

## TRILEMMA TRIANGLE AND MACROECONOMIC POLICY PREFERENCES IN TURKEY\*

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### Abstract

This study investigates the validity of the trilemma hypothesis and various trilemma policy configurations among the exchange rate stability, financial openness and monetary autonomy in Turkey covering the period of 1970-2014. Trilemma policy measures are obtained from Aizenman, Chinn, and Ito (2013). Estimation results confirm that trilemma constraint is binding, and the policy-makers in Turkey pursue a policy combination of capital mobility and monetary autonomy between 2001 and 2014. More importantly, growing international reserves at the same period gave CBRT more self-confidence to violate trilemma constraint and pursue more stable exchange rates. This result potentially explain why Turkey has been accumulating international reserves in parallel with rising deviations from the trilemma constraint.

**Keywords:** Trilemma, Exchange rate stability, Monetary autonomy, Financial openness, International reserves

### *İmkansız Üçleme ve Türkiye'nin Makroekonomik Politika Tercihleri*

#### Öz

Bu çalışmanın amacı, imkansız üçleme hipotezinin geçerliliği ile birlikte döviz kuru istikrarını, finansal serbestliği ve bağımsız para politikasını içeren imkansız üçleme politikalarını, 1970-2014 dönemi için Türkiye özelinde araştırmaktır. İmkansız üçleme değerleri Aizenman, Chinn ve Ito (2013)'dan elde edilmiştir. Tahmin sonuçları, imkansız üçleme hipotezinin geçerli olduğunu ve Türkiye'nin 2001-2014 yılları arasında finansal serbestlik ve bağımsız para politikası kombinasyonuna ağırlık verdiğini göstermiştir. Daha da önemlisi, aynı dönemde artan uluslararası rezervler, Türkiye Cumhuriyeti Merkez Bankası'na (TCMB) imkansız üçleme kısıtından sapmalar konusunda daha fazla güven vermekte ve ek olarak TCMB'nin döviz kurlarında istikrarı da kovalayabilmesine olanak sağlamaktadır. Bu sonuç muhtemelen, Türkiye'nin son yıllarda imkansız üçleme kısıtından artan sapmalara paralel olarak neden daha fazla uluslararası rezerv biriktirdiğini de açıklamaktadır.

**Anahtar Sözcükler:** İmkansız üçleme, Döviz kuru istikrarı, Parasal bağımsızlık, Finansal serbestlik, Uluslararası rezervler

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## Trilemma Triangle and Macroeconomic Policy Preferences in Turkey

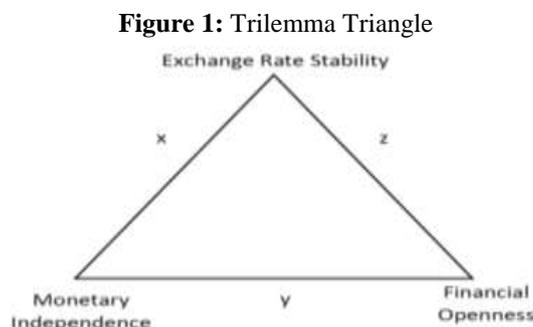
### Introduction

“Impossible trinity” or the “trilemma” is a simple rule which states that a country cannot have an independent monetary policy (monetary autonomy), an open capital account (financial openness) and an exchange rate stability (fixed exchange rate) at the same time. That is, there always exists a trade-off among these policy goals, and the country may simultaneously achieve any two but not all the three goals<sup>1</sup>.

The “trilemma triangle” is illustrated in Figure 1. Each of the three vertexes of the triangle represents exchange rate stability, monetary independence, and financial openness. Suppose a country chooses a position x, then policy-makers pursue only a combination of an exchange rate stability and independent monetary policy (but not a financial openness). If a country chooses a position y, then policy-makers pursue only a combination of a financial openness and independent monetary policy (but not an exchange rate stability). Finally, if a country chooses a position z, then policy-makers pursue only a combination of an exchange rate stability and a financial openness (but not an independent monetary policy). To make this more comprehensible, suppose that a country maintains a combination of exchange rate stability and financial openness. If home country's interest rate ( $i$ ) does not closely trace the base country's interest rate ( $i^*$ ), an increase in the base country's interest rate ( $\Delta i^* > 0$  and  $\Delta i = 0$ ) would lead to funds flowing into the base country, which generates a depreciation of the home currency.

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<sup>1</sup> “Impossible trinity” or the “trilemma” hypothesis was first made popular by Mundell (1963). Marcus Fleming also independently studied the relationship among exchange rates, capital flows, and monetary policy in the 1960s. Therefore, “impossible trinity” is also called the Mundell-Fleming trilemma.



Strict interpretation of the trilemma means that countries are forced to be positioned on one of sides of the trilemma triangle as stated above. On the other hand, many country examples showed that policy-makers may assign various weights on all the three policies in number of ways. For example, a country might pursue a managed floating regime with some capital controls, and sacrifice some monetary independence. Similarly, if financial markets are partially open, more monetary independence requires lower degree of exchange rate stability. Therefore, an economy might be positioned at a point somewhere in the interior of the triangle instead of being at a point on any side as policy-makers may desire to achieve all policy objectives partially. Natural questions then arise: First, does trade-off exist among the trilemma objectives in Turkey? Additionally, is it possible to find out what policy configurations in the trilemma triangle are conducted over time in Turkey? What are the main determinants of trilemma policy goals? And finally, if trilemma constraint exists, can policy-makers relax the trilemma constraint? If so, how?

The main purpose of this paper is to find out answers to these questions. That is, this study investigates the Turkey's trilemma policy configurations for the period between 1970 and 2014. Additionally, it aims to explain how international reserves play an active role in satisfying the desire of the policy-makers to be able to relax trilemma constraint. For the purpose of investigating trilemma hypothesis in Turkey, I first introduce the three trilemma indices, exchange rate stability, financial openness, and monetary independence, developed by Aizenman, Chinn, and Ito (2013). Second, existence of trade-off among the three policy objectives or validity of linearity among the indices is investigated. If these indices are shown to be linearly related, then the weighted sum of the three policy variables must add up to a constant suggesting that an increase in one of the trilemma indices is followed by a decrease in the weighted sum of the other two indices. Additionally, how trilemma configurations of Turkish economy evolved during post Bretton-Woods is examined based on the linearity results. Third, a set of simple economic

fundamentals which are considered to impact the trilemma variables are tested by applying the seemingly unrelated regression (SURE) estimation method with linearity constraint. Finally, many researchers argue that holding large scale of reserves may enable policy-makers to deviate from trilemma constraint. Hence, the deviations from the optimal trilemma policy combinations are calculated, and why these deviations rose between 2001 and 2014 is explained in conjunction with increasing international reserves (IR). Investigation of a relation between the international reserves and trilemma deviations may give scholars a better understanding regarding the reason behind the significant increases in international reserve holdings by many developing countries in recent years.

The remainder of the paper is organized as follows: Section 1 provides a summary of the trilemma measures and discusses how they change in Turkey over time. Section 2 surveys the empirical literature on the trilemma framework while Section 3 presents empirical estimates of the trilemma hypothesis and examines various trilemma policy choices implemented in Turkey during the sample period. Section 3 also investigates the determinants of the trilemma policies based on the simple economic fundamentals. Section 4, on the other hand, investigates whether there exists a link between deviations from the trilemma optimality and the growing international reserves in Turkey. Finally, last section concludes.

## 1. Trilemma Measures and Tracking the Indices

### 1.1. Trilemma Measures

Aizenman et al. (2013) introduced the "trilemma indices" constructing the three dimensions of the "trilemma triangle": exchange rate stability, monetary independence, and financial openness. I briefly outline them here<sup>2</sup>.

#### *Monetary Policy Independence (MI)*

Aizenman et al. (2013) define the index for monetary policy independence (MI) as follows:

$$MI = 1 - \frac{\text{corr}(i_i, i_j) + 1}{2}$$

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<sup>2</sup> These indices are publicly available at [http://web.pdx.edu/~ito/trilemma\\_indices.htm](http://web.pdx.edu/~ito/trilemma_indices.htm) for more than 181 countries. More detailed discussion of the indices can be found in Aizenman et al. (2013).

where  $i_i$  and  $i_j$  are the monthly interest rates of home country (Turkey) and the U.S. (base country), respectively.  $\text{Corr}(i_i, i_j)$  is the annual correlation between  $i_i$  and  $i_j$ . The U.S. is the base country since Turkey's monetary policy is most closely linked with U.S. as in Shambaugh (2004)<sup>3</sup>. By construction, the maximum and minimum values take 1 and 0, respectively, and MI varies between 0 and 1. The higher value of MI denotes greater monetary independence.

#### *Exchange Rate Stability (ERS)*

Aizenman et al. (2013) measure the exchange rate stability (ERS) by the following formula:

$$ERS_t = \frac{0.01}{0.01 + \text{stdev}(\Delta \log(ER_t))}$$

where  $ER_t$  is the nominal exchange rate measured by home currency units per U.S. dollar. By construction,  $ERS_t$  takes value between 0 and 1, as well. The larger value of  $ERS_t$  represents greater exchange rate stability.

#### *Financial Openness (FO)*

Aizenman et al. (2013) employ the index of capital account openness or KAOPEN derived by Chinn and Ito (2006, 2008) for the measure of financial openness (FO). KAOPEN is based on the restrictions on cross-border financial transactions reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*<sup>4</sup>. KAOPEN is normalized between 0 and 1, a larger value indicates more financial openness.

The annual dataset in this study covers the period 1970-2014 since the annual data for FO are available from 1970. Appendix 1 contains all data definitions and sources employed in this study.

## **1.2. Major Turning Points in Turkish Economy, 1970-2014**

Turkey adopted a fixed exchange rate regime until the 1980s. In the 1980s, Turkey switched its exchange rate regime into a managed floating in which foreign exchange rates were driven by the continuous intervention of the

3 Aizenman et al. (2013) define the base country as the country that a home country's monetary policy is most closely linked with as in Shambaugh (2004).

4 More details are available at [http://web.pdx.edu/~ito/Chinn-Ito\\_website.htm](http://web.pdx.edu/~ito/Chinn-Ito_website.htm).

Central Bank of the Republic of Turkey (CBRT). The second change in the exchange rate regime was introduced in 2000, and CBRT allowed the exchange rates to fluctuate within the band (crawling bands). However, Turkish economy was hit by the biggest financial crisis in its history in 2001. The massive capital outflows and melting international reserves during the crisis forced the monetary authorities to abandon the crawling bands, and Turkey has experienced floating exchange rate regime since 2001. By adopting floating exchange rates, CBRT intervenes in the exchange rate market to reduce excessive volatility of exchange rates and build reserves, but exchange rates are not driven by CBRT, suggesting that CBRT does not aim to determine the direction and current level of the exchange rates. 1989 is another turning point in Turkish economy as capital account was fully liberalized with the complete convertibility of the Turkish lira. Hence, Turkey has started to face trilemma trade-off during 1990s. Additionally, through implementing a floating exchange rate in 2001 and announcing an inflation targeting regime in 2002, CBRT has played a vital role in reaching the price stability with a more independent monetary policy (Akcelik, Cortuk and Turhan, 2014; 104).

### 1.3. Tracking the Trilemma Indices in Turkey

Many researchers mentioned a link between the various options of the trilemma and the level of IR (Aizenman and Lee (2007), Aizenman et al. (2010, 2013), Steiner (2015), Popper, Mandilaras, and Bird (2013), Cheung and Ito (2009), Obstfeld, Shambaugh, and Taylor (2010)). These researchers concluded that an economy with large stocks of international reserves<sup>5</sup> may temporarily relax (or deviate) the trilemma conditions. To account for this fact, IR holdings are also included into the analysis.

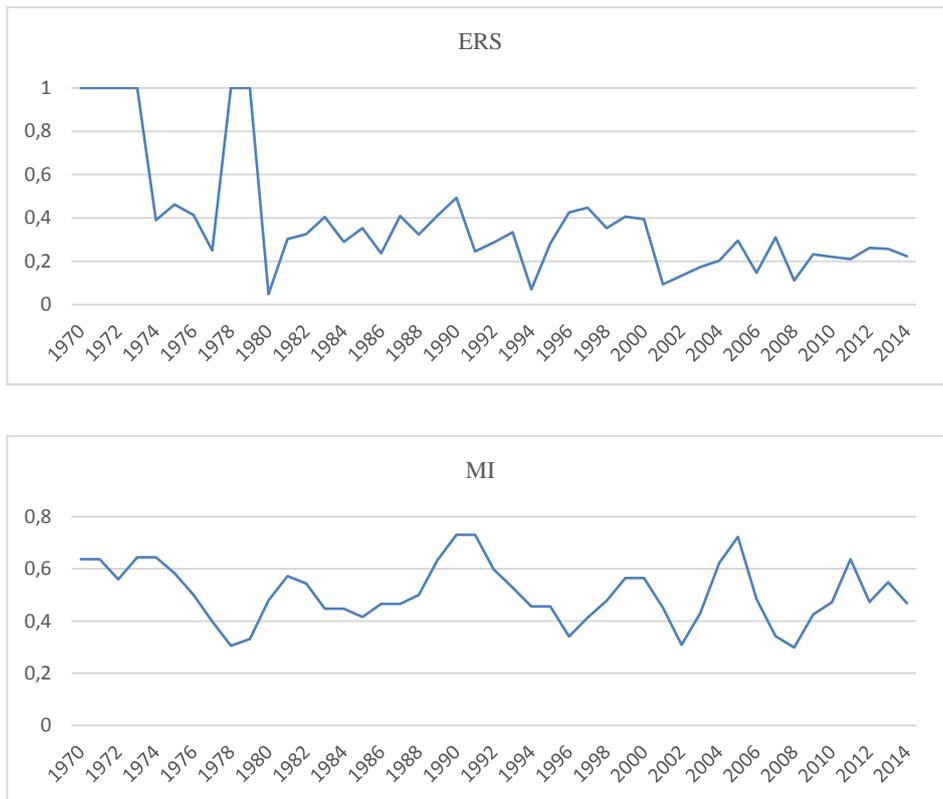
Figure 2 shows that how the trilemma and IR variables evolve between 1970 and 2014. As seen in Figure 2, ERS gradually decays over time consistent with adopted exchange rate regimes. More importantly, substantial rises in IR between 2001 and 2014 give policy-makers an opportunity to be able to relax trilemma constraint, as suggested above. This crucial point will be discussed in Section 5 in conjunction with deviations from the trilemma optimality.

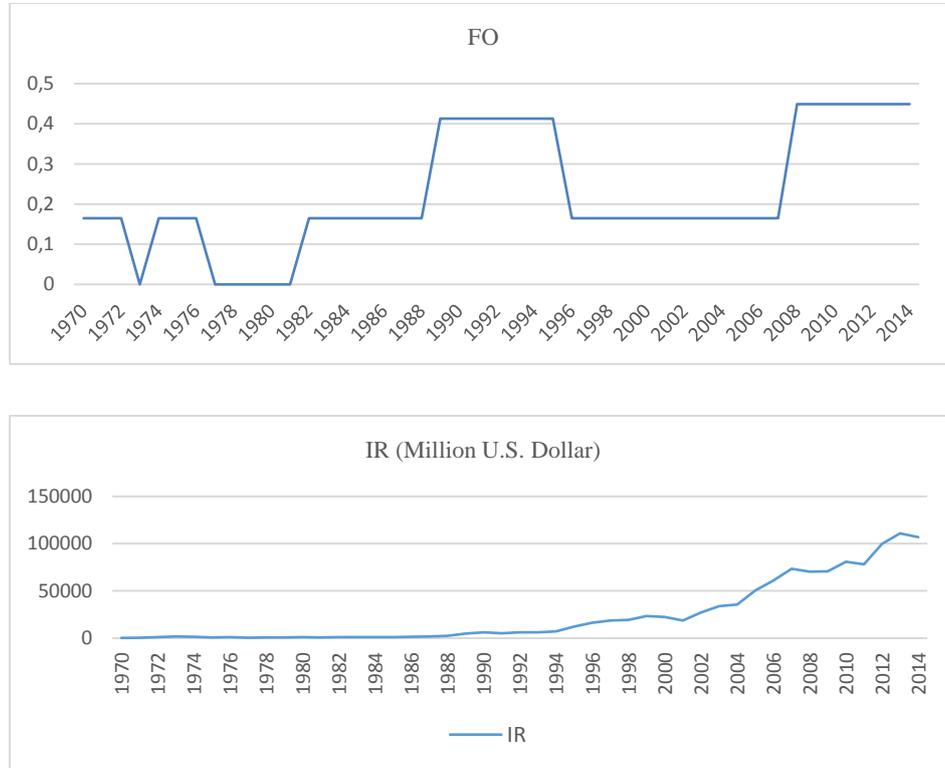
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5 Since the early 2000s, especially in the wake of the East Asian crises, the developing countries are stimulated by the International Monetary Funds (IMF) to raise their international reserves. According to the IMF, holding larger amount of reserves can bring significant benefits in conjunction with consistent economy policies. For example, these reserves help preserve financial stability against pressures on exchange rates and create a room for greater monetary independence.

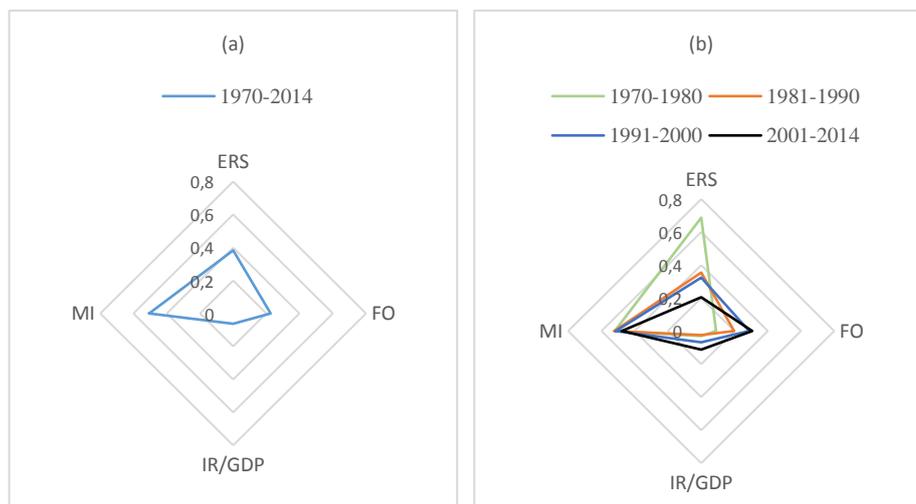
Additionally, MI index is roughly fluctuated around its mean, suggesting no excessive changes in monetary independence. Figure 3 illustrates the diamond graphs including IR/GDP ratio as the fourth vertex in addition to ERS, MI, and FO vertexes. The origin of the diamond graphs represents pure floating exchange rate, zero reserve holdings, complete capital controls, and zero monetary independence. Figure 3a reveals that Turkey maintained a policy configuration of greater monetary independence, fair degree of control over exchange rates, and low degree of free capital movements over the period of 1970 to 2014. Figure 3b illustrates that the trilemma policy objectives have evolved during the sample period, and Turkey moved towards to greater financial openness and IR/GDP ratio but forewent high degree of exchange rate stability over time. More crucially, Turkey has started to pursue a policy configuration of monetary autonomy and liberalized financial transactions in addition to increasing amount of IR holdings for the period between 2001 and 2014.

**Figure 2:** ERS, MI, FO and IR over the Sample Period 1970-2014





**Figure 3: Trilemma and IR/GDP Configurations over the Sample Period, 1970-2014**



## 2. Literature Review

There are many studies in the exchange rate literature testing the trilemma hypothesis and trilemma policy configurations. The objective of this section is to review the related literature on trilemma.

Hutchison, Sengupta, and Singh (2012) studied the India's trilemma policy configurations for the period between 1996 and 2009 covering 54 quarters. First, they found that trilemma constraint is binding in India. Second, they revealed that an increase in financial integration, after the mid-2000s, has changed the trilemma policy objectives in India, and the increase in financial openness has occurred at the expense of the reduction in monetary policy independence or exchange rate stability.

Aizenman et al. (2013) introduced the new metrics to measure the ERS, MI, and FO. They tested the linearity constraint for 184 countries and showed that trilemma variables are linearly related for both developing and developed countries over the period of 1970-2014. While the exchange rate stability and financial openness were more dominant after the beginning of the 2000s among industrialized countries, the policy combinations of monetary independence and exchange rate stability became more prevalent throughout the sample period among developing countries. Additionally, an economy with open financial markets and fixed exchange rate can independently relax monetary policy temporarily, as long as it holds a massive amount of IR.

Ito and Kawai (2014) developed the first empirical framework in the literature estimating the trilemma policies simultaneously instead of controlling one or two other trilemma indices for 78 countries from 1970 to 2010. First, they found that trilemma policy indices added up to a constant. Second, they investigated the macroeconomic variables which determine the trilemma policy combinations. They also showed that short-term deviations from the trilemma constraint must be corrected; otherwise, market forces might punish the authorities by creating a financial crisis.

Steiner (2015) revealed the existence of trilemma policy goals based on the framework of the portfolio balance model of a large country panel data set covering the period 1970–2010. He claimed that exchange rate interventions provide an effective instrument to relax the trilemma. That is, the weighted sum of the three trilemma goals increases in the degree of foreign exchange market intervention. He also documented that an active reserve policy allows central banks to pursue independent monetary and exchange rate policies when the capital account is liberalized. Shambaugh (2004) examined the 155 countries over the period 1973-2000 and found strong evidence for the validity of the trilemma constraint. The main conclusion of his study is that fixed exchange

rates force countries to follow the monetary policy of the base country more closely than floating rate countries. That is, a country can pursue fixed exchange rate at the expense of a loss of monetary policy autonomy. Similarly, Obstfeld, Shambaugh, and Taylor (2004, 2005), Popper et al. (2013) found strong evidence in favor of the trilemma constraint. Popper et al. (2013) also concluded that the combination of fixed exchange rates and financial market openness is the most stable policy combination in the trilemma triangle using a sample of 177 economies with annual data from 1970 to 2010. Finally, they revealed that greater reserves tend to come with higher trilemma policy stability in low-income economies.

Klein and Shambaugh (2015) asked the question of whether the intermediate trilemma policies (such as narrowly targeted capital controls or limited exchange rate flexibility), afford a complete monetary policy autonomy. Their results proved that extensive capital controls or floating exchange rates provides monetary autonomy, as suggested by the trilemma. They also concluded that rounded corners of the trilemma triangle (or intermediate trilemma policies) enables a country to pursue more monetary autonomy compared to its vertexes (fixed exchange rate and open capital account). Huh, Ji, and Park (2016) investigated the trilemma constraint for Fiji. Their results suggested that trilemma constraint is binding for Fiji, and policy-makers prioritized exchange rate stability and monetary policy independence over the period of 1980-2012. They also found that the implemented trilemma policies do not deviate substantially from optimal level.

Akcelik et al. (2014) studied the trilemma hypothesis for the Turkish economy covering the period 2002-2011 by employing Kalman filter to capture the time-varying character of trilemma policy combinations. They first test the validity of trilemma constraint assuming linearity among trilemma indices, and then investigated the role of foreign reserves on the trilemma trade-off. Their results supported the validity of trilemma, and they concluded that foreign reserves have a role in relaxing the trilemma trade-off. Similarly, Cortuk and Singh (2013) found supportive evidence in favor of trilemma trade-off from 1998 to 2010 for Turkey. They constructed trilemma indices by following Aizenman et al. (2013). Their analysis revealed that financial openness and monetary autonomy have increased from late 1990s to 2010 at the cost of sacrificing exchange rate stability.

### 3. Empirical Analysis of the Trilemma

#### 3.1. Trilemma Constraint

While the preliminary analysis in Section 1.3 reveals the evidence in favor of the trade-off among different trilemma policy goals, it is still empirically required to show whether these three trilemma goals are binding. As shown in Figures 2 and 3, Turkey does not fully commit the any of the three policy goals. Instead, Turkey pursues various trilemma policy configurations throughout the the whole sampe period. In this section, I empirically test whether these three trilemma policy goals are linearly dependent, or equivalently, they are binding. Since impossible trinity framework does not impose any obvious functional form, Aizenman et al. (2013) formulate the trilemma goals under the assumption of linearity, suggesting that weighted sum of the all three trilemma goals must be a constant. Hence, the validity of the trilemma constraint are tested by following simple linear regression as suggested by Ito and Kawai (2014)<sup>6</sup>:

$$2 = \theta_1 ERS_t + \theta_2 MI_t + \theta_3 FO_t + \omega_t \quad (1)$$

where  $\omega_t$  is the error term. Table 1 illustrates the linear regression results of the equation (1). As seen in Table 1, adjusted  $R^2$  is quite high, and all the estimated coefficients are statistically significant at 10 percent level. Additionally, Figure 4 presents the predicted values of  $ERS+MI+FO$ , or equivalently,  $\widehat{\theta}_1 ERS_t + \widehat{\theta}_2 MI_t + \widehat{\theta}_3 FO_t$ , over the full sample period. The predicted values move around the the value of 2 closely, and the null hypothesis that the mean of the prediction values is equal to 2 cannot be rejected. Overall, all these estimation results yield an existence of trade-off among the three policy objectives. That is, these policy goals are linearly related to each other, and increase in one of the indices are balanced by a decrease in the weighted sum of the other two indices.

Despite the fact that trilemma constraint is binding in Turkey, the preceding estimation results do not provide quite valuable information regarding how much of the trilemma policy configurations are actually implemented at different subperiods in Turkey. The weighted predictions of  $ERS_t$ ,  $MI_t$ , and  $FO_t$ , are required to be employed to answer this crucial question.

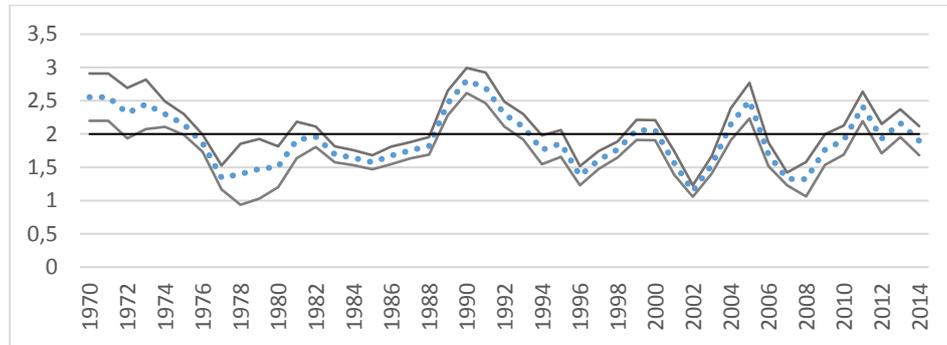
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<sup>6</sup> The left-hand side of the regression is set equal to 2, since all three policy choices are normalized to remain in the range from 0 to 1. A policy combination staying on the triangle plain is subject to the trilemma constraint that the sum of the three indices is always 2, as suggested by Ito and Kawai (2012).

**Table 1:** Linear Regression Estimation of the Trilemma Indices

Variables	Estimated Coefficient	Adjusted R <sup>2</sup>
ERS	0.45**	0.95
MI	3.09*	
FO	0.77**	

**Notes:** Newey-West standart errors are employed to produce consistent estimates when there is autocorrelation in addition to possible heteroskedasticity. \* and \*\* represent that corresponding coefficients are statistically significant at five and ten percent level, respectively.

**Figure 4:** Predicted Values of ERS+MI+FO

**Note:** The grey lines indicate the 95% confidence interval for  $\widehat{\theta}_1ERS_t + \widehat{\theta}_2MI_t + \widehat{\theta}_3FO_t$ . Since the null hypothesis that the mean of the prediction values is equal 2 cannot be rejected, one can conclude that trilemma constraint is binding for Turkey.

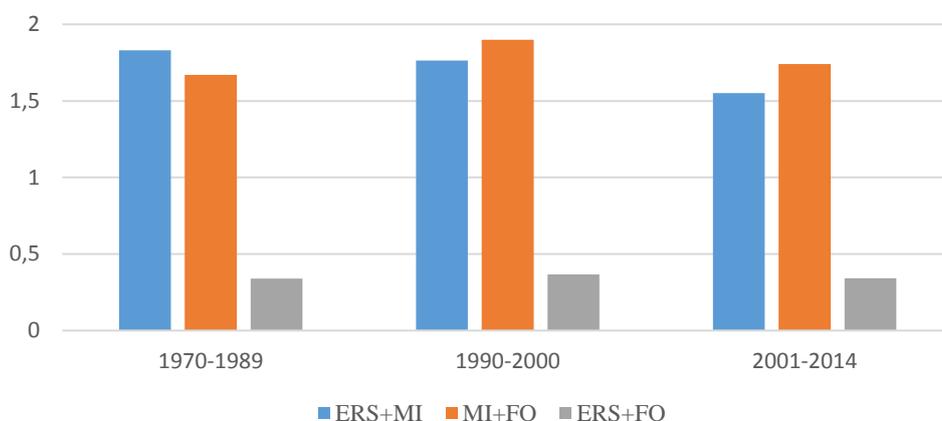
Figure 5 illustrates the weighted predictions of various trilemma policy combinations,  $\widehat{\theta}_1ERS + \widehat{\theta}_2MI$ ,  $\widehat{\theta}_2MI + \widehat{\theta}_3FO$ , and  $\widehat{\theta}_1ERS + \widehat{\theta}_3FO$ . The sample period splits into three parts: 1970-1989, 1990-2000, and 2001-2014. The years 1989 and 2001 are quite crucial for the Turkish economy as the capital account was fully liberalized in 1989, and Turkey has started to pursue floating exchange rate regime since the economic crisis in 2001. Figure 5 can be summarized as follow:

- i) Turkey has never prioritized the combination of exchange rate stability and financial openness (ERS+FO) over other two policy combination options in any subperiod.
- ii) ERS+MI dominates MI+FO policy combination for the period between 1970 and 1989 since ERS+MI traces the trilemma constraint

closer than MI+FO. This result is quite reasonable as one consider the fact that the main two characteristics of the 1970-1989 period are the existence of fixed and managed floating exchange rate regimes and the absence of liberalized capital accounts.

- iii) MI+FO dominates ERS+MI due to the fully liberalized capital accounts and managed floating exchange rates for the period between 1990 and 2000. Adoption of the managed floating exchange rate regime instead of fixed rates throughout 1990 and 2000 reveals the reason why exchange rate stability reduces compared to 1970-1989 period.
- iv) The policy makers in Turkey has been committing to MI+FO through 2001-2014 period. The policy combination of financial openness and monetary independence has naturally become more dominant throughout 2000s as Turkey started to pursue floating exchange rate regime in 2001.

**Figure 5:** Trilemma Policy Configurations, 1970-2014



### 3.2. Determinants of the Trilemma Policies

So far, it has been shown that (i) trilemma constraint is binding, and (ii) ERS+MI and MI+FO policy configurations dominated each other in different subperiods of the sample period. In this section, the determinants of the three trilemma policies will be identified empirically. In literature, there are several economic fundamentals employed as the explanatory variables of the various

trilemma policies. In this section, four explanatory variables are chosen among the variables that are most commonly used in the existing literature. These variables are relative per-capita income (per capita GDP as a percentage of the U.S. level); international reserves (excluding gold, as a percentage of GDP); financial development (private credit as a percentage of GDP); domestic savings (gross domestic savings as a percentage of GDP).

By following Ito and Kawai (2014), I use Zellner's seemingly unrelated regressions (SURE) procedure (Zellner 1962; Zellner and Huang 1962; Zellner 1963) with trilemma constraint, and estimate three trilemma policies simultaneously. The first reason to employ the SURE is that the contemporaneous errors associated with each trilemma index equations are likely to be correlated. Second, SURE estimation allows one to impose trilemma constraint on the system. Thus, I regress the three trilemma indices, ERS, FO, and MI on the same set of explanatory variables in the following system:

$$ERS_t = \beta_{ERS} + X_t' \Omega_{ERS} + \omega_{t,ERS} \quad (2)$$

$$MI_t = \beta_{MI} + X_t' \Omega_{MI} + \omega_{t,MI} \quad (3)$$

$$FO_t = \beta_{FO} + X_t' \Omega_{FO} + \omega_{t,FO} \quad (4)$$

where  $\beta$  is an intercept term,  $X_t$  is 4x1 vector of explanatory variables,  $\Omega$  is a 4x1 vector of coefficients, and  $\text{Cov}(w_{t,j}, w_{t,k}) \neq 0$  for  $j$  or  $k=(ERS,MI,FO)$ . Following two constraints were imposed in the SURE estimation such that the linear dependence of the three indices are hold in the long run, but there might exist some deviations from the linearity in short run:

$$\text{i.) } \beta_{ERS} + \beta_{MI} + \beta_{FO} = 2 \quad \text{and} \quad \text{ii.) } \Omega_{ERS} + \Omega_{MI} + \Omega_{FO} = 0 \quad (5)$$

That is, the summation of the three equations (2), (3), and (4) are equal to 2 plus the sum of the error terms which has the zero mean but may deviate from zero in each period temporarily.

**Table 2:** Expected Signs of Explanatory Variables

Explanatory Variables	Exchange Rate Stability (ERS)	Monetary Policy Independence (MI)	Financial Market Openness (FO)
Relative per-capita income	-	+	+
International Reserves	+	+	+
Financial Development	-	?	+
Domestic Savings	+	?	-

**Notes:** +/- indicates the theoretically expected sign of the explanatory variables on ERS, MI, and FO indices. “?” means no prediction is asserted by the theory. Source: Adapted from Ito and Kawai (2014)

Table 2 illustrates the theoretically expected signs of the explanatory variables on trilemma policy goals while Table 3 reports the estimated signs of the explanatory variables obtained by SURE with imposing restrictions. Most of the estimated signs are consistent with theoretical expectations summarized in Table 3; although, there are a few deviations from the expectations. Now, I discuss them below.

First, the relative per-capita income is predicted to have positive signs on MI and FO, and a negative sign on ERS. Theoretically, higher-income economies are expected to be well-prepared to defend themselves against the possible exchange rate shocks with more sophisticated and advanced institutions, suggesting that higher-income countries tend to pursue more flexible exchange rates<sup>7</sup>. On the other hand, rising income in an economy enable policy makers to maintain more independent monetary policies thanks to their increasing policy credibility<sup>8</sup>. Also, a country with higher income level stimulates policy-makers to liberalize financial markets since such a country is expected to be more capable to resist external financial shocks due to the

7 For example, Devereux and Lane (2003) revealed that richer countries have more stable exchange rates. Edwards (1996) indicated that adoption of a flexible regime requires sophisticated institutions, and more advance countries tend to select more flexible rates. Moreover, Breedon, Petursson and Rose (2012) concluded that small countries mostly choose tightly managed exchange rate regime.

8 For example, Ito and Kawai (2014) presented evidence that higher income economies pursued greater monetary policy independence. Additionally, Huh et al. (2016) showed that an increase in per-capita income strengthens monetary independence.

advanced institutions, and financial /legal systems. In contrast, lower-income economies attempt to impose larger capital controls to aid the development of national enterprises<sup>9</sup>. Table 3 reveals that the impact of the relative per-capita income on ERS is negative (and statistically significant) as expected. Moreover, the effects of the relative per-capita income on MI and FO are both positive cohering with the theory while only the one on FO is statistically significant.

**Table 3:** Estimated Signs of the Determinants of Trilemma Indices

Equation	Variables	Coefficients	MSL
ERS	Relative per-capita income	-/(*)	0.000
	International Reserves	+/(*)	
	Financial Development	-/(*)	
	Domestic Savings	-/(*)	
	Intercept	+/(*)	
MI	Relative per-capita income	+	0.008
	International Reserves	+/(*)	
	Financial Development	-/(*)	
	Domestic Savings	-/(**)	
	Intercept	+/(*)	
FO	Relative per-capita income	+/(*)	0.000
	International Reserves	+	
	Financial Development	+/(**)	
	Domestic Savings	+/(*)	
	Intercept	-/(*)	

**Notes:** \* and \*\* represent that corresponding coefficients are statistically significant at five and ten percent level, respectively. MSL represents the marginal significance level (or the p-value) of the any equation with all explanatory variables.

<sup>9</sup> Klein (2012) and Leblang (1997) suggested that poor countries have more tendency to restrict foreign financial transactions.

Second, the amount of international reserves is expected to have positive impacts on ERS, FO, and MI. A country with large international reserves tend to adopt lower exchange rate flexibility since reserves are considered as “insurance” to stabilize exchange rate movements<sup>10</sup>. Similarly, an economy with larger amount of reserves are considered to have enough “ammunition” to fight against external shocks possibly triggered by open financial markets. Finally, monetary authorities in a country with large amount of reserves can pursue a greater monetary policy independence since they can conduct sterilized interventions to restore the monetary base to its desired original size. As seen in Table 3, all coefficients are theory-coherent and all but one on FO are statistically significant.

Third, the level of financial development is predicted to have a negative sign on ERS, a positive sign on FO, and an ambiguous sign on MI. A country with highly developed financial markets tends to pursue floating exchange rates since such developed financial markets easily absorb exchange rate instabilities<sup>11</sup>. Theoretically, a country with more developed financial markets have more tendency to liberalize their financial markets since such a country is expected to be more capable to resist against possible external shocks and speculative attacks. Finally, theory does not provide a priori prediction of the sign of the financial development on MI. The results in Table 3 show that the coefficients of financial development on ERS and FO are consistent with theoretical considerations, and both are statistically significant.

Finally, domestic savings are expected to have a positive, negative, and ambiguous impact on ERS, FO, and MI, respectively. A country with higher domestic savings are expected to keep exchange rate more stable since a recovery in the current account balances by an increase in domestic savings suggests more ability to resist against possible exchange rate instabilities.<sup>12</sup> Moreover, an economy with higher level of domestic savings do not require high degree of financial market openness as they can provide their domestic savings from their own credit markets. Finally, theory does not provide a priori prediction of the sign of domestic savings on MI. Table 3 reveals that the

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10 Obstfeld, Shambaugh, and Taylor (2009), Aizenman and Riera-Crichton (2008) and Hviding, Nowak and Ricci (2004) concluded that holding adequate reserves reduces exchange rate volatility.

11 Lin and Ye (2011), Ito and Kawai (2014) found that countries with higher levels of financial development are more likely to exit fixed exchange rate.

12 For example, high savings rates have allowed China to keep the exchange rate stable over a long period by inducing a trade surplus.

statistically significant coefficients of domestic savings on ERS and FO are not consistent with theoretical expectations. This finding is somewhat puzzling.

#### 4. Deviations from the Trilemma Optimality and International Reserves

In Section 3.1, it has been shown that trilemma constraint is binding over the whole sample period, and the policy objectives in trilemma triangle are linearly related to each other. However, policy-makers sometimes conduct macroeconomic policies which violate the trilemma constraint. For example, suppose policy-makers of an economy pursue a policy combination of financial openness and monetary autonomy at the expense of a loss of exchange rate stability. However, the central bank of the economy can also desire to increase exchange rate stability with continuous interventions, which implies deviations from trilemma constraint. If the policy-makers insist on deviating trilemma constraint, “market forces will punish the authorities by creating a financial crisis or some form of economic or financial turbulence, or force them to alter policies in a way consistent with the trilemma constraint” (s.25) as stated by Ito and Kawai (2014).

Ito and Kawai (2014) define a measure of deviations ( $d$ ) from the optimal trilemma policy combination by using following equation:

$$d = (ERS_t - ERS_t^{OPT}) + (MI_t - MI_t^{OPT}) + (FO_t - FO_t^{OPT})$$

where  $ERS_t^{OPT}$ ,  $MI_t^{OPT}$ , and  $FO_t^{OPT}$  represent the long run optimal values of each trilemma indices. These values are fitted values estimated from SURE estimation in Section 4.2 while ERS, MI, and FO represent actual indices<sup>13</sup>. The key idea here is that trilemma constraint is binding in the long run, suggesting that measure of deviations is equal to 0 ( $d=0$ ), while there might exist short run deviations.

Table 4 illustrates the absolute deviations. First, the null hypothesis that the mean of the deviations is equal zero cannot be rejected. Second, as seen in Table 4, the absolute deviations from 1970 to 2000 are lower than those over the period 2001-2014. An increase in  $d$  represents larger deviations from the trilemma constraint. Similarly, the IR/GDP ratio substantially increases at the

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<sup>13</sup> SURE estimation is run by imposing long run trilemma constraint with possible short run deviations as suggested by Section 3.2; hence, SURE naturally provides the optimal long-run level of the trilemma indices.

same period (see Figure 2). Now, the motivation for Turkey to hold greater IR in conjunction with rising deviations is required to explain.

**Table 4:** Absolute Deviations and International Reserves

Period	$ d $	IR/GDP
1970-2000	0.21	0.04
2001-2014	0.31	0.12

**Table 5:** Direct Foreign Exchange Interventions under the Floating Exchange Rate Regime (Million U.S. Dollar)

Date	Amount Purchased	Amount Sold
11.07.2002		3
02.12.2002	16	
24.12.2002		9
12.05.2003	62	
21.05.2003	517	
09.06.2003	566	
18.07.2003	938	
10.09.2003	704	
25.09.2003	1442	
16.02.2004	1283	
11.05.2004		9
27.01.2005	1347	
09.03.2005	2361	
03.06.2005	2056	
22.07.2005	2366	
04.10.2005	3271	
18.11.2005	3164	
15.02.2005	5441	
13.06.2006		494
23.06.2006		763
26.06.2006		848
18.10.2011		525

30.12.2011		1865
02.01.2012		525
03.01.2012		326
04.01.2012		155
23.01.2014		3151
Total Number of Interventions:27	Total Purchases:25534	Total Sales:8673
		Total Purchases and Sales:34207

**Source:** Reprinted from CBRT

As mentioned in Section 3.1, the policy combinations of monetary independence and financial openness has become more prevalent between 2001 and 2014. This is not unexpected as CBRT relaxes the exchange rate stability by adopting floating exchange rate regime since 2001. However, as shown in Table 5, CBRT intervenes in the exchange rate market 27 times between 2001 and 2014 to reduce the excess volatility of exchange rates. These interventions normally create some deviations from the trilemma constraint. Probably substantial increase in IR/GDP ratio between 2001 and 2014 stimulated CBRT to frequently intervene in exchange rate markets since international reserves are considered as “ammunition” to defend the country against economic or financial turbulences. That is, growing ratio of IR/GDP gave CBRT more desire to relax trilemma constraint as CBRT considered itself to be secured against any possible economic and financial turbulences which might be triggered by its interventions. This result is consistent with Steiner (2015), Aizenman et al. (2010, 2013), and Popper et al. (2013) claiming that an active reserve policy with liberalized capital account allows central banks to pursue policy combination of independent monetary policy and more stable exchange rate policies. This potentially explains why Turkey has been accumulating international reserves in parallel with rising deviations from the trilemma constraint.

### **Concluding Remarks**

Impossible trinity is quite important concept in international economics since it gives theoretical insight regarding how to pursue various policy configurations such as monetary independence, exchange rate stability, and financial openness. It simply states that a country cannot achieve a stable

exchange rates, independent monetary policy and free flow of capital simultaneously.

This study investigated the trilemma hypothesis and various trilemma policy configurations over a long period, 1970-2014 for Turkey and answered several questions. First, I investigated the linearity of the three trilemma policy goals and concluded that an increase in one of the trilemma indices is followed by a decrease in the weighted sum of the other two variables. That is, there exists a trade-off among three macroeconomic policy goals. Second, simple economic fundamentals which possibly determine the trilemma goals are investigated by applying SURE. Most of the explanatory variables are found to be statistically significant and coherent with theoretical expectations. Third, the weighted predictions of various trilemma policy combinations showed that actual trilemma policy configurations have changed over time, and the policy configuration of financial openness and monetary independence has become more dominant during 2000s. Finally, this study revealed that CBRT tends to relax trilemma constraints by its interventions since 2001. Even though violation of trilemma constraint made Turkish economy more fragile against economic and financial turbulences, growing international reserves gave CBRT more self-confidence to relax trilemma constraint and pursue more stable exchange rates. This result may also explain why most countries in East Asia over the past decade could maintain open capital markets and monetary autonomy in addition to a fair degree of exchange rate stability contrary to what is asserted by trilemma hypothesis.

However, there is one last point worth mentioning. Even though increasing reserves enable CBRT to deviate trilemma constraint, CBRT cannot increase them forever. Many scholars including Feldstein (1999) have pointed out that accumulating reserves are costly. Central banks tend to lower the net cost of holding international reserves by investing them mostly in the form of low-yielding U.S. Treasury Bills. Hence, CBRT should take the total net cost of holding large stock of reserves, which is simply the difference between the cost of external borrowing and yield on U.S. Treasury Bill, into account when accumulating reserves.

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**Appendix 1: Variables and Data Sources (1970-2014)**

Variable	Data Source
Index for Exchange Rate Stability	Aizenman, Chinn, and Ito (2013)
Index for Financial Openness	Aizenman, Chinn, and Ito (2013)
Index for Monetary Autonomy	Aizenman, Chinn, and Ito (2013)
GDP (Gross Domestic Product)	World Bank, World Development Indicators
International Reserves (Excluding Golds)	World Bank, World Development Indicators
Financial Development (Domestic Credit as a Percentage of GDP)	World Bank, World Development Indicators
Domestic Savings (Gross Domestic Savings as a Percentage of GDP)	World Bank, World Development Indicators
Relative Per-Capita Income (As a Percentage of U.S. Per-Capita Income)	World Bank, World Development Indicators