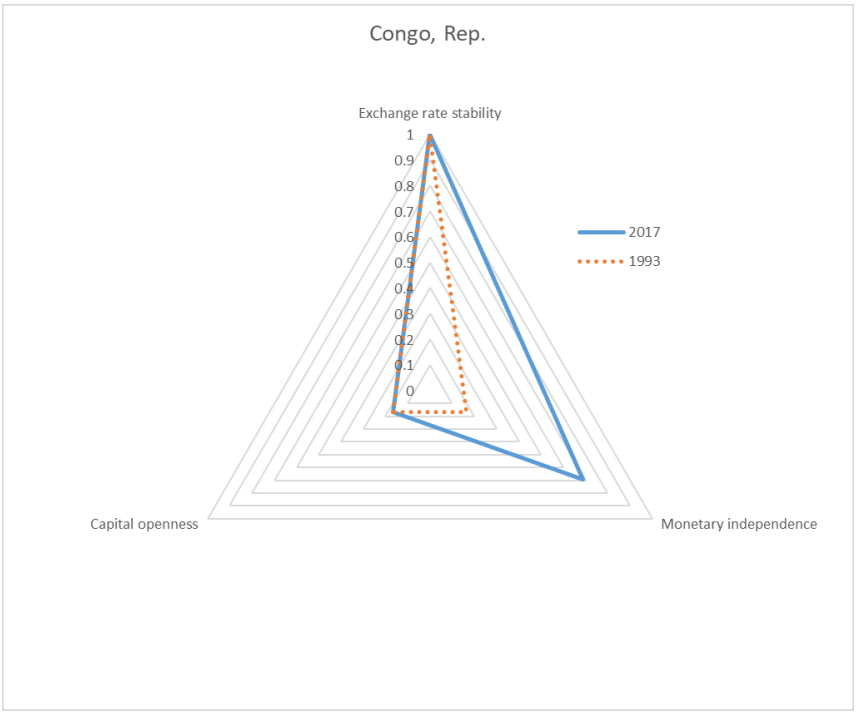
Note: ***, **, and * indicate statistical significance at the 1, 5, and 10 percent levels, respectively. Figures in parentheses are t-statistics. Wald test reports the Wald statistic of the null hypothesis that all coefficients except the constant are zero. Arellano–Bond test for zero autocorrelation in first-differenced errors. Because of data restrictions on the Polity index, we exclude Congo, Rep., and Seychelles from the sample countries.

Figure 1. Trilemma policy changes between 1990 to 2017

(a)

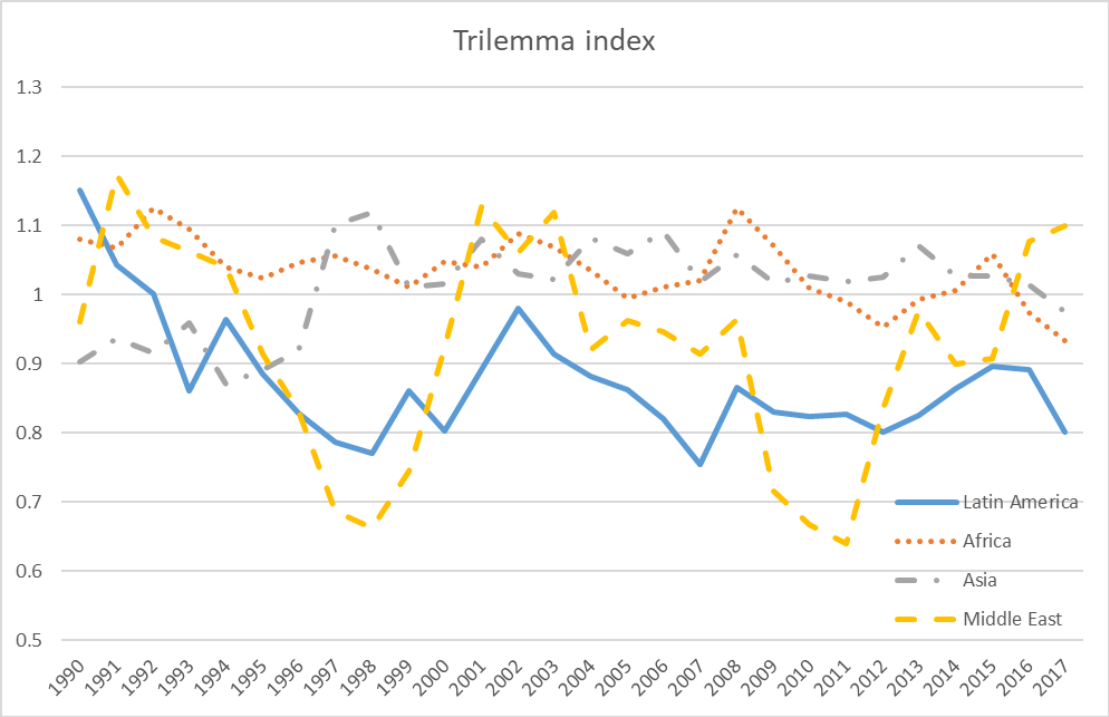


(b)



Note: To show cases with drastic changes in trilemma policy, we draw the figures by maximum and minimum value during the full sample period.

Figure 2. Trilemma policy index among different country groups



Note: Calculated by average of group countries separately.