

Turkey' Trilemma Trade-offs: Is there a role for reserves?

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Abstract

In this paper, we empirically investigate the Mundell-Fleming theoretical concept of an "impossible trinity" (trilemma) for Turkey, following the Aizenman, Chinn and Ito approach. However, we also introduce alternative empirical techniques in order to deal with possible misspecification problems that we detect in the mentioned approach. Accordingly, we show that financial integration and monetary independence have increased from late 1990s to 2010, with corresponding limitations on exchange rate stability. Our analysis continues by exploring the implications of changes in the trilemma indices for inflation in a regression in which we find that trilemma indices have certain impact on inflation. Finally by introducing international reserves (as a percentage of GDP) to the equation, we also attain role for international reserves on decreasing inflation conditional upon it is above a certain threshold.

Keywords: Trilemma, Impossible Trinity, International Reserves.

JEL Classification: E44, E58, F41.

Özet. Türkiye'nin İmkânsız Üçlü Kuramındaki Açmazları: Uluslararası Rezervler İçin Rol Var mı?

Bu çalışma Mundell-Fleming'in imkânsız üçlü kuramını Türkiye için Aizenman, Chinn ve Ito yaklaşımı çerçevesinde incelemektedir. Çalışmanın ilk bölümünde söz konusu yaklaşımın Türkiye için spesifikasyon hatası içerdiği gösterilmekte ve bu durum alternatif teknikler kullanmak suretiyle giderilmeye çalışılmaktadır. Yapılan incelemede Türkiye'de 1990'ların sonlarından 2010 yılına kadar olan dönemde; döviz kuru oynaklığını azaltıcı politikaların ağırlığının azaldığı, finansal entegrasyonun ve para politikası serbestliğinin ağırlığının ise artmış olduğu gözlenmiştir. Çalışmanın ikinci kısmında imkânsız üçlü kuramını oluşturan endekslerin enflasyona etkisi regresyon analizi çerçevesinde irdelenmiş ve istatistiki olarak anlamlı bir etki bulunmuştur. Bu kapsamda uluslararası rezervlerin de kilit bir role sahip olduğu ve (GSYİH'ya oran olarak) belirli bir seviyenin üzerine çıkıldıkça enflasyon üzerinde azaltıcı bir etki yarattığı gösterilmiştir.

Anahtar Kelimeler: İmkânsız Üçlü Kuramı, Uluslararası Rezervler.

JEL Sınıflaması: E44, E58, F41.

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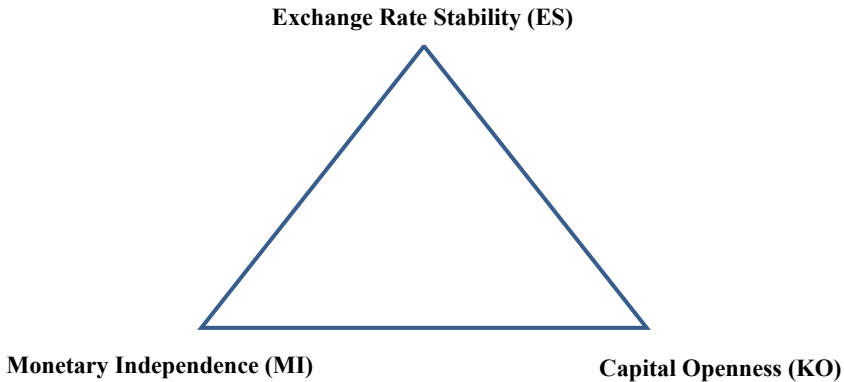
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1. Introduction and Literature Review

The macroeconomic policy “trilemma” for open economies, also known as the impossible trinity, states that a country simultaneously can choose at most two of the following three goals: monetary independence (MI), exchange rate stability (ES) and capital account openness (KO). The trilemma policy trade-offs are conveniently represented via a triangle, where each vertex of the triangle in Figure 1 represents full attainment of one of the three goals. Therefore, as shown, being at any side of the triangle represents attainment of two of the three goals, at the expense of abandonment of the third.

Clearly, an economy cannot be positioned on all three vertexes of the Figure 1 triangle at once. However, since each of the three goals is potentially desirable, it is conceivable that policy makers would attempt to meet all three partially, which is captured in Figure 1 as being at a point somewhere in the interior of the triangle. For example, a country might have a managed float and some capital controls, sacrificing some monetary independence as well in the face of international capital flows.

Figure 1: The Trilemma Framework



In fact, the partial attainment of all three policy goals has seemed to characterize policy-making in practice, and has perhaps even been the dominant global policy stance, especially for emerging market economies. This “mixed” approach to the trilemma has been characterized by continual adjustment of policies in response to a rapidly changing global environment, as well as attempts to implement market-oriented economic reforms. At the same time, government policy makers have not always had clear guidance on how precisely to manage the trade-offs: in terms of Figure 1, what is the optimal position in the triangle at any given time? Or, even more fundamentally, what are the joint implications of a complex set of macroeconomic policy decisions

for the policy stance of an economy, viewed from the lens of trilemma trade-offs? Can a country's policy-makers even know where they are positioned in the triangle?

Therefore, it is important to have a better understanding of how to characterize and measure various different mixtures of trilemma policy stances, and the present paper contributes to an emerging literature in this area. The underlying theoretical framework of the trilemma, namely the Mundell-Fleming model, is not very easily adapted to analyzing the partial attainment of all three goals in formal theoretical modeling. In the literature following Mundell (1963) and Fleming (1962), there have been works on achieving all three goals to some extent. Obstfeld and Taylor (1997) use the term as "open-economy trilemma" and Obstfeld (1998) argued that policymakers will have to face this tradeoff even more fiercely with the global capital market integration speeding up further. Rodrik (2000) provided a lucid overview of the general working of the trilemma in an international environment. Calvo and Reinhart (2001) argue that under the free oat there could be limited monetary autonomy while Bordo and Flandreau (2003) show that even under the classical gold standard domestic monetary autonomy is considerable. Likewise, Obstfeld et al (2005) discussed that under capital mobility and national monetary policy, fixed exchange rates will invariably break down. More recently Akyüz (2007) contributed to the literature by examining the issue from a developing country perspective.

On the empirical side, Benassy-Quere, A. and Cure, B. (2002) have shown that the optimal exchange rate policy is not necessarily the hard peg or free oat but somewhere in between, in which the exact location depends on country structural characteristics and government preferences. Within this context, Aizenman, Chinn and Ito (2008, 2010) recently developed a new methodology to empirically characterize the mixed approach to the trilemma in practical policy-making. In their approach, ACI (2008, 2010) initially measure each policy dimension via an empirical index. For each index, a higher value represents greater closeness to that policy goal. In this case, the question of how trilemma-based policy trade-offs are managed becomes an empirical exercise.

The theoretical constraint of trade-offs between the three policy goals is then captured by estimating a regression equation in which the dependent variable is a constant (in their case, one), and the independent variables are the three trilemma indices (with the constant term excluded, of course). However, in this regression, the estimated coefficients alone will not provide sufficient information about "how much of" the policy choice countries have actually implemented even though they should give us some approximate estimates of the weights countries put on the three policy goals. Hence, following ACI,

looking into the contributions using the estimated coefficients and the actual values for the variables (such as $a*MI$, $b*ES$, and $c*KO$) will be more informative. The coefficients multiplied by the values of the indices therefore indicate the *relative contributions* of the three variables to the overall trilemma policy stance. Besides, while making comparisons between sub-periods, we calculate the share of each trilemma index's contribution by dividing it to the sum of the contributions as the latter might also vary from time to time.

The ACI methodology is applied to large cross-sections and time-averaged panels of countries, in order to discern patterns of trilemma policy stances in different groups of countries, and at different points in time. Cross-country analysis can also be useful for individual country policy-makers, but it will typically not be sufficient for understanding a single country's past policy choices and future policy options. Our focus in this paper is therefore on applying the ACI methodology to a single country, Turkey, with the objective of more specifically understanding the detailed evolution of the policy stance toward the trilemma trade-offs. In this regard, this paper is similar to Hutchison, Sengupta, and Nirvikar Singh (2012). Authors of this paper also focused on a single country, India, in their work and investigated evolution of India's trilemma indices over time. They empirically confirm that a rise in one trilemma variable is traded off with a drop in the weighted sum of the other two, i.e. the trilemma configuration is binding in India. Another work in this context belongs to Aizenman and Sengupta (2011) who compare India and China with respect to the financial trilemma.

Nevertheless, applying ACI approach to a single country increases the possibility of misspecification given that a regression is performed without a constant on the right hand side of the equation. In the case of a misspecification, regression coefficient estimates become biased and inconsistent. Thus, we also perform a specification test i.e. the Ramsey RESET test, to check the specification of the regression. In the case of a possible misspecification, we attempt to overcome it by employing alternative techniques; i.e. two stage least squares (TSLS) and employing Kalman filtering methodology into ordinary least squares (OLS) framework that allow coefficients vary over time. Among these alternative different techniques, our examination favors the Kalman filtering methodology and according to the results obtained from applying this methodology, we find that financial integration and monetary independence have increased from late 1990s to 2010, with corresponding limitations on exchange rate stability. Lastly, our analysis has explored the role of trilemma indices and international reserves on inflation. In this context, we find that there is a key role for international reserves as trilemma trade-offs and their effects on inflation can be mitigated with its accumulation.

The paper proceeds as follows: Section 2 gives a brief description of

Turkish macroeconomic policies in the period of 1998-2010. Section 3 describes the methodology and the dataset used in this study. Section 4 and 5 conduct the econometric analysis and report the results on the trilemma-influenced policy configuration respectively. Section 6 investigates impacts of the trilemma policy configuration, including the role of foreign exchange reserves on inflation. Lastly, Section 7 presents the conclusions.

2. Dealing with the Trilemma Trade-offs

Liberalization of the Turkish economy started in the early 1980s and was effectively completed in 1989 with the recognition of full convertibility of the Turkish Lira. Two decades of experience after liberalization have provided a basis for examination of Turkish economic policies with regards to the trilemma trade-offs. Since 1989 when Turkey became financially liberalized, the Turkish economy could not manage to achieve a solid economic performance at all times. In fact, two serious exchange rate crises hit the economy in 1994 and 2001 due to the vulnerability caused by financial liberalization and accompanying high current account and budget deficits. With the later one, devaluation rate reached 100 percent and the Turkish economy has changed completely its strategy in dealing with the trilemma trade-offs. Before 2001, exchange rate policy was to devalue the Turkish Lira in line with inflation against a currency basket. However, after 2001, the exchange rate was allowed to float freely and monetary independence gained a more active role. Below, we examine macroeconomic policy implementations of Turkey in two main periods: the pre-2001 period and the period from 2001 till today.

2.1. Pre-2001 Period

After the completion of capital account liberalization in 1989, there has been a relatively massive short term capital inflow to Turkey whereas long term inflows including direct investment remained limited¹. In consequence, Turkey's macroeconomic performance soon became dependent on short-term capital inflows, besides Turkey had lived through chronic fiscal imbalances and a high and chronic inflation. In order to overcome inflation and to achieve macroeconomic stability, Turkey has launched many stabilization programs, at the center of which lay the exchange rate stability. However, as most of the exchange rate based stabilization programs were either interrupted or stopped, Turkey could achieve neither price stability nor sustainable growth rates. (Central Bank of the Republic of Turkey, 2004). As the economy has been trapped into high real interest rates together with an overvalued domestic

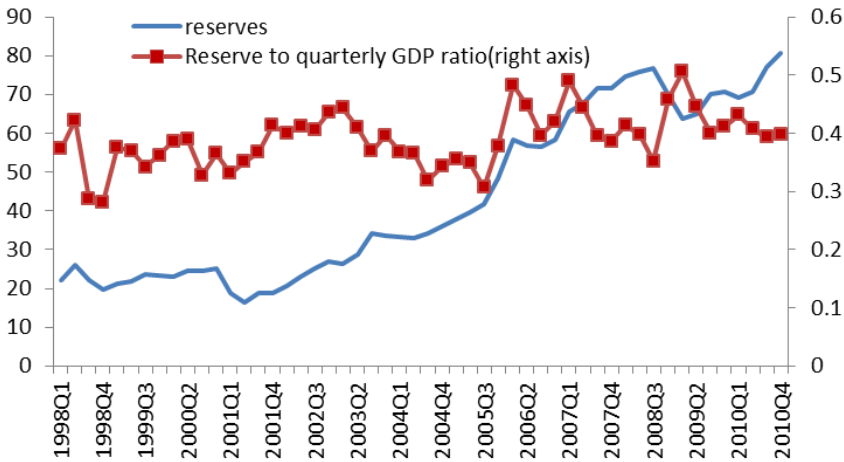
¹ The level of FDI inflows remained stable in Turkey during the 1990s averaging less than 0.5% of GDP, while FDI surged over the world (OECD reviews of Regularity Reform in Turkey, 2002).

currency, the monetary authority was bound to a passive role in this period (Balkan and Yeldan, 2002).

2.2. Post 2001 Period

The 2001 crisis was an important watershed for the Turkish economy as it made clear that any version of pegged exchange rate regime was not possible to carry out due to the loss of confidence of economic agents in the sustainability of such a regime. Hence, on 22nd February of 2001, the Turkish Lira was allowed to float freely in order to prevent further damage to the economy. Under this exchange rate regime, the Central Bank of Republic of Turkey (CBRT) does not have a nominal or real exchange rate target. Nevertheless, the CBRT held foreign exchange buying auctions to build up reserves at times when foreign exchange supply increases relative to foreign exchange demand. This attitude is in accordance with the view that deems strong foreign exchange reserve positions as a great contributor for emerging economies in curbing the unfavorable effects of shocks. Within this context, the Central Bank has undertaken a net purchase of around USD 80 billion in the period of 2002-2010 (as shown in Table 1) and Central Bank's foreign exchange reserves surged as shown in Figure2.

Figure 1: International Reserves



By implementing a floating exchange rate regime, the Turkish Central Bank had to chance to gain a more active role after 2001 in achieving price stability. In this context, a new monetary policy strategy, namely an inflation targeting (IT) regime, was designed. This regime was implemented implicitly during the period between 2002-2005 and explicitly thereafter which indicates to a significant move in positioning within the trilemma triangle.

3. Data

Our approach of constructing the trilemma indices mainly follows Aizenman, Chinn and Ito (2008, 2010). Hence, we initially construct indices for each of the three policy objectives of the trilemma: monetary independence, exchange rate stability and capital account openness (or financial integration). Nevertheless, our study has two departures from Aizenman, Chinn and Ito (ACI) approach. First of all, instead of using cross-country data and time-averages of annual data, we use data for a single country, Turkey. Besides, the data we employ, being quarterly, is higher in frequency than employed by ACI. Secondly, we use a different measure of capital account openness than the preceding authors whereas this last departure being dictated by the needs of a time series analysis of trilemma policy stances.

For composing the trilemma indices, we obtain quarterly data on GDP, exchange rate, interest rates and capital flows from the CBRT website. We use the nominal Turkish Lira-to-US dollar exchange rate series to construct a quarterly index of exchange rate stability, as described in the next subsection. For calculating the monetary independence index, we use interbank overnight interest rates for Turkey and for the US. For the latter, we use effective Federal fund rates which we obtain from Federal Reserve System database. The correlations between these two are used to create a quarterly index of monetary independence, again as described in the next subsection. To examine the impact of international reserves, we use data from the CBRT website where the data is weekly. We average international reserve figures for each quarter to construct a quarterly series for international reserves of Turkey². For the policy outcome of inflation, we use the CPI index together with its expectations from the CBRT database. The inflation series is quarterly averages of monthly inflation figures.

Lastly, the main data constraint in this work is related with the capital openness index. Quarterly data for capital flows is available starting from 1992. Nevertheless, since we describe capital openness as a ratio over GDP as explained in the next subsection, our data starts from 1998Q1 and extends to 2010Q4, covering 52 quarters. The reason for losing the period of 1992 to 1998 is mainly because the up-to-date GDP series for Turkey starts from 1998. Year of 2011 and 2012 are not included in the analysis as the CBRT has been implementing a new policy mix since then³.

² Since reserves are a stock, and GDP is a flow variable, one can calculate the reserves-to-GDP ratio using quarterly data after annualizing the GDP figure by multiplying it by four. However, this will not change any of our results in our analysis.

³ New policy mix is discussed in more detail by Aktas and Cortuk (2012). With regard to this new policy mix, some argue that CBRT was trying to do “too much” defying the impossible trinity (assuming a role that it should not as it involves some form of control over the exchange rate, etc.) as discussed by Akçay and Ocakverdi (2012).

3.1 Construction of Indices

The key constructs for examining the policy configuration with respect to the trilemma are indices of monetary independence (MI), exchange rate stability (ES) and capital account openness (KO). These indices are constructed as follows:

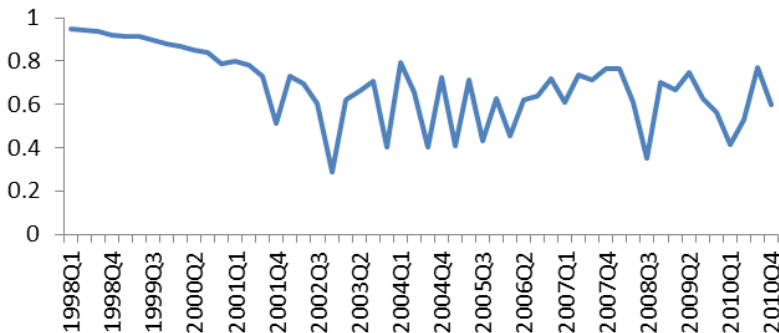
Exchange Rate Stability (ES) Index

Following ACI (2008), we construct this index by calculating the quarterly standard deviations of the change in the log of the Turkish Lira-US dollar exchange rate, and the index is then constructed according to the formula below:

$$\frac{1}{1 + \frac{\text{stdev}(\text{exch_rate})}{|d \log E_t / dt| + 0.01}} \quad \text{where } |d \log E_t / dt| \text{ is the absolute value of the}$$

quarter-on-quarter depreciation rate. The scaling ensures that the index lies between 0 and 1, with the highest value indicating the greatest degree of exchange rate stability. In the calculation of this index, we depart from ACI (2008) by employing daily series in order to be more precise. The evolution of this index for the sample period is shown in Figure 3 which is line with the implemented exchange rate policies. As exchange rate is allowed to float freely after 2001, its stability fluctuates during 2000s. Yet, it becomes much lower on average compared to the pre-2001 period.

Figure 3: Exchange Rate Stability (ES) Index



Monetary Independence (MI) Index

We again follow Aizenman, Chinn and Ito (2008) in measuring MI as the reciprocal of the correlation of interest rates in the home country (here Turkey) and the base country (here the United States). Quarterly correlations

are calculated using daily interest rate data whereas ACI (2008) used monthly interest rates. As mentioned earlier, the interest rates are overnight interbank rates. The formula used for constructing this index is:

$$MI = 1 - \frac{corr(i_H, i_B) - (-1)}{1 - (-1)}$$

The scaling ensures that the index lies between 0 and 1, with the highest value indicating the greatest degree of monetary independence. The plot of the MI index is shown in Figure 4. The index fluctuates around 0.5 throughout the entire period of 1998-2010. However, the variation of the index increased considerably after 2001 indicating to a more responsive monetary policy implementation under the inflation targeting regime.

Figure 4: Monetary Independence (MI) Index



Capital Openness (KO) Index

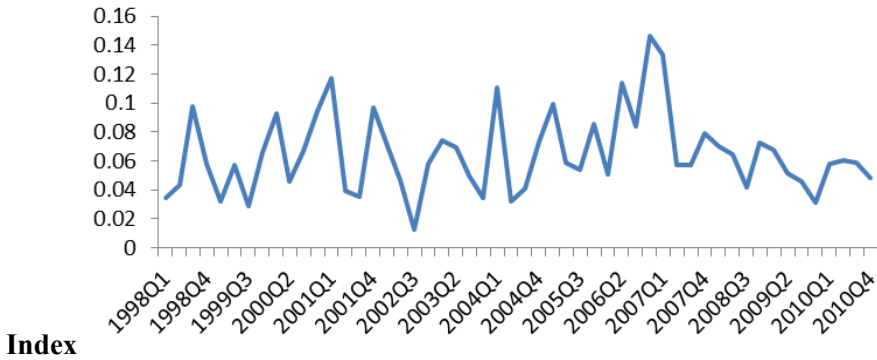
For construction of the KO index, we need to differ from the ACI approach of employing a de jure measure due to lack of data with sufficient frequency. Instead, we use simple de facto measure of capital account openness, the ratio of the sum of inward and outward foreign investment flows to GDP following Hutchison et al (2012). Within this definition, we add FDI and portfolio flows and get a ratio by dividing their sum over GDP⁴. This can also be justified by the fact that de facto capital openness is not only driven by de jure restrictions on capital flows but also those on current account transactions as well as export proceeds and exchange rates. Within this context, a country like Turkey, while having an open capital account, may still restrict the flow of capital by limiting transactions on the current account or controlling

4 One can also argue that “other investments” item should be added to the sum of FDI and portfolio flows following Aizenman and Sengupta (2011) in obtaining a capital openness index. For Turkish case, however, other investment item includes IMF credits which are used during weak capital flows epoch instead of a strong one. Hence, adding other investment item can mislead the results in Turkish case. With regard to other alternative capital openness measures that take into account the price based measures (e.g. deviation from uncovered interest rate parity), data availability is usually a big concern.

exchange transactions.⁵ In contrast, a country with capital controls can still be financially more open than a country without capital controls as private sector can circumvent such controls in most cases.

A critical point regarding our measure of capital account openness is that the KO index is not theoretically constrained to lie between 0 and 1 – the upper bound cannot be imposed. However, for the sample period, it is easily met as shown in Figure 5 which illustrates a rise in capital openness on average from 1998 to 2007 and a decline afterwards possibly due the global crisis experienced.

Figure 5: Capital Openness (KO)



4. Methodology

In analyzing Turkey's trilemma trade-offs, we start with employing the ACI approach which is described in more detail in the next sub-section for the post crisis period.

4.1 ACI Approach

Following ACI (2008), we initially test the validity of the trilemma framework in an OLS regression but with no constant as an explanatory variable. This reduces to examining the goodness of the fit of the below regression⁶:

$$2 = aMI_t + bES_t + cKO_t + \varepsilon_t \quad (1)$$

5 Taxing imports for some specific goods and a restricted exchange rate regime are examples of these kinds of restrictions that Turkey has implemented.

6 For this regression, we detect autocorrelation in our robustness checks in several cases, even though the significance of our coefficients is affected only in a limited manner. Hence, we employ Newey-West standard errors in our regressions in order to be more precise and consistent in the presence of both heteroskedasticity and autocorrelation. The constant term on the left hand side of the regression is set equal to 2, since policy configurations on the vertices of the trilemma triangle would correspond to two indices equal to 1 and the third index equal to zero. Of course, this is just a normalization, and following ACI in using 1 on the left hand side would simply halve the estimated coefficients.

The contributions obtained from equation (1) for the subsamples are reported in Table 2. This table reports the means, coefficients and contributions of the three indices. The overall fit is extremely good, reflected in the high adjusted R-squared figure.

Table 1 OLS Coefficients and Contribution Estimates

<u>2001Q2-10Q4</u>		
	MI	0.503
MEANS	ES	0.618
	KO	0.065
	MI	0.718***
COEFF.	ES	2.21***
	KO	3.215*
	MI	0.361
CONTRIB.	ES	1.365
	KO	0.209
	<u>Adj. R Square</u>	<u>0.96</u>

*, **, *** denote statistical significance at 10%, 5% and 1% levels respectively.

Nevertheless, we need to examine the robustness of the contribution estimates as the basic analysis may possess specification problems. In this regard, Ramsey and Alexander (1984) showed that the **Ramsey Regression Equation Specification Error Test (RESET)** test could detect specification error in an equation which nonetheless gives satisfactory values for traditional test criteria (goodness of fit, high t-ratios etc). Thus, as a next step in our analysis, we assess the appropriateness of ACI approach by performing the Ramsey RESET test.

4.2 Testing the Specification: Ramsey RESET Test

The Ramsey RESET test developed by Ramsey (1969) is a general specification test for the linear regression models. More specifically, it tests whether non-linear combinations of the explanatory variables have any power in explaining the endogenous variable. Technically, Ramsey (1969) proposed to generate new regressors that are functions of fitted values of the initial regression and test the nonlinearity as the Wald test of restrictions in which null hypothesis is “No misspecification”.

For our trilemma regression, Ramsey RESET test indicates to misspecification as shown in Table 3 despite the attractive results. Accordingly, ACI approach may have at least one of the following types of specification

errors which make its estimates biased and inconsistent:

- Endogeneity problem
- Incorrect functional form

In the next sub-section, we attempt to overcome those different types of specification errors.

Table 3 Contribution Estimates for the Period of 2001Q1-2010Q4

		ACI Approach	TOLS-1	TOLS-2	Kalman F. Approach
	MI	0.361	-0.16	0.867	0.298
	ES	1.365	-0.67	2.397	1.410
	KO	0.209	2.819	-1.270	0.154
Ramsey	F stat	341.60	1.595	1.350	
RESET Test	(prob)	(0.00)	(0.214)	(0.253)	

4.3 Attempts to Adjust Misspecification

4.3.1. Dealing with the First Potential Problem of Endogeneity

Endogeneity, i.e., correlation between the disturbance and explanatory variables, can arise as a result of omitted variables and measurement error in our case⁷. Omitted variables problem occurs if the OLS analysis does not include all relevant variables. However, as we are constrained with three indices theoretically, we cannot add any other variables into our regression⁸. Regarding the measurement error problem, it occurs when a variable cannot be measured precisely. We are faced, therefore, with using an approximate measure, including some error of measurement.

The standard approach in dealing with endogeneity is to estimate the equation using *instrumental variables* regression. The idea behind is to find a set of variables, termed *instruments*, that are both correlated with the explanatory variables of the equation, and uncorrelated with the disturbances. Hence, these instruments are aimed to eliminate the correlation between right-hand side variables and the disturbances. In our case, we employ instrumental variables in two stage least squares (TOLS) analyses. In the first one, lagged values of capital openness solely and in the second one, lagged values of all indices are used as instruments. While the latter is the most straightforward alternative and serves as robustness check, the former is due to the fact that

⁷ Simultaneity and sample selection errors, which are not related with our context, are other problems that give rise to endogeneity.

⁸ We can still *add* quadratic (and/or even higher power) terms of the same indices into our regression equation. Yet, taking the higher power terms of indices results in small numbers given that the range of indices vary between zero and one. Besides, by adding extra terms, coefficients of the indices become insignificant and contribution figures become imprecise since our sample employs a limited number of observations.

we cannot observe capital openness precisely⁹.

4.3.2 Dealing with the Second Potential Problem of Incorrect Functional Form

Regarding the incorrect functional form problem, the linearity assumption embedded in ACI approach might have caused the specification error. To address this issue, some or all of the variables can be transformed to logs, powers, reciprocals, or in some other way. Hence, there is a wide range of alternatives in the form of *non-linear least squares*. To capture such issues, we employ the Kalman filter technique in the context of the classical linear regression but allowing its coefficients to vary over time. Hence, we take ACI approach into a more general and flexible framework in which OLS remains as a particular case in the analysis.

In fact, both the Kalman filter and OLS can be described as optimal procedures in that they are theoretically capable of providing minimum variance and unbiased estimators of the unknown coefficients of the classical linear regression model. In practice, however, because certain underlying assumptions of OLS are often violated, optimality may not result an AOLS regression is performed. On the other hand, Kalman filter framework has more flexibility in dealing with such violations. Thus, as Watson (1983) discusses, the Kalman filter can provide optimal estimates whenever OLS does and moreover is also capable of doing so even when OLS does not.

To perform the Kalman filter technique, we need to represent our trilemma regression as a state-space specification in which a measurement and three transition equations are employed. The transition equation shows the evolution of unobserved variables and the measurement equations show how the observed variables evolve as a function of the unobserved variables. In this context, our state space specification is as below:

Measurement equation:

$$2 = C(1)_t * MI_t + C(2)_t * ES_t + C(3)_t * KO_t + \delta_t$$

Transition equations:

$$C(1)_t = \rho_1 C(1)_{t-1} + v_t, \quad C(2)_t = \rho_2 C(2)_{t-1} + \eta_t, \quad \text{and} \quad C(3)_t = \rho_3 C(3)_{t-1} + \varepsilon_t$$

where $\delta, v, \eta, \varepsilon$ are

are assumed to be drawn from a normal distribution with zero mean.

Accordingly, measurement equation is our main trilemma regression where we regress a constant on the trilemma indices. With regard to the transition equations, we treat the parameters of the trilemma indices as unobserved and allow them to vary over time as AR(1) processes.

⁹ Measurement errors are expected to have no structure in our case (i.e. they are independent of their true indices) validating our instrumental variable choice of lagged values.

5. Trilemma Contributions: Findings

In this section, we assess different techniques discussed so far under the guidance of Ramsey RESET test. Starting with OLS (which ACI approach is based on), we have already shown that Ramsey RESET test rejects this specification. As OLS approach is misspecified, our contribution figures are biased and inconsistent. This is a crucial finding as it indicates that it is misleading to some extent to apply the ACI approach for Turkey. Next, we perform two TSLS regressions both of which are verified by the Ramsey RESET test. Nevertheless, contribution estimates of both versions differ from each other at a great deal and these estimates indicate to negative and imprecise contributions for the trilemma indices. Such a finding is crucial to understand that the results depend highly on the choice of instrumental variables even they are verified by the Ramsey RESET test. Hence, we can conclude that employing instrument variables is not a feasible option in search of consistent contribution figures.

Next, we have performed the Kalman filtering framework. Contribution estimates of this analysis are comparable to those obtained from the OLS analysis¹⁰. According to the contribution estimates of the Kalman filter approach, exchange rate stability is again the highest contributor whereas contributions of monetary independence and capital openness are rather limited.

Nevertheless, we need to investigate the results of Kalman filter approach to make sure that this approach is indeed superior to the ACI approach. As Ramsey RESET test can be applied to only linear regressions, we compare Kalman filter approach with the ACI approach by examining the residuals of both techniques. These are shown in Table 5. Accordingly, residuals obtained from the Kalman filtering set up have smaller sum of square and are more likely to exhibit a normal distribution than those obtained from ACI approach. Based on this consequence and given that ACI approach suffers from misspecification problems, we continue our analysis in the next section with the Kalman filter framework.

Table 5 Comparison of Residuals Obtained from Kalman and ACI Approaches

Residuals	Standard deviation	Sum of squared errors	Jarque-Bera statistics
Kalman approach	0.32	4.81	3.81
ACI approach	0.36	4.96	4.80

¹⁰ This is mainly because ACI methodology is still a good approximation.

5.1 Calculating Contribution Estimates of Different Sub-Periods

In this sub-section, we compare the contribution estimates of different sub-periods to see how implemented policies affected the trilemma configuration and whether the contribution estimates obtained by employing the Kalman filter technique can capture these changes. Thus, first of all, we add the period of 1998Q1 to 2000Q4 into our analysis horizon and calculate the contribution estimates of the trilemma indices for this period. Secondly, we divide the period of 2002Q1-2010Q4 into two as 2002Q1-2005Q4 and 2006Q1 and 2010Q4 representing the epochs of implicit and explicit inflation targeting regimes respectively¹¹. Accordingly, we obtain contribution estimates of each trilemma index for three time frames as shown in Table 6.

Table 6 Contribution Estimates of Different Periods

	1998Q1-2000Q4	2002Q1-2005Q4	2006Q1-2010Q4
MI	0.064 (3.30 %)	0.307 (16.78 %)	0.331 (17.28 %)
ES	1.842 (95.45 %)	1.373 (75.02 %)	1.414 (73.86 %)
KO	0.024 (1.25 %)	0.150 (8.20 %)	0.170 (8.86 %)
TOTAL	1.930 (100 %)	1.83 (100 %)	1.915 (100 %)

Before going into details, a critical point that should be raised is that the sum of the contributions of trilemma indices also differs from first sub-period to the last representing how binding is the trilemma trade-offs during the each sub-period. While sum of the contributions of the trilemma indices as presented in Table 6 is 1.93 in the first period, it realized as 1.83 and 1.915 in the second and third sub-periods¹². Hence, in order to make comparisons between sub-periods regarding the contribution of each index, we calculate the shares of each trilemma index's contribution.

Starting with the first period of 1998Q1-2000Q4, exchange rate stability dominates the trilemma framework with the highest contribution figure by far whereas other two indices (MI and ES) have negligible contributions. During this period, the Turkish government implemented a disinflation program under the guidance of IMF in which the exchange rate basket was announced on a daily basis for the following 12 months. The increase in the FX basket was targeted to increase by as much as the monthly inflation rates. Within this regard, our results are in line with the policies implemented during this period.

11 Main difference between implicit and explicit inflation targeting regimes is that monetary aggregates were also used as complementary anchors on certain central bank balance sheet items regarding the former one.

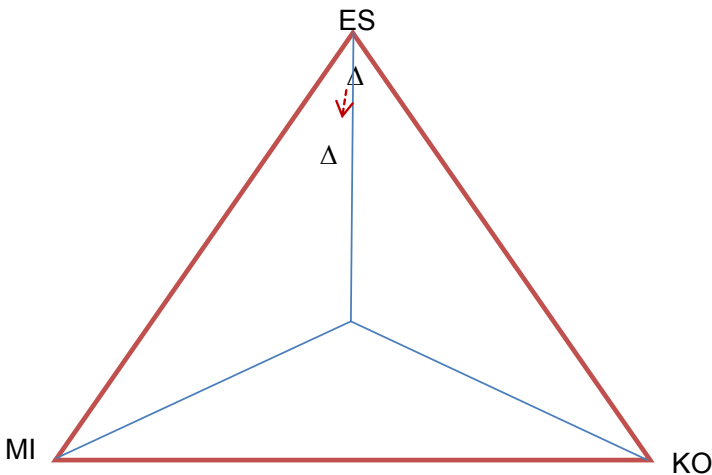
12 As argued by ACI (2008, 2010), the closer the sum of the contributions to 2 (the constant on the left hand side of the regression), the more binding the trilemma is.

For the period of 2002Q1-2005Q4, contribution of exchange rate stability diminishes possibly due to the floating exchange rate regime implemented. Meanwhile, this reduction is compensated by the contribution increases of monetary policy and capital openness indices and their contributions reach to a considerable level during the period. The increase in the contribution of monetary policy independence can be considered as a result of the (implicit) inflation targeting regime implemented. With the implementation of (implicit) inflation targeting regime, inflation has decreased to single digit levels, and confidence felt towards the Turkish economy has increased. This resulted in a surge in capital inflows and contribution of capital openness also has risen up to some level.

Finally, for the period of 2006Q1-2010Q4 during which the inflation targeting regime was implemented explicitly, contribution estimates of all indices are similar to those obtained for the previous sub-period while all contributions have increased slightly. This indicates that trilemma tradeoffs have become more binding during this period possibly due to the financial fluctuations experienced. Hence, while comparing the second and third sub-periods, we take into account the shares of the contribution estimates of the indices: monetary policy and capital openness indices have increased their share while the share of exchange rate stability has diminished further, albeit these changes are limited.

Accordingly, Turkey has moved in the triangle from late 90's to 2010. This relocation is geometrically shown in Figure 6. Furthermore, this relocation is also in line with what has happened in Turkey with regard to the economic transformation.

Figure 6 Trilemma Triangle



6. Impacts of Trilemma Policy Configuration on Inflation and Role of Reserves

In this section, we analyze how the trilemma policy configuration and its interaction with the level of reserves affect inflation. Hence, the basic model we estimate is given by:

$$\text{inf}_{it} = \alpha_0 + \text{inf}_{it-1} + \alpha_1 TLM_{it} + \alpha_2 TR_{it} + \alpha_3 (TLM_{it} \times TR_{it}) + \alpha_4 E(\text{inf}_{it+1}) + \varepsilon_t \quad (2)$$

inf_{it} is the measure of current inflation, $E(\text{inf}_{it+1})$ is the expected inflation of following period, TLM_{it} represents the trilemma indices (namely, *MI*, *ES*, and *KO*) included individually and TR_{it} is the level of gross international reserves as a ratio to GDP. $(TLM_{it} \times TR_{it})$ is an interaction term between the trilemma index and the level of international reserves. We include lagged value of inflation to cover all other control variables given the limited degrees of freedom as the whole sample reduces to 2003-2010 due to stationary issues. Expected inflation is also added in the regression since a forward looking inflation model can be expected to be more relevant considering the inflation targeting regime.

6.1 Findings

Results of the regression are presented in Table 7. According to the table, lagged inflation has a positive and highly significant effect on inflation while impact of expected inflation is highly insignificant. With regard to trilemma indices, greater monetary independence is likely to lower inflation as expected. Furthermore, *ES* has also a negative effect on inflation indicating that higher exchange rate stability leads to experience lower inflation. This finding is in line with the literature as Ghosh et al. (1997) and many others have shown that pegged exchange rate regimes tend to experience lower inflation. On the other hand, greater capital openness, in tandem with loss of monetary independence and exchange rate stability, comes at the cost of higher inflation. Although this might somewhat contradict with the studies that find negative openness-inflation relationship, this might stem from accelerating credit growth that occurs during the strong capital inflows. Yet, we provide the bivariate correlations of trilemma indices and inflation rate as Table 8.

Table 7 Inflation, 2003Q1-2010Q4

	(1)		(2)		(3)		(4)		(5)	
	Coefficients	Standard Error	Coefficients	Standard Error	Coefficients	Standard Error	Coefficients	Standard Error	Coefficients	Standard Error
Intercept	4.399**	1.775	4.397	4.605	-11.772	10.86	-2.826	12.566	5.15	5.69
Lagged	0.842***	0.137	0.843***	0.154	0.857***	0.148	0.837***	0.160	0.843***	0.157
Inflation	-0.039	0.140	-0.039	0.169	-0.054	0.162	-0.032	0.177	-0.039	0.173
MI	-1.875*	0.951	-1.874	1.347	24.566*	13.06	-1.850	1.276	-1.851	1.410
ES	-4.750*	2.466	-4.750*	2.519	-4.114	2.566	7.636	22.24	-4.680	2.738
KO	14.437**	7.007	14.436*	7.339	8.693	6.343	14.847**	6.97	2.482	63.985
Res/GDP			0.005	8.428	40.28*	24.457	18.791	32.42	-1.950	13.41
MI*Res					-66.91**	32.911				
ES*Res							-32.139	57.72		
KO*Res									28.47	146.79
Adj. R ²	0.9001		0.896		0.9005		0.893		0.891	

*, **, *** denote statistical significance at 10%, 5% and 1% levels respectively.

Table 8 Bivariate Correlations of Trilemma Indices and Inflation Rate

	Correlations
MI & Inflation	-0.110
ES & Inflation	0.009
KO & Inflation	0.025

Regarding the impact of reserve accumulation, its direct effect is usually insignificant although it tends to have a positive effect on inflation. However, as we suspect that international reserves may complement or substitute for other policy stances, we are particularly interested in the effect of those interaction terms ($TLM_t \times TR_t$) in addition to the direct effect of reserves. The coefficient of the interaction terms, in general, measures the amount by which the change in response with one predictor is affected by the other predictor. If this coefficient is not statistically significant, then the data have not demonstrated the change in response with one predictor depends on the value of the other predictor. Within this context, our only statistically significant interaction term is between reserves and monetary independence. To interpret this result which is given in the third column of the Table 7, we can rewrite it as below:

$$\text{inf}_t = -11.7 + 0.86 * \text{inf}_{t-1} - 4.1 * ES_t + 8.7 * KO_t + 40.3 * TR_t + (24.56 - 66.91 * TR_t) * MI - 0.05 * E(\text{inf}_{t+1}) + \varepsilon_t$$

In such a case, impact of monetary independence varies with the value of reserves to GDP ratio. Given the level of gross international reserves as a ratio to quarterly GDP is above the threshold value of 0.367 (24.56/66.91), monetary independence has a negative impact on inflation. Otherwise MI has a positive effect. Within this framework, monetary policy aimed to reduce inflation becomes credible. For Turkey, this level of reserves holding is below the average figure of 40 percent during the sample period; hence the impact of monetary independence is more likely to be negative on inflation. For other trilemma indices, same argument is valid but not statistically significant. Accordingly, we conclude that *the reserve accumulation can relax the impact of the Turkish trilemma policy stance on inflation depending on its level.*

7. Conclusion

In this paper, we investigate Turkey's macroeconomic policies of the last two decades in the context of trilemma trade-offs. In this investigation, we also try to get an answer to the question whether there is a role for accumulating international reserves for Turkey. In line with this aim, we start with searching the point Turkey stands with respect to the trilemma triangle.

Our methodology starts with following ACI (2008) approach. Using quarterly data from 1998 to 2010, we construct trilemma indices for each of the three policy objectives: monetary independence, exchange rate stability and capital account openness. Next, we employ different regression techniques (i.e. TSLS, Kalman filtering framework) to examine trilemma trade-offs in addition to ACI approach of OLS estimation. As a consequence of our examination, we adopt the Kalman filter approach into our trilemma

framework which provides contribution figures that are consistent with the behavior of the economy.

Next, taking into account Turkey's macroeconomic policies, we compare the contributions of the trilemma indices for different sub-periods. At first cut, our results are in line with the transformation of Turkey's macroeconomic policies during 1998-2010. The most remarkable change is the decrease of exchange rate stability contribution although it dominates others in the trilemma configuration throughout the entire period. Naturally, this reduction on exchange rate stability was accompanied by the increases in two other indices, namely monetary policy independence and capital openness. Besides, our results indicate that trilemma trade-offs become less binding for Turkey over the same period.

We also show that this transformation among the trilemma indices has influenced the economic outcome of inflation for the period of 2003-2010. Accordingly, monetary independence and exchange rate stability have diminishing effects on inflation while capital openness has an increasing impact. Finally, we investigate the role played by international reserves in mitigating the intensity of the trilemma trade-offs faced by Turkey. Our examination verifies that indeed there is a role for international reserves in softening Turkey's trilemma trade-offs with respect to inflation. Such reserve management contributes to inflation while helping monetary policy to regain control of it after reaching a threshold level.

APPENDIX: Data Sources

Turkish data obtained from the CBRT website, available at the address:
<http://evds.tcmb.gov.tr/yeni/cbt-uk.html>

US data obtained from the Federal Reserve System database, available at:

<http://research.stlouisfed.org/fred2/categories>

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