

A Threshold VAR Model of Interest Rate and Current Account: Case of Turkey

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Abstract:

Following the recent literature on trying to understand the relationship between monetary, fiscal and real variables in a complete setting, this study is an attempt to document the impact of monetary policy on current account for a small open economy for which country risk premium is important. A threshold vector autoregression model composed of monetary policy variable, current account and interest rate spread indicates a two state economy defined by high and low probability of default of Turkish government. The results indicate that the level of the probability of default affects the magnitude of a monetary shock on current account, whereas it does effect the direction of a spread shock.

Keywords: Monetary Policy, Fiscal Policy, Probability of Default, Current Account

JEL Codes: E52, E62, F32, F41

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1. Introduction:

Current account balance is listed as an indicator variable for the sustainability of economic policies and a very important variable, especially for capital attracting, developing countries – like Turkey, which are open to financial crises. Therefore, it is crucial to note the possible effects of policies on current account in detail.

The relationship between monetary policy and current account is rather easy to analyze since, current account balance identifies the relation between aggregate national savings and investments, which are functions of interest rate that is traditionally assumed to be controlled by monetary policy authority.

Based on this relationship traditional models indicate the existence of a positive correlation between interest rate and current account, since an increase in real interest rate stimulates savings, reduces investment and hence improves current account balance. Following many theoretical and empirical studies analyzing this unidirectional relation, recently, Bergin and Sheffrin (2000), Bernhardsen (2000) and Obstfeld and Rogoff (2000) support the argument that an increase (decrease) in the real interest rate is generally followed by an increase (decrease) in current account balance. However, following the issue of fiscal dominance and “twin deficit” argument Blanchard (2004) takes attention to the importance of fiscal policy variables on this direct link between interest rate and current account.

Literature on twin deficit phenomenon states the importance of the nature of fiscal (im) balance, existence of tax distortions (as well as other types of distortions) and the validity of Ricardian Equivalence theorem for modeling various channels of fiscal expansions

effecting current account balance.¹ In that context, Kim and Roubini (2003) states country's default risk premium as one important fiscal policy variable that is negatively correlated with current account balance².

Fiscal probability of default can also affect monetary policy /current account relationship. Blanchard (2004) argues that since probability of default reflects fiscal authority's capacity of paying back its debt, it is possible that under high risk premium monetary policy authority may lose its control on the market. Contrary to the conventional argument that a contractionary monetary policy leads to a currency appreciation and deterioration in trade balance, depending on the initial level of debt, an increase in interest rate may drive up expectations on higher government debt and makes government bonds less attractive. Therefore, a contractionary monetary policy leads to currency depreciation and an improvement in trade balance.³

Although the literature defines various channels for real effects of monetary / fiscal policy variables, only recently few empirical studies analyze and search for possible nonlinearity in their relation with current account. Belloc and Gandolfo (2005) analyses the validity of that state dependent affects of interest rates on current account by non linear estimation methodology and proves nonlinearity of current account for the case of Italy.

This empirical study on Turkey not just searches for current account nonlinearity but, analyzes the role of fiscal policy variable in direction and/or persistence of monetary policy shocks on current account balance. For that purpose a simple vector autoregression

¹ Here one important assumption for effectiveness of fiscal policy is, economic agents being Ricardian. However, it has to be noted that in general, the nature and persistence of fiscal shock determines the validity and the direction of fiscal policy effectiveness on real variables and current account

² High and / or unsustainable debt, current and expected monetization of government debt and / or increasing stock of public debt in portfolio under conditions of imperfect asset substitution are some factors that affect country's risk premium.

³ If an analysis depends on only expenditure switching effect of monetary policy then, this open economy conclusion of fiscal dominance will conclude that fiscal policy arguments are a source of nonlinearity in response of current account balance to interest rate shock. However, as Kim, S. and N. Roubini (2003) notes the literature is very careful on monetary policy effect on current account, since monetary policy lead to an improvement or deterioration in trade balance depending on income absorption and / or expenditure switching effects.

model of interest rate / current account relationship is analyzed for possible threshold effects. Since the data indicated existence of state dependent effects on the relationship in question, the dynamics of the model composed of country risk premium, current account balance and interest rate, is analyzed in detail using threshold vector autoregression (TVAR) estimation tools to capture the impact of nonlinearity in response of current account balance to monetary policy shocks based on fiscal conditions.⁴

The following section summarizes the methodology that has been used. Section Three is devoted to the empirical results and the last section is the conclusion

2. Threshold Vector Autoregression Model:

Threshold vector autoregression (TVAR) methodology is actually a vector autoregression (VAR) modelling generalised to capture the nonlinearity in systems due to asymmetry, periodic movements, regime changes and etc. To model nonlinearity Tong (1978) note the possibility that the space at which the system is defined can be composed of at least two Euclid spaces and although the system behaves linearly in every Euclid space, it will operate nonlinearly considering the space as a whole. Based on that argument, Tsay (1989) sets an easy application of the methodology of Tong (1978) and Tong and Lim (1980) by defining a threshold variable to capture the movement of the system from one Euclid space to another⁵.

The two regime threshold –VAR can be modelled as:

$$Y_t = D^1 + A^1 Y_t + B^1(L)Y_{t-1} + (D^2 + A^2 Y_t + B^2(L)Y_{t-1})I_t + e_t \quad (*)$$

where Y_t is a vector of endogenous variables, $I_t(.)$ is a variable that takes the value 1 when the d -lagged threshold variable c_t is lower than the threshold critical value γ and 0

⁴ Probability of default is used as a fiscal policy argument since it captures the importance of fiscal debt and how policy reacts to questions of sustainability of fiscal debt. Hence, this variable states both the issue of sustainability of fiscal policy and the reactions of economic agents to fiscal policy shocks.

⁵ Depending on the characteristics of the relationships in question, the system can be modelled as Threshold Autoregression, (TAR), Threshold Vector Autoregression, (TVAR) or Threshold Cointegration.

otherwise. Note that, the model identifies two separate regimes based on the value of c_{t-d} relative to γ , which is endogenously determined in the system via simulations.

The equation (*) notes that the linear VAR model – at which $I_t(\cdot)$ takes the value of zero – estimates D^1 , A^1 and $B^1(L)$, and the threshold VAR model – at which $I_t(\cdot)$ takes the value of one – estimates $D^1 + D^2$, $A^1 + A^2$ and $B^1(L) + B^2(L)$. Thus, the asymmetry in the model, that is captured by the threshold variable allows for the vector of constant term, D , the coefficient matrices A and $B(L)$ vary across regimes.

The threshold variable, c_t used to distinguish between different regimes is modeled as a variable in vector Y_t to allow for regime switching be endogenously determined in the system itself. Since VAR modeling considers all variables in the system as endogenous, shocks to any of the variables in Y_t may- via their impact on the variable c_t - induce a shift to a different regime.

First of all, the existence of the threshold behavior, that is the validity of the argument, $D^2 = A^2 = B^2(L) = 0$ has to be tested. Note that the threshold critical value γ is identified only under threshold VAR and it is not known a priori. To solve this nuisance parameter problem and to test for the linearity of the system, the model is estimated by least squares methodology for each possible γ and for each system different Wald statistics are calculated.

The search over c_t and γ under the hypothesis of no difference between regimes, leads to three different test statistics for the existence of threshold behavior: Sup- Wald, Avg- Wald and Exp- Wald, which are the maximum, average and a function of sum of exponential Wald statistics over all possible threshold values respectively. To calculate the p values and to conduct inference, the empirical asymptotic distributions of each Wald statistics are simulated as is proposed by Hansen (1996). If the tests reject the null

hypothesis of linear modeling, threshold critical value is calculated as the one that minimizes the log determinant of the variance-covariance matrix of residuals.⁶

After the model is selected and the coefficients are estimated the dynamics of the nonlinear system is evaluated via non linear impulse response analysis. The questions we seek to answer for is, how the system that is switching between regimes responds to shocks?

Similar to linear vector autoregression (VAR) methodology, vector moving average (VMA) representation is used to investigate the interaction between the variables of the system. However, under threshold VAR methodology VMA is not linear in shocks. Thus, following Balke (2000) this study uses simulations to calculate the expected value of Y_{t+k} conditional on the information set Ω_{t-1} given the shock, $E[Y_{t+k}|\Omega_{t-1}, \varepsilon_t]$ and in the absence of the shock, $E[Y_{t+k}|\Omega_{t-1}]$.⁷ Note that, in order to calculate the impulse response function that is $E[Y_{t+k}|\Omega_{t-1}, \varepsilon_t] - E[Y_{t+k}|\Omega_{t-1}]$, entire history of the variables Ω_{t-1} has to be defined as well as the size and the direction of the shock. Therefore, although, the initial conditions $(\Omega_{t-1}, \varepsilon_t)$ are regime dependent, the methodology of nonlinear impulse response functions let the system switch between two regimes.

To see whether if and how monetary policy / current account relationship changes under different fiscal conditions, this study analyzes a system composed of country risk premium, interest rate and current account balance with threshold VAR methodology. After testing for the presence of different regimes, non-linear impulse responses are calculated to capture the threshold effects in sign and amplitude of the reaction of current account balance to asymmetric shocks across different regimes.

The impact of country risk premium on the dynamic relation between current account balance and monetary policy is analyzed for Turkey, because this country has gone

⁶In search over C_t and γ , the parameter space γ is restricted to prevent over fitting such that each regime contains minimum number of observations. Hansen (1996) proposes 10% of the number of observations. Following Blake (2000) this study states that in each regime at least 15% of the observations plus the number of parameters are used for an individual equation.

⁷ Detailed information on simulation methodology is given in Balke (2000) and Calza and Sousa (2005)

through separate episodes in terms of monetary / fiscal policy conditions during the last two decades.

To fight with long lasting high inflation, Turkey has gone through structural changes in terms of monetary and fiscal policy conditions during the late 1990's –early 2000. Central Bank has applied contractionary monetary policy, whereas fiscal policy authority aimed at low debt ratios. The reflections of these contractionary policies are seen in country risk premium rates. Aside 2008, comparing to 1990's and early 2000, it is seen that Turkey's risk premium rate has improved, especially after 2004.

3. Estimation:

The study models a TVAR system composed of country risk premium, interest rate (i) and current account balance. EMBI spread is used as a proxy for country risk premium and monetary policy is represented by central bank overnight interest rate⁸. The monthly data on current account balance and central bank overnight rate for the period of 1991:12 – 2008:02 are gathered from The Treasury and The Central Bank of Turkey. The data on EMBI spread is taken from Bloomberg.

Since TVAR methodology requires stationarity of the time series in question, growth rate of current account balance (ca) and EMBI spread (rp) are used in estimation procedure⁹. As is supported by unit root tests, interest rate is used in levels.

⁸ Note that EMBI spread (which is a standard measure of probability of default) is the difference between the rate of return of local's foreign denominated and foregin's foreign denominated government bonds of the same maturity. Hence, it includes information on both interest rate spread and degree of risk aversion of economic agents.

⁹ The calculated unit root test statistics are:

	ca	i	rp
Augmented Dickey-Fuller, τ_μ			
Augmented Dickey-Fuller, τ_τ	-2.89	-3.56	-3.58*
Phillips –Peron, τ_μ			
Phillips –Peron, τ_τ	-3.89	-3.64	-3.32*
KPSS			

*The values are statistically significant at %5 significance level

Due to parsimonious property Schwarz Information (SC) criteria is preferred to solve the lag selection problem of this system in question. Thus, the system composed of ca , i and rp is modeled with lag length one¹⁰. The SC criteria selected a one month delay for the threshold variable, which is chosen to be two months moving average of rp .

Following previous theoretical and empirical studies discussing current account / monetary policy relationship under different fiscal policy conditions, this study searches for possible nonlinearity of the system ca , i and rp by three test statistics, Sup –Wald, Avg –Wald and Exp –Wald. The results given in Table 1 are strong evidence of existence of threshold effects, which is free of alternative structural orderings or to possible changes in the contemporaneous relationships. The results indicate that the system exhibits two different regimes depending on interest rate spread and throughout the rest of the paper, two months moving average of growth rate of EMBI spread being higher than -2 percent will be named as regime 1, which is an indicator of high risk premium and the rest will be named as regime 2, for the case of low risk premium.

Table 1. Testing for Threshold Variable, Threshold Effect in Contemporaneous Relations

	Estimated Threshold Value	Sup-Wald	Avg-Wald	Exp-Wald
Probability of Default Lag 1, MA = 2, d = 1	$\gamma = -0.02$	65.63	30.78	29.05

*The values in parenthesis are p values calculated based on Hansen (1996). For fiscal variable, 1% critical value for Sup-Wald is 21.46, for Avg-Wald is 15.77 and for Exp-Wald is 8.73.

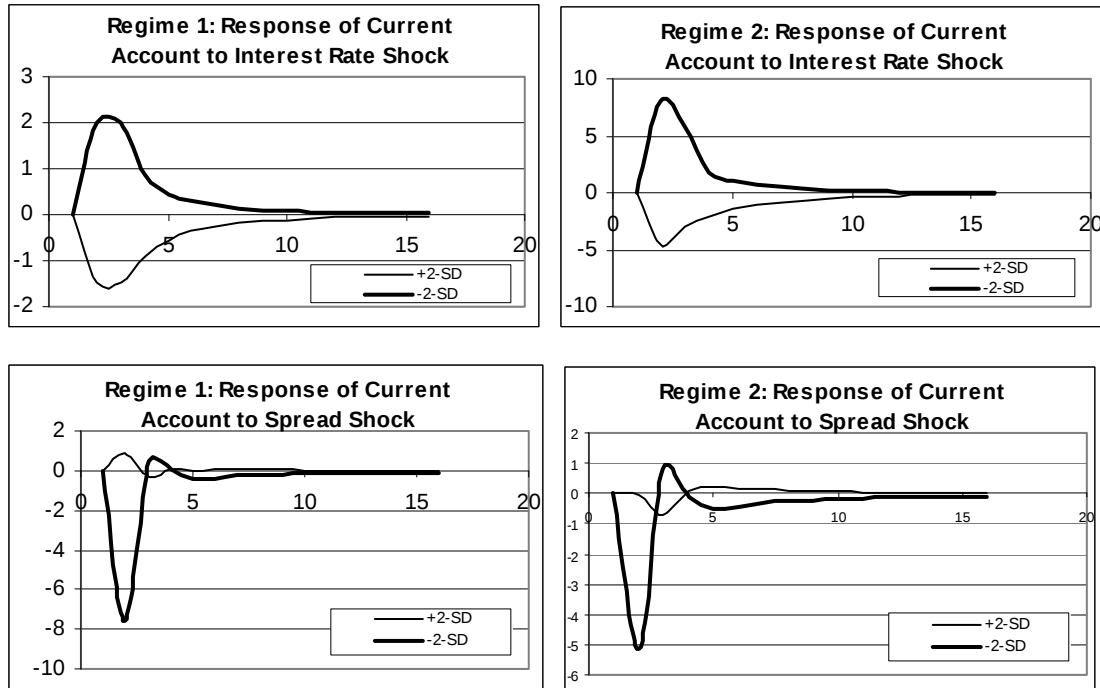
Before giving the dynamics of this system, it has to be noted that a block recursive structure of Cholesky decomposition is used to solve the identification problem in VAR modeling. Following Leeper and Zhao (2002), Gordon and Leeper (1994), Sims and Zha (1998) and Blanchard (2004) the contemporaneous correlation matrix is modeled based on the idea that it takes time for the real sector to react to the exogenous shocks of the economy.¹¹ Since the procedure uses monthly data, current account balance is treated as

¹⁰ It has to be noted that both the lag selection and SC criteria indicated the same TVAR model.

¹¹ Leeper and Zhao (2002) notes the Keynesian view that “...the sluggishness in the goods market due to contract and advance planning of production, money market variables and information variables do not enter this sector”. Gordon and Leeper (1994), Sims and Zha (1998), Leeper and Zha (2002) and Blanchard (2004) also follow the idea that it takes time for the real sector to react to the exogenous shocks of the

contemporaneously exogenous of interest rate and EMBI spread. Independent central bank requires interest rate to be exogenous of fiscal policy effects and it has been assumed that current account balance and central bank interest rate affect the EMBI spread contemporaneously. Hence, the impulse response functions, which are used to evaluate the dynamics of a system by analyzing the way system responds to shocks, are calculated based on a contemporaneous coefficient matrix at which the coefficient of the variables are arranged in the order of ca, i, rp . The results are given in Figure 1.

Figure 1 Impulse Response Functions:



The impulse response functions for monetary policy interest rate indicate that whatever the state of the economy is, a contractionary monetary policy deteriorates current account balance¹². This result is consistent with the conventional wisdom that high interest rate stimulates capital inflows, which does appreciate national currency and hence leads to the deterioration of trade balance and current account balance. However, although the direction of current account reaction to monetary policy shocks is same under both

economy and so solve the identification problem by treating production side of the economy as contemporaneously exogenous. Since monthly data is used it is reasonable to assume the sluggishness of financial variables on real sector.

¹² The reported impulse response functions of current account balance are calculated to two standard deviation shocks. Similar results are obtained for impulse response functions of current account to one standard deviation shocks

regimes, there is a difference in the magnitude of positive shocks. In case of low risk premium, the symmetry between reaction of current account to positive and negative shocks collapses. As is seen from Figure 1, once the economy is in low risk premium state, current account responds more aggressively to a negative interest rate shock. It is seen from impulse responses that the lack of contractionary effect of spread shock is one reason for that.

To sum up, the impulse response analysis indicates that whatever the state of the economy is, a negative interest rate shock improves, whereas a negative spread shock deteriorates current account balance. This general result supports Blanchard (2004) on the significance of default probability in attracting capital. Lower spread states the information that the government's probability of default has declined. This stimulates capital inflows, which leads to appreciation of national currency and a deterioration of current account balance. Spread and overnight interest rate gives totally different signals to the investors and so create opposite results. Thus, taking negative spread as a proxy for improvement of fiscal budget balance, the impulse response analysis for negative shocks contradicts the traditional Keynesian, Real Business Cycles and New Open Economy Models that fiscal contractions associated with an improvement of current account.¹³

However, once the interest rate on government bonds increases, the impact on current account depends on the state of the economy.

The impulse response analysis for positive spread shock under Regime 1 supports Kim and Roubini (2003), which argues that country's default risk premium, is one important fiscal policy variable that is negatively correlated with current account balance¹⁴. An increase in interest spread seen as higher risk which flies away capital. National currency

¹³ Contrary to the twin deficit arguments, the estimation results of vector autoregression model of Kim and Roubini (2003) indicate a negative correlation between "exogenous" fiscal shocks and the current account "...1) a fall (increase) in investment driven by crowding-out (crowding-in) caused by changes in real interest rates following fiscal shocks and, 2) a partial Ricardian movement in private savings...." are listed as the factors for fiscal expansions leading to an improvement of the current account.

¹⁴ High and / or unsustainable debt, current and expected monetization of government debt and / or increasing stock of public debt in portfolio under conditions of imperfect asset substitution are some factors that affect country's risk premium.

depreciates and trade and current account balance improves at first. However, this impact is very short lived. In fact, the impulse response analysis for regime 1 indicates that the effect of a fiscal shock dies off so much faster than a monetary policy shock.

Although, the impulse responses functions of current account to positive / negative monetary or spread shocks under regime 1 are somehow explained by how investors react to “risk”, the situation is rather different for regime 2.

Once spread decreases, the reaction of current account balance under Regime 2 is similar to the one under Regime 1. However, in case of low probability of default, current account balance reacts rather different to an increase in spread. At first, current account do not react to fiscal policy. Then, higher interest rates are seen as an opportunity of higher profits and leads to capital inflows. As a results current account deteriorates. However, the “risk aligsi” overcome this opportunity of profit and almost in 3 months time, national currency depreciates and at the end higher spread leads to an improvement of current account balance.

One striking point of that analysis is that, the spread shocks persist longer under the case of low risk premium. It takes almost a year for the impact of a negative shock die off.

4. Conclusion

Conventional wisdom in international macroeconomics models a direct link from interest rate to current account via national savings. The literature flourishes at that point. Besides stating many different channels of interest rate / current account relationship, recent studies investigate the nature of this relationship by stating possible non equilibrium and non linearity conditions. This paper analyzes this relationship in detail and focuses on the impact of monetary policy on current account for a small open economy for which country risk premium is important. Therefore, this study documents not only the relation between interest rate and current account but also, the dynamics of the current account

balance based on the Central Bank and the Treasury interest rate. A nonlinear TVAR model shed some light on the question.

Although, the results state the expected negative relationship between interest rate and current account, the behavior of the system, composed of current account, monetary policy and interest rate spread, differs slightly depending on the state of the economy, which is defined by the growth rate of EMBI spread. Besides documenting the existence of threshold level for the relation between current account and interest rate, the nonlinear dynamics of the model indicates two main conclusions.

Spread effect:

Regime 2:

1. Faiz arttı=

- a. Sermaye giris=para deger kazanir = ca deteriorate kar gudusu
- b. sermaye cikisi=para deger kaybeder = ca improve risk algisi artti

2. Faiz azaldı = risk azaldi= Sermaye giris=para deger kazanir = ca deteriorate

Regime 1:

1. Faiz arttı= risk arttı= sermaye cikisi=para deger kaybeder = ca improve

2. Faiz azaldı = risk azaldi= Sermaye giris=para deger kazanir = ca deteriorate

First of all, although the direction of the current account reaction to monetary policy shock is same under all regimes, the magnitude of this reaction is smaller if country's risk premium is high. This is a guidance point for monetary policy authorities since it links the magnitude of monetary policy shocks to the level of country's risk premium, which is determined by fiscal policy. Secondly, the reaction of current account balance to positive spread shock documents different perceptions of investors in case of low probability of default. The results indicate that the positive impact of expansionary fiscal policy persists longer in under low probability of default.

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