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Estimation of the Effects of Macroeconomic Variables on the Impossible Trinity

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Abstract:
The examination of exchange rate management, interest rate, and capital market openness is one of the topics under discussion in macroeconomic policies. The assumption in maintaining equilibrium among these three policies is that any change in one of these policies requires an appropriate change in the combination of the other two policies, and there is always an equilibrium among them. The selection of three indicators; exchange rate stability, monetary policy independence, and financial market openness, is well known as the Mundell-Fleming model or the Impossible trinity. The current study explores the common determinants of exchange rate stability, monetary policy independence, and financial market openness using the panel data from a period of 2001 to 2020. Initially, using economic and structural principles, the common determinants of the impossible trinity policy are identified, then parameter estimation is carried out using the SUR model. Finally, it is examined how deviations from the impossible trinity assumption create a political pressure that may lead to a crisis unless policymakers adjust a proper combination compatible with it.

1. Introduction

Over the past 20 years, many developing countries have taken steps to increase financial integration. Maintaining exchange rate stability, monetary policy independence, and open financial markets simultaneously presents a problem, as a country can generally only choose two out of the three at a time. Specifically, to

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maintain a degree of monetary policy independence, exchange rate stability may be ignored, or vice versa, monetary policy independence may be forfeited to preserve exchange rate stability. Due to limited policy tools, when one variable increases, policymakers are often forced to reduce one of the other two variables to compensate (Aizenman & et al, 2008).

In light of financial crises, policymakers must consider how to shield their economy from unstable external forces while sustaining continuous, steady economic growth. Operating in such a vast global environment carries a substantial and intricate responsibility. Indeed, economists face a theoretical constraint known as the "impossible trinity" or "trilemma hypothesis[1]". First proposed by Mundell[2] (1963), this hypothesis posits that a country can simultaneously prioritize two, but not all three, of the objectives of monetary policy independence, exchange rate stability, and open financial markets.

2. Theoretical Foundations

2.1. The Impossible Trinity

The impossible trinity hypothesis is commonly represented by an equilateral triangle (Figure 1), with three sides denoting exchange rate stability, financial market openness, and monetary policy independence. It is possible to fully achieve only two of these policy goals simultaneously, meaning we cannot occupy all three corners of the triangle at once. For example, if financial market openness and monetary policy independence are fully realized, policymakers must adopt a floating exchange rate regime. Similarly, if the exchange rate regime is fixed and monetary policy independence is fully realized, policymakers must completely close the financial market. Likewise, if the exchange rate regime is fixed and the financial market is fully open, policymakers must abandon monetary policy independence.

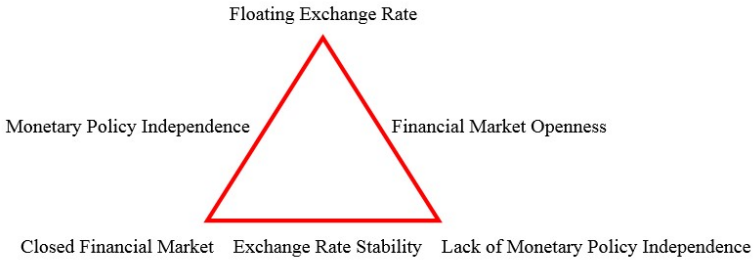


Figure 1. The Impossible Trinity

Source: Authors' configuration

[1]. Trilemma Hypothesis
[2] . Mundell

Each point inside the triangle can symbolize a combination of the three desired policies. There are countless potential combinations. Policymakers are compelled to select the policy mixture best suited to their country's economic and structural conditions. The impossible trinity encompasses scenarios such as a floating exchange rate, monetary policy independence, financial market openness, a closed financial market, constrained monetary policy independence, and exchange rate stability.

Macroeconomically, a country can pursue three distinct strategies:

1. Stabilizing the exchange rate while opening financial markets and relinquishing independent monetary policy;
2. Stabilizing the exchange rate through independent monetary policy while constricting financial markets; or
3. Opening markets and retaining monetary policy independence but allowing exchange rates to fluctuate.

Considerable economic scholarship has traced the historical perspective of selecting two from these three macroeconomic objectives.

Obstfeld and et al. (2005) delineated three eras with divergent viewpoints concerning this trilemma:

1. Gold Standard period;
2. Bretton Woods period; and
3. After the Bretton Woods period.

During the Gold Standard period, the establishment of a monetary bank was limited by the country's gold reserves, as there was a guaranteed fixed exchange rate between currency and gold. This period saw significant capital movement and a fixed exchange rate due to the global market. As a result, countries' ability to manage an independent monetary policy was limited. In the Bretton Woods period, a system of fixed exchange rates supported by the US dollar as the benchmark currency, backed by gold, was employed. Central banks were required to maintain the exchange rate, but due to severe limitations on capital markets, they were also able to guide an independent monetary policy. In fact, the Bretton Woods system financially constrained countries but allowed them to implement an independent monetary system and stabilize their currency. After the abandonment of the Woods system, exchange rates became essentially flexible and the capital market became freer, providing an opportunity for assertive monetary policy (Aizenman & et al, 2011).

2.2. Geometric Analysis

Figure 2 depicts an optimization image, representing the impossible trinity in a three-dimensional domain. This triangle in Figure 2 is equivalent to the shaded dark sections of an equilateral triangle with sides of length 1.

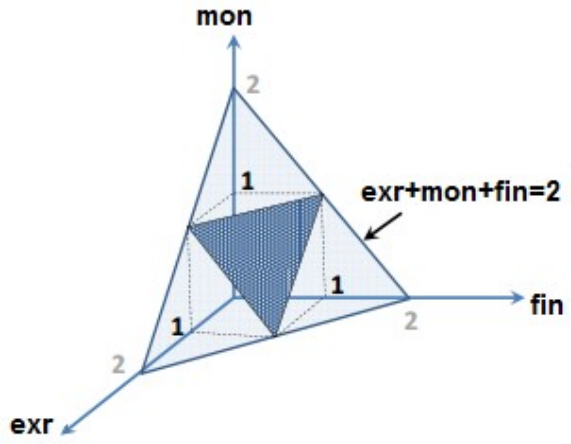


Figure 2. Three-dimensional Image of the Impossible Trinity
Source: Authors' Configuration

As seen in Figure 1, we have a pyramid with a height of 2 and a base length and width of 2 at the origin of the coordinates. The impossible trinity is equivalent to the face of the pyramid, which takes the form of an equilateral triangle placed inside a cube, representing the criteria considered for three indices (each index ranging from 0 to 1). Therefore, each policy combination can be represented as a point within the shaded area of this triangle (the impossible trinity). As shown, there is always the constraint within this impossible trinity that the sum of the three indices equals 2 (EXR+FIN+MON=2). Any policy combination inside the cube with a side length of 1, located towards the origin from the surface of the impossible trinity, is attainable because the sum of the three indices for this policy combination will be less than 2 (EXR+FIN+MON <2). However, such a policy combination will not be efficient. Additionally, a policy combination inside the cube with a side length of 1, located beyond the surface of the impossible trinity (away from the origin), will also not be efficient because the sum of the three indices for this policy combination will be greater than 2 (EXR+FIN+MON >2).

Figure 3 illustrates optimization in two dimensions. Here, financial market openness is equal to 1, and the center of the ellipse aligns with the point (1,1). The ellipse is tangent to the constraint line of the impossible trinity at point E1, indicating how the remaining value of 1 should be divided between exchange rate stability (EXR) and monetary policy independence (MON). In other words, the constraint of the impossible trinity for countries with fully open financial markets is only specific to EXR and MON.

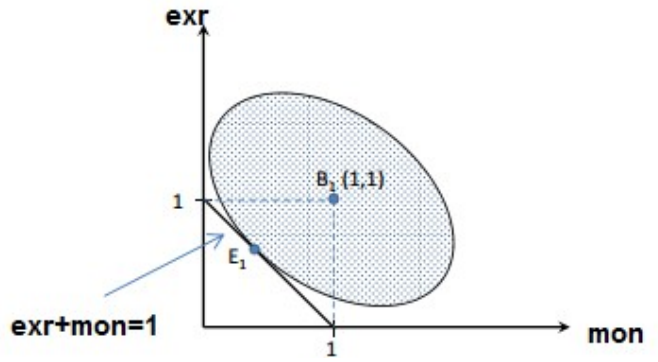


Figure 3. Optimization under the constraint of the impossible trinity when FIN=1
Source: Authors' configuration

Figure 4 depicts optimization when financial market openness is zero (FIN=0). Here, the objective function (ellipse) and the constraint of the impossible trinity are not tangent to each other. The center of the ellipse aligns with (1,1), and the constraint of the impossible trinity is specific to the maximum values for MON and EXR, which correspond to reaching their full levels, i.e., one.

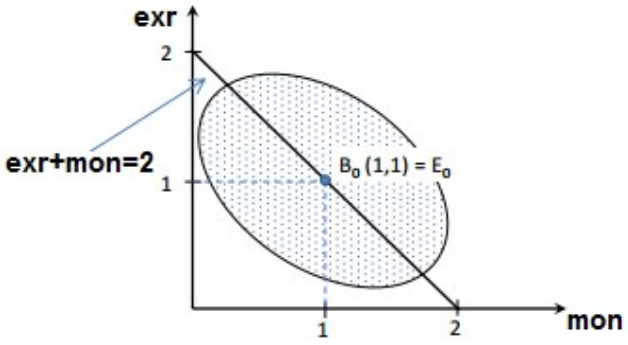


Figure 4. Optimization under the constraint of the impossible trinity when FIN=0
Source: Authors' configuration

Figure 5 shows a scenario where FIN takes a value between 0 and 1. This case is similar to Figure 3, with the difference that the center of the ellipse aligns with the point (2-FIN,2+FIN). The optimal point is obtained from the tangent of the ellipse with the constraint of the impossible trinity (EXR+MON=2-FIN).

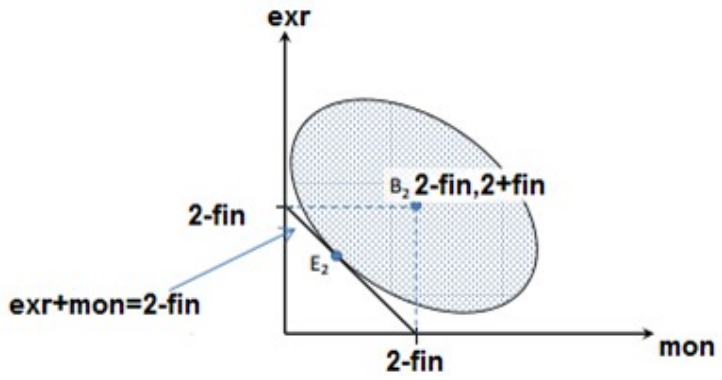


Figure 5. Optimization under the constraint of the impossible trinity when 0<FIN<1
Source: Authors' configuration

3.2. Predicting the signs of estimated coefficients

There are a series of variables that influence the indicators of the impossible trinity, the expected signs of the descriptive variables are based on theoretical considerations and past empirical findings. Most empirical studies conducted so far have examined the factors affecting exchange rate stability (EXR) or the exchange rate regime. Studies on the factors affecting trade openness (FIN) are limited, as well as studies on the determinants of monetary policy independence (MON). Even if some explanatory variables lack theoretical foundations, they have been considered in the estimation, as they are expected to be influenced by at least one of the impossible trinity indicators.

- According to previous studies, it is expected that economic size has a negative effect on exchange rate stability (EXR), an ambiguous effect on financial market openness (FIN), and a positive effect on monetary policy independence (MON). Theories suggest that larger economies may have the ability to absorb external shocks under a floating exchange rate, while smaller economies are expected to be affected by exchange rate fluctuations. Therefore, policymakers in larger economies are less inclined towards exchange rate stability. Juhn and Mauro (2002) show that the most influential factor in the exchange rate regime is economic size. Larger economies tend to have a floating exchange rate regime. Several other studies, such as Heller (1978), Rizzo (1998), Poirson (2001), Méon and Rizzo (2002), and Von Hagen and Zhou (2007), have found similar results.

Theoretical findings suggest that the size of the economy has an ambiguous effect on the openness of financial markets, which is indicated in the table with (-/+). Policymakers in larger economies tend to favor opening their financial markets to foreign investors and financial fluctuations. Additionally, in smaller economies, policymakers may prefer to open their financial markets and attract

foreign financial service providers. Johnston and Tamirisa (1998) also demonstrated that larger economies tend to tightly control capital inflows and outflows and restrict open financial markets.

Policymakers in larger economies are more inclined to maintain independence in monetary policy to stabilize domestic sectors, while in smaller economies, they tend to relinquish this independence.

- Policymakers in higher-income economies are inclined to have greater flexibility in exchange rates (Edwards 1996, Holden, Holden, and Suss 1978, and Savvides 1990).

Theories also indicate that policymakers in higher-income economies are inclined to open their financial markets.

Alesina, Grilli, and Milesi-Ferrett (1994), Grilli and Milesi-Ferrett (1995), and Leblang (1997) showed that less developed countries tend to control capital. For example, countries with lower levels of financial market openness have a positive coefficient of relative income per capita. Policymakers in larger economies are more inclined to maintain independence in monetary policy to stabilize domestic sectors, while policymakers in smaller countries are more easily swayed and tend to follow the monetary policy of larger economies.

The trade openness is expected to positively impact exchange rate stability and the openness of financial markets, and have a negative impact on the independence of monetary policy. The Optimal Currency Area (OCA) theory predicts that policymakers in open economies tend to adopt a more stable exchange rate regime. However, some researchers like Heller (1978), Dreyer (1978), Holden, Holden and Suss (1979), Bernhard and Leblang (1999), and Von Hagen and Zhou (2007) have shown that increased trade openness leads to the adoption of a floating exchange rate regime. Other studies, like Collins (1996), Berger, Sturm and De Haan (2000), and Méon and Rizzo (2002) have reported conflicting results, suggesting that economies with open trade tend to adopt a floating exchange rate regime. Despite these findings and based on OCA theory, it is generally expected that the impact of trade openness on exchange rate stability is positive.

Trade openness is often considered a prerequisite for international trade openness. Johnston and Tamirisa (1998), Tornell, Westermann and Martinez (2004), and Chinn and Ito (2006) have found that increased trade openness leads to more open financial markets. However, Quinn and Inclan (1997) have not found such evidence.

In open economies, maintaining independence in monetary policy is challenging, so trade openness is expected to lead to a lower level of independence in monetary policy.

- It is expected that foreign exchange reserves will have a positive impact on exchange rate stability, financial market openness, and independence in monetary

policy. However, it is unlikely that all three indicators can be simultaneously positive. Poirson (2001) has shown that economies with lower levels of foreign exchange reserves tend to have greater flexibility in exchange rates.

Obstfeld, Shambaugh and Taylor (2009) demonstrated that countries maintaining larger international reserves experience smaller declines in domestic currency valuation. Theoretically, expanded forex reserves enable policymakers to open trade environments, as reserves may counter external shocks or speculative attacks that potentially arise from financial market liberalization.

Monetary authorities possessing higher foreign exchange reserves can likewise conduct more proactive sterilized interventions, thereby allowing augmented autonomy in setting monetary policy. However, as noted previously, foreign exchange reserves cannot exhibit a positive coefficient across all three equations, requiring empirical examination to discern the equation wherein a negative coefficient manifests.

- The export goods share is anticipated to exert a favorable influence on exchange rate stability and financial market openness while its impact on autonomous monetary policy setting remains obscure. Given pricing tied to the U.S. dollar, policymakers in nations with substantial exports prefer stability relative to said currency. Consequently, the export goods proportion is anticipated to positively impact exchange rate stabilization. Similarly, as exporting countries derive income from a prominent currency like the dollar, proclivity arises to invest internationally, potentially preferring open financial markets. No theoretical framework conclusively validates the export share's impact on sovereign monetary conduct.

- Financial advancement is anticipated to exert a negative influence on exchange rate stabilization, a favorable impact on financial market openness, and an uncertain consequence on monetary policy setting autonomy. Policymakers in highly developed financial environments exhibit amplified susceptibility to currency valuation fluctuations. Empirically, Lin and Ye (2011) demonstrated that nations with less evolved financial systems are inclined toward fixed exchange rates. Von Hagen and Zhou (2007) showed states with broader, deeper capital markets, similarly adopt fixed exchange rates, maintaining stability. Despite dual past empirical results, theoretical predictions suggest financial development negatively impacts exchange rate stability.

Theories indicate policymakers in more financially developed nations favor open domestic markets, as augmented flexibility counters external shocks. This implies that financial development positively corresponds to the market openness equation.

No specific framework validates the relationship between financial development and independent monetary policy.

- Elevated domestic savings are anticipated to positively influence exchange rate fixing, and unfavorably impact market openness, while their consequence on

autonomous policy conduct remains unclear. Economies with substantial domestic savings prefer preserving current account balances, which facilitates trade equilibrium maintenance.
Such economies do not need to open their financial markets to have access to external savings. Conversely, lower domestic savings nations potentially need to borrow from foreign countries, through their domestic capital markets.
No theoretical framework confirms domestic savings' impact on monetary independence.
- Finally, TOT shocks' effect on exchange rate stabilization and financial market openness remain uncertain, while positively impacting the independence of monetary policy.
Policymakers potentially prefer flexible exchange rates when confronting substantial terms of trade shocks, facilitating shock attenuation. Meanwhile, policymakers may try to stabilize their economy by maintaining exchange rate stability. Frieden, Ghezzi and Stein (2001) found nations encountering larger TOT shocks prioritize exchange rate stabilization. Conversely, Rizzo (1998) and Poirson (2001) demonstrated nations exposed to sizeable TOT shocks embrace enhanced currency flexibility as a shock absorptive mechanism.
Predicting the influence of TOT shocks on financial market openness remains ambiguous. Policymakers may desire to maintain their markets close to avoid sizeable external shocks, yet simultaneously may decide market openness to benefit from risk sharing.
Such policymakers potentially prioritize independent monetary policy, essential to maintain economic equilibrium amid the shocks.

Table (1): Initial predictions from the signs of explanatory variables

	exchange rate stability	trade openness	monetary policy independence
economic size	-	-/+	+
relative per capita income	-	+	+
trade openness	+	+	-
foreign exchange reserves	+	+	+
share of export goods	+	+	?
financial development	-	+	?
domestic savings	+	-	?
trade shocks	-/+	-/+	?

3- Literature Study

Popper and colleagues (2011) evaluated the stability of international macroeconomic policies in developing economies after the Bretton Woods period, using the simple geometry of two of the three classic goals of the open economy to create a new one-variable scale of macroeconomic international political stability and to specify international macroeconomic arrangements

according to their similarity to the main policy-determining model, and using the limitation of this choice to provide a measure of monetary governance.They concluded that most international macroeconomic stability exists among developing economies where capital control and limited exchange rate flexibility exist. The least stable policies occur in developing economies with open financial markets and flexible exchange rates. Official reserves are weakly correlated to political stability. Also, the political stability of developing countries is weakly dependent on the official assets of foreign exchange reserves. This study demonstrated that most developing economies are still close to the initial model of fixed exchange rates and closed financial markets.

Rey[1] (2015) suggests that when a country has a fixed or flexible nominal exchange rate regime, it seems that there may not be much difference between them. However, when there is capital control, it appears that there are differences. Reymakes the famous argument that capital control is necessary and sufficient for any country to help it withstand global crises.

Han et al[2]. (2018) reached different results. For countries that do not have capital control, a flexible nominal exchange rate allows them to have political autonomy when the central government has a tight monetary policy. On the other hand, when the central government reduces its fiscal policy, it fears an increase in its value and often pursues a similar contractionary monetary policy even if the Taylor rule indicates other policies. In this sense, a flexible exchange rate provides incomplete or asymmetric coverage of external monetary policy shocks.

Aizenman (2019) concluded that the impossible trinity model, like the Mundell-Fleming model, still holds its credibility in the twenty-first century and that no trilemma framework is suitable for all times for the country. Additionally, a modern interpretation of the impossible trinity is necessary for understanding the evolution of global financial architecture and for providing ways to reduce financial fragility. The financial crises of the 1990s led emerging markets to converge to the middle point of this impossible trinity, which includes managed exchange rate flexibility, controlled financial integration, and independence of monetary policy. Capital flight crises added financial stability to the goals of the impossible trinity and turned it into an impossible quadruple. New policies to address financial fragility related to financial integration were also added, including precautionary management of international reserves by emerging markets, swap lines between central banks of the OECD, and Macroeconomic prudential regulations.

In their 2020 study, Aizenman and colleagues examined the impossible trinity of political economy. Policymakers trade-off between three political-economic goals (globalization, democracy, governmental control) by selecting two of them. Indicators identified achievement levels for each goal across 139 nations. The

[1] .Rey
[2] . Han & et al

examination also evaluated how political-economic factors impact political and financial stability. Results demonstrated industrialized democratic states prefer political stability. Developing nations emphasizing democracy prefer to stabilize policies. The lower the level of government control in a country, the more likely it is to have a stable political situation. Additionally, globalized countries, industrialized and developing, tended to favor economic steadiness. Indeed, economic growth shrinks policies. Trade liberalization may allocate more resources to private markets, facilitating economic growth and development. However, this globalization trend tends to create political constraints on domestic economic policy and shrink the domestic political space.

Nabioni et al. (2011) evidenced real exchange rate turbulence and fluctuation negatively impact additional sectors including exports. Non-petroleum export pattern estimation from 1961-2006 denoted exchange rates and gross domestic product as primary determinants. Results displayed these two variables' positive, meaningful impacts. In the aforementioned period, a positive relationship existed between non-oil exports and exchange rates. This means that the increase in the exchange rate (decrease in the value of the national currency) has led to an increase in non-oil exports. However, this relationship does not play an important role in the growth and development of non-oil exports in the country. Favorable, stable environments reduce risks, incentivize investment, and eventually increase production and export.

Sedghi (2012) investigated exchange rate fluctuations' impact on the debts of economic enterprises, and also the impact of financial instability on open economy. He demonstrated that if the accumulated debts of companies lead to an imbalance and financial instability in the economy, the monetary policy maker should increase the bank interest rate based on the monetary policy law designed in the reaction model.

Hosseinzadeh, Yousefabad, et al. (2013) evaluated monetary politics' effects on exchange rates in Iran. Using the autoregressive distributed lag (ARDL) model, they demonstrated that the domestic money supply and domestic price variables have a positive and significant effect on the exchange rate, but the effect of national income was negative and significant, both in the short and long term.

Fattahi et al. (2013) investigated the "trilemma hypothesis" in Iran's economy from 1974-2012. The results indicated that the sum of these three indicators was not equal to two in any year, and the trilemma hypothesis between the three options was rejected. Additionally examining exchange rate stability, independent monetary policy, and financial market openness on Iran's economy inflation, inverse relationships emerged for the initial two factors whereas insignificant connection between the latter two and inflation.

Amini (2016) studied common determinants of exchange rate stability, independence of monetary policy, and financial market openness across 2001-2014 involving Iran's foremost trade partners.

4- Introduction of Variables and Model Description

4-1 Introduction of Variables

This study analyzes panel data balanced over 20 years from 2001-2020 for eight selected emerging economies based on Wikipedia: Iran, Indonesia, India, Russia, South Korea, Turkey, and Malaysia. The data is collected from the World Bank, central banks, and UNCTAD (www.unctadstat.unctad). Variables include economic size, relative per capita income, financial market openness, foreign exchange reserves, export goods share, financial development, domestic savings, trade shocks, exchange rate stability, and monetary policy independence.

4-2 Model Description

This study proposes a theoretical framework using a seemingly unrelated regression (SUR) model to examine determinants of exchange rate stability, financial market openness, and monetary policy independence. The main model is specified as follows:

$$EXR_{i,t} = \alpha_{EXR} + X'_{i,t}\beta_{EXR} + \varepsilon^{EXR}_{i,t} \quad (1\text{-}4)$$

$$MON_{i,t} = \alpha_{MON} + X'_{i,t}\beta_{MON} + \varepsilon^{MON}_{i,t} \quad (2\text{-}4)$$

$$FIN_{i,t} = \alpha_{FIN} + X'_{i,t}\beta_{FIN} + \varepsilon^{FIN}_{i,t} \quad (3\text{-}4)$$

Where X is a vector of explanatory variables including GDP: economic size (partnering in world gross domestic product in purchasing power parity), RPI: relative per capita income (per capita gross domestic product), TO: trade openness (total exports and imports), FER: foreign exchange reserves (excluding gold), EX: share of export goods (share of commodity exports in total exports), FD: financial development (bank credits), DS: domestic savings (gross domestic savings), and TOT: trade shocks (standard deviation from TOT in the past 5 years).

β is a vector corresponding to the coefficients.

Cov($\varepsilon^j, \varepsilon^k$) $\neq 0$ for j or k=$\{ES, KAOPEN, MI\}$

We also have the following linear constraints:

$$\alpha_{EXR} + \alpha_{FIN} + \alpha_{MON} = 2 \quad \& \quad \beta_{EXR} + \beta_{FIN} + \beta_{MON} = 0 \quad (4\text{-}4)$$

5- Results of the SUR Model Estimation

This section reports the results of the Breusch–Pagan test and the SUR model estimates for 3 common policy indicators, considering the constraints. Some estimates align with table (1) predictions. Furthermore, as the SUR model serves as the basis for interpretation, a 2SLS model is estimated to examine the SUR model's robustness. If coefficient signs remain mostly consistent with SUR, then

the SUR model is deemed sufficiently robust and its interpretations are relatively valid. The Breusch–Pagan test, conducted to examine the SUR specification, produced a prob value of 0.0368. Since the prob is less than 0.05, the null hypothesis of no correlation between equation disturbances is rejected, validating the SUR structure. Therefore, the model is SUR and three equations must be satisfied simultaneously.

Table 2: the SUR model estimates for the exchange rate stability indicator

Dependent variable: exchange rate stability		
Variables	**Coefficients**	***p-value***
economic size (gdp)	-9.417761	0.138
relative per capita income (rpi)	-.000011	0.000
trade openness (to)	-.0006046	0.298
foreign exchange reserves (fer)	1.65e-13	0.605
share of export goods (ex)	-.0015099	0.419
financial development(fd)	.0022331	0.007
domestic savings (ds)	.0071274	0.023
trade shocks (tot)	-1.96e-13	0.787
Constant	.4181827	0.026

The first equation results, the exchange rate stability index (EXR) as the dependent variable, and the independent variables are shown in the table above.
The table indicates coefficients of independent variables for relative per capita income, financial development, and domestic savings were significant. The coefficient interpretations essentially indicate sensitivity between explanatory and dependent variables. In this estimate, the relative per capita income coefficient (-0.000011) is negative, signifying a weak inverse linkage to the EXR dependent variable. Financial development's coefficient (0.0022331) is positive, representing a relatively weak direct relationship. The domestic savings coefficient (0.0071274) is also positive, indicating a weak positive relationship. Coefficients for economic size, trade openness, foreign exchange reserves, export goods share, and trade shocks were statistically insignificant, requiring no interpretation.

Table (3): The SUR model estimation results for the financial market openness index

Dependent variable: financial market openness		
Variables	**Coefficients**	***p-value***
economic size (gdp)	-22.89213	0.000
relative per capita income (rpi)	2.58e-06	**0.389**
trade openness (to)	-.0015823	0.007
foreign exchange reserves (fer)	8.38e-13	0.009
share of export goods (ex)	.0040911	**0.027**
financial development(fd)	.0016099	**0.057**
domestic savings (ds)	-.0130113	**0.000**
trade shocks (tot)	2.02e-12	**0.006**
Constant	.550289	**0.002**

The second dependent variable results are presented in the above table, with the financial market openness index (FIN) as the dependent variable and the remaining as independent. The coefficients for independent variables - economic size, trade openness, foreign exchange reserves, export goods share, financial development, domestic savings, and trade shocks - were significant. In this estimation, the economic size coefficient (-22.89213) indicates a strong negative relationship with financial market openness. Trade openness (-0.0015823) exhibits a negative and relatively weak linkage. The foreign exchange reserves coefficient (8.38e-13) represents an extremely weak positive association with the financial market openness variable. The export goods share coefficient (0.0040911) is positive, signifying a minor direct effect. Economic development's coefficient (0.0016099) reflects a meaningful positive relationship with financial market openness. Trade shocks' coefficient (2.02e-12) is positive, portraying a weak direct effect on the dependent variable. The coefficient of relative per capita income independent variable was statistically insignificant, requiring no commentary.

Table (4): SUR Model Estimation for the Monetary Policy Independence Index

Dependent variable: Monetary Policy Independence		
Variables	**Coefficients**	***p-value***
economic size (gdp)	-20.60391	0.003
relative per capita income (rpi)	-2.43e-06	0.492
trade openness (to)	-.0005023	0.455
foreign exchange reserves (fer)	4.97e-13	**0.182**
share of export goods (ex)	-.0071909	**0.001**
financial development(fd)	-.0015057	**0.131**
domestic savings (ds)	.0078954	**0.036**
trade shocks (tot)	3.03e-12	**0.001**
Constant	1.031528	**0.000**

The third dependent variable results are displayed above, with the monetary policy independence index (MON) as the dependent variable and the others as independents. Significant coefficients included economic size, export goods share, domestic savings, and trade shocks. The economic size coefficient (-20.60391) was negative, signaling an inverse and relatively high association with the dependent variable. The export goods share coefficient (-0.0071909) was also negative, representing a weak negative linkage with the dependent variable. The domestic savings coefficient (-0.0078954) indicated a minor negative relationship. The trade shocks coefficient (3.03e-12) portrayed a weak positive linkage. Relative per capita income, trade openness, foreign exchange reserves, and financial development coefficients were statistically insignificant, requiring no interpretation.

5-1- Signs of Explanatory Variables in Model Estimation with 2SLS

The table (5) presents the coefficient signs of the explanatory variables as estimated using the two-stage least squares (2SLS) method. As shown, for the dependent variable of exchange rate stability, all signs match those of the coefficients estimated using the seemingly unrelated regression (SUR) method. For the dependent variable of financial market openness, only the foreign exchange reserves variable differs. For the dependent variable of monetary policy independence, relative per capita income and foreign exchange reserves differ.

Table (5): The signs of explanatory variables as estimated using the two-stage least squares (2SLS) method

	exchange rate stability	trade openness	monetary policy independence
economic size	-	-	-
relative per capita income	-	+	+
trade openness	-	-	-
foreign exchange reserves	+	-	-
share of export goods	-	+	-
financial development	+	+	-
domestic savings	+	_	+
trade shocks	-/+	+	+

5-2- Deviating from the Impossible Trinity and Financial Crises

Now that macroeconomic policy determinants have been estimated by the impossible trinity framework, we can examine whether policymakers can challenge this constraint. Occasionally, policymakers are observed attempting to implement a policy mix in violation of the impossible trinity limitation. For example, authorities facing heavy capital inflows and economic prosperity under a fixed exchange rate regime may pursue independent monetary policy without

curbing financial market openness to Slow down the economic contraction. In such situations, authorities ultimately lose control over monetary policies and abandon the fixed rate system, or impose capital controls. In other words, short-term deviations from the impossible trinity constraint by authorities may trigger financial crises through market forces, or force them to change their policies in a direction that is consistent with the constraint. The estimation framework can model the impossible trinity constraint in the long run while in the short run, it may deviate. This implies stable exchange rates, financial market openness, and monetary policy independence values can be predicted via the SUR model to achieve desired levels over the long term. Ultimately, persistent deviations from such optimal levels will force authorities to adjust policies through changes in each policy or financial crisis. This section examines whether deviations from the impossible trinity constraint relate to financial crisis occurrences. The deviation size is defined using exchange rate stability, financial market openness, and monetary policy independence estimates from SUR against the actual value of these indicators:

$$d_{i,t} = \left(EXR_{i,t} - \widehat{EXR_{i,t}}\right) + \left(FIN_{i,t} - \widehat{FIN_{i,t}}\right) + \left(MON_{i,t} - \widehat{MON_{i,t}}\right) \qquad (5\text{-}1)$$

The impossible trinity constraint is represented by the equations below:

$$\alpha_{EXR} + \alpha_{FIN} + \alpha_{MON} = 2 \qquad \& \qquad \beta_{EXR} + \beta_{FIN} + \beta_{MON} = 0$$

The equations show that in the long run, d=0. A continuously non-zero d value, especially above zero, renders such policy mixes intolerable to markets and requires adjustment. The value of d is obtained based on the results of the SUR estimation in tables 3, 2, and 4, and Figure 6 shows d values for countries studied in this research during and after the crisis. We expect d to increase above zero during market turmoil and decrease to zero or even below it as conditions stabilize. "Year 0" denotes the 2007 banking crisis, or the first year, when d peaked, decreasing in surrounding years.

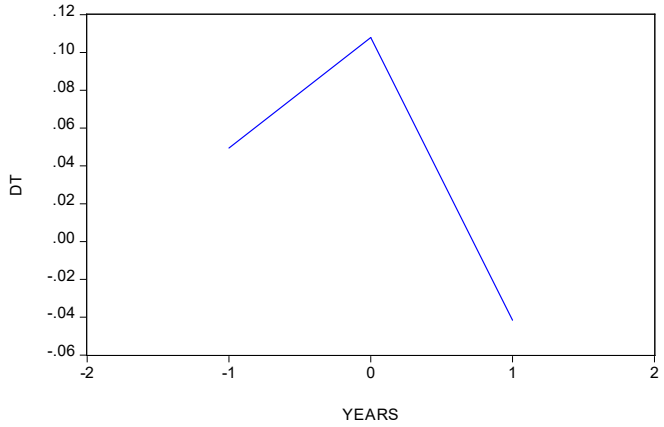


Figure 6. Deviations from the impossible trinity constraint during the 2007 banking crisis.

Figure 7 represents the 2010-2011 European debt crisis, when deviation (dt) peaked for the studied countries, with less deviation surrounding this period.

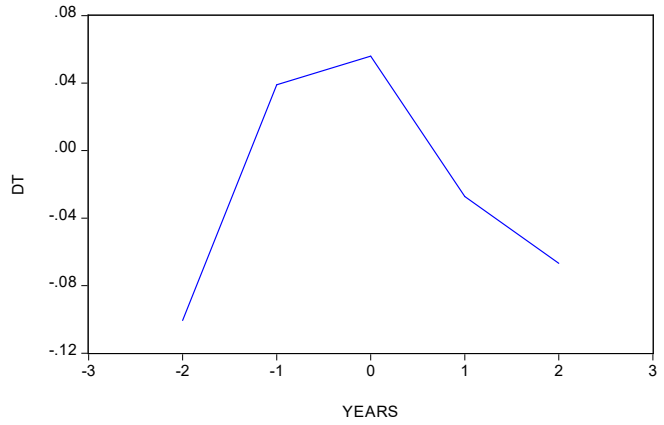


Figure 7. The 2010-2011 European debt crisis.

Section 6- Conclusion and Recommendations:

This research examines factors influencing exchange rate stability, financial market openness, and monetary policy independence in selected six countries during 2001-2020.

The Breusch–Pagan test initially confirmed the cross-sectional dependency in the model by rejecting the null hypothesis. Estimating via Seemingly Unrelated

Regressions (SUR) for exchange rate stability as the dependent variable across countries found independent variable coefficients for financial development and domestic savings, positive and significant, while the relative per capita income coefficient proved negative and significant. The coefficients for relative per capita income and domestic savings are consistent with empirical evidence. Economic size, trade openness, foreign reserves, export share, and trade shock coefficients proved statistically insignificant. In model estimation with the SUR method for financial market openness as the dependent variable, foreign reserves, export share, economic development, and trade shock coefficients were found positive and significant, with economic size and trade openness negative and significant—therefore, economic size, foreign exchange reserves, share of export goods, economic development and trade shocks coefficients are compatible with empirical evidence.

The coefficient of trade openness as the independent variable proves statistically insignificant. Subsequently, estimating the SUR model with monetary policy as the dependent variable, the trade shock coefficient proves positive and significant. Meanwhile, coefficients for economic size, export share, and domestic savings show as negative and significant. Among these, coefficients for export share, domestic savings and trade shocks manifest consistency with empirical evidence. The economic size coefficient proves statistically insignificant.

Comparing 2SLS and SUR explanatory variable coefficient signs confirms the SUR model's robustness and the interpretations are based on the SUR model. The value 'd' measures deviation from the optimal impossible trinity policy combination. While 'd' equals zero long-term, short-term deviations from zero are expected. 'd' surpasses zero amid market turmoil, and approaches zero and even below zero, as conditions stabilize.

Policy mixes straying from the impossible trinity become intolerable for markets, necessitating correction via policy changes.

If deviations from the desired optimal level persist, policymakers will ultimately be compelled to enact corrective measures. Accordingly, effective policy design demands diligent adherence to the imperatives of the impossible trinity. In case of violation, market forces will punish authorities by creating a financial crisis, or make them change their policies in a way that is compatible with the impossible trinity constraint.

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بررسی عوامل تعیین کننده ثبات نرخ ارز، استقلال سیاست پولی و باز بودن بازار مالی

چکیده

یکی از موضوعاتی که در سیاست‌های اقتصاد کلان مورد بحث است، بررسی مدیریت نرخ ارز، نرخ بهره و باز بودن بازار سرمایه است، فرضیه ای که در تعادل این سه سیاست برقرار است این است که با تغییر یکی از این سیاست‌ها می‌بایست تغییر مناسبی در ترکیب دو سیاست دیگر صورت گیرد و همواره یک تبادل بین سه سیاست مذکور وجود دارد. این پدیده بررسی و انتخاب سه شاخص ثبات نرخ ارز، استقلال سیاست پولی و باز بودن بازار مالی به ساختار مدل ماندل–فلمینگ یا سه گانه غیرممکن شهرت یافته است. این تحقیق به بررسی عوامل تعیین‌کننده مشترک ثبات نرخ ارز، استقلال سیاست پولی و باز بودن بازار مالی می‌پردازد. در این تحقیق از داده‌های پانل طی دوره زمانی ۱۹۹۵ تا ۲۰۲۰ استفاده شده است. ابتدا با استفاده از اصول اقتصادی و ساختاری، عوامل تعیین‌کننده سیاست سه‌گانه غیرممکن را تعیین و سپس با استفاده از مدل SUR به تخمین پارامترها پرداخته می شود. و در آخر بررسی می شود که انحرافات از فرضیه سه‌گانه غیرممکن یک فشار سیاستی خلق می‌کند که ممکن است منجر به بحران شود مگر اینکه سیاست‌گذاران یک ترکیب سیاستی در مسیری سازگار، با سیاست سه‌گانه غیرممکن تنظیم کنند.

کلمات کلیدی: سه‌گانه غیرممکن، استقلال سیاست پولی، ثبات نرخ ارز، باز بودن بازار مالی، مدل SUR.