ESSAYS ON MACROECONOMICS

A Ph.D. Dissertation

by

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ESSAYS ON MACROECONOMICS

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September 2018

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Doctor of Philosophy in Economics.

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ABSTRACT

ESSAYS ON MACROECONOMICS

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This dissertation consists of three essays on macroeconomics. The first essay models the term structure of interest rates in an international framework from a macro-finance perspective. Other essays focus on the Turkish economy. The second essay measures the potential growth rate of the Turkish economy. Finally, the third essay examines the stance of monetary policy in Turkey in the post-2001 period.

In the first chapter, I develop a two-country affine term structure model that accounts for the interactions between the macroeconomic and financial variables of each country. The model features a structural preference side and reduced form macroeconomic dynamics. The economies are connected through covered interest parity. Using this framework, I provide an empirical application of the model using data from the United States and the United Kingdom. I quantify the extent to which economic dynamics in one country explain the other's nominal term

structure. I find that the variation in the bond yields in each country is explained mostly by domestic factors. The cross-country effects are more prominent in pricing of the U.S. bonds.

In the second chapter, I estimate the potential growth rate of the Turkish economy using a bivariate filter. I define the potential growth as the output growth rate at which selected macroeconomic imbalance indicators do not diverge from their targets. This definition of the potential growth implies results that are substantially different than those suggested by the Hodrick-Prescott filter. I find that these imbalance indicators would not have deteriorated, had Turkey grown at much lower rates particularly after the Great Recession. I also find that for the last five years, Turkey's potential growth rate is 3 percentage points below the trend growth rate on average. Finally, the results of this study are consistent with the growth target published in the recently announced economic plan of Turkey.

The third chapter is a joint work with Refet Gürkaynak, Zeynep Kantur and Seçil Yıldırım-Karaman. In this chapter, we present an accessible narrative of the Turkish economy since its great 2001 crisis. We broadly survey economic developments and pay particular attention to monetary policy. The data suggests that the Central Bank of Turkey was a strong inflation targeter early in this period but began to pay less attention to inflation after 2009. Loss of the strong nominal anchor is visible in the break we estimate in Taylor-type rules as well as in asset prices. We also argue that recent discrete jumps in Turkish asset prices, especially the exchange value of the lira, are due more to domestic factors. In the post-2009 period the Central Bank was able to stabilize expectations and asset prices when it chose to do so, but this was the exception rather than the rule.

Keywords: Fiscal Policy, Kalman Filter, Monetary Policy, Potential Growth, Yield Curve

ÖZET

MAKROEKONOMİ ÜZERİNE MAKALELER

Taş, Mustafa Anıl

Doktora, İktisat Bölümü

Tez Danışmanı: Prof. Dr. Refet Soykan Gürkaynak

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Bu çalışma, makroekonomi üzerine üç makaleden oluşmaktadır. Birinci makalede, faiz oranlarının vade yapısı uluslararası bir çerçevede makro-finans perspektifiyle modellenmiştir. Diğer makaleler Türkiye ekonomisi üzerinedir. İkinci makalede, Türkiye ekonomisinin potansiyel büyüme oranı hesaplanmıştır. Son olarak, üçüncü makalede Türkiye'de 2001 sonrası para politikası uygulamaları incelenmiştir.

Birinci makalede, iki ülkenin makroekonomik ve finansal değişkenleri arasındaki etkileşimi dikkate alan bir afin vade yapısı modeli geliştirilmiştir. Tüketici tercihleri yapısal olarak modellenmiş ve makroekonomik değişkenlerin indirgenmiş formda olduğu varsayılmıştır. İki ülke ekonomisi arasındaki ilişki örtülü faiz haddi paritesi üzerinden kurulmuştur. Sonra Amerika Birleşik Devletleri ve İngiltere verisi kullanılarak modelin ampirik bir uygulaması yapılmıştır. Bir ülkedeki ekonomik dinamiklerin diğer ülkenin nominal vade yapısını ne ölçüde

açıkladığı sayısal olarak gösterilmiştir. Her ülkenin tahvil getirisinin çoğunlukla kendi iç faktörleriyle açıklandığı ve ülkeler arası etkileşimin A.B.D. tahvil fiyatlamasında daha belirgin olduğu bulunmuştur.

İkinci makalede, iki değişkenli filtre kullanılarak Türkiye'nin potansiyel üretim büyüme oranı tahmin edilmiştir. Potansiyel büyüme, seçilmiş makroekonomik dengesizlik göstergelerini hedeflerinden saptırmayan üretim büyüme oranı olarak tanımlanmıştır. Bu şekilde tanımlanmış potansiyel büyüme, Hodrick-Prescott filtresi kullanılarak yapılan tahminlerden çok farklı sonuçlar ima etmektedir. Seçilmiş makroekonomik dengesizlik göstergelerinin bozulmasına yol açmayan büyüme oranlarının özellikle Büyük Resesyon'dan sonraki dönemde gerçekleşen oranlardan daha düşük olduğu bulunmuştur. Son beş yılın ortalamasına göre potansiyel büyüme oranının trendin 3 yüzde puan altında olduğu gösterilmiştir. Son olarak, bu çalışmanın sonuçları Türkiye'nin yeni açıklanan ekonomi modelindeki büyüme hedefiyle tutarlıdır.

Üçüncü makale, Refet Gürkaynak, Zeynep Kantur ve Seçil Yıldırım-Karaman ile ortak bir çalışmadır. Bu makalede Türkiye ekonomisinin 2001 krizi sonrası dönemi değerlendirilmekte ve iktisadi gelişmeler özellikle Merkez Bankası'na vurgu yapılarak aktarılmaktadır. Değerlendirilen veri TCMB'nin üzerinde çalışılan dönemin başında kuvvetle enflasyon hedeflediğini ancak 2009'dan sonra enflasyona atfettiği ağırlığın azaldığını göstermektedir. Merkez Bankası'nın enflasyona kuvvetle tepki vermemesi enflasyon üzerindeki kontrolün, dolayısı ile de nominal çıpanın kaybına yol açmıştır. Nominal çıpanın kaybı, Taylor tipi kurallarda ekonometrik olarak bulunan kırılmada olduğu gibi, menkul kıymet fiyatlarında da görülmektedir. Makalede döviz kurunda yakın dönemde görülen büyük sıçramaların Türkiye'deki gelişmelerden kaynaklandığı da savunulmaktadır. Yapılan vaka çalışmasında görülmektedir ki yakın dönemde Merkez Bankası beklentileri ve mali piyasaları istediğinde stabilize edebilmekle birlikte, genellikle bunu yapmamayı tercih etmiştir.

Anahtar Kelimeler: Getiri Eğrisi, Kalman Filtresi, Maliye Politikası, Para Politikası, Potansiyel Büyüme

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CHAPTER 1

AN INTERNATIONAL MODEL OF THE TERM STRUCTURE

1.1 Introduction

Understanding the movements in bond yields across countries is a central theme for monetary policy discussions. Central banks control the short-term interest rates and private decision makers mostly care about the longer-term rates. This makes the question of how short end of the yield curve transmits into the long end important. Affine term structure models are useful and tractable devices to answer that question, and have become popular beginning with the work of Duffie and Kan (1996).

Most of the studies in the literature on affine term structure models focus on a single country. The few existing multi-country studies investigate the local and global factors that drive the bond yields of countries. Diebold, Li, and Yue (2008) estimate a four-country affine term structure model in which the bond yields are determined by two country-specific latent factors. Those factors then load on the global counterparts. They show that two global factors are responsible for the joint movements of the yield curves. Recently, Abbritti et al. (2018) build on Diebold, Li, and Yue (2008) and use a factor-augmented vector autoregression framework to analyze the yields curves of eight economies. Their model includes only latent factors extracted as the principal components from the cross section of yields. They find that global factors explain the dynamics at the long end of the yield curves whereas country-specific factors are important at the short end.

These studies assume a unidirectional interaction between the pricing factors such that the global ones affect the local ones but not vice versa. The aim of this paper is not to explore the global factors in the term structure of interest rates but instead to gauge the possible effects of the local factors of one country on the yield curve of the other in a two-country setting.

There are two papers that are close to my study. Spencer and Liu (2010) develop a multi-country macro-finance model in which the United States and aggregate OECD economies form the world economy. They allow for mutual interaction between the economic variables of the United States and the OECD. They look at the effects of the world economic factors on the United States and the United Kingdom economies. Bauer and de los Rios (2012) build an international affine term structure model with macroeconomic factors and impose uncovered interest parity under the risk neutral measure. They restrict their model such that the bond yields are a function of country-specific latent factors. This renders macroeconomic variables and exchange rates unspanned.

My study differs from these papers in several aspects. First, both Spencer and Liu (2010) and Bauer and de los Rios (2012) use an ad hoc pricing kernel as in Ang and Piazzesi (2003) that lacks economic interpretation. I derive it from a utility function that makes all pricing factors spanned. Second, contrary to Bauer and de los Rios (2012), I impose covered interest parity since I make no restrictions on the risk neutral state dynamics. Covered interest parity accounts for the risk premium in the foreign exchange market. Third, I allow the parity condition to enter into the inflation dynamics of each country, thereby introducing an exchange rate pass-through effect. In this sense, my model can be thought of as the two-country version of Wachter (2006) enriched with a foreign exchange market.

1.2 The Model

I build a two-country representative agent term structure model to explain the nominal government bond yield dynamics in each country, where their economies are connected. The model is semi-structural. I consider an endowment economy in which the preferences are modeled with a constant relative risk aversion type utility function and economies in each country have reduced form dynamics. The infinitely-lived representative agent maximizes the discounted sum of her expected utility. Countries share the same model structure, therefore I present the home country dynamics for ease of notation. Variables and parameters with asterisks belong to the foreign country. The agent's problem is given by

$$\max_{\{C_t\}_{t=0}^{\infty}} E_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma} Q_t \right], \tag{1.1}$$

where β is the time-discounting parameter, γ is the relative risk aversion and Q_t is an exogenous preference shock.[1] The processes for consumption growth and inflation are exogenous:

$$\Delta c_{t+1} = \mu_c + \phi_c \Delta c_t + \phi_{c,\pi} \pi_t + \varepsilon_{c,t+1}, \tag{1.2}$$

$$\pi_{t+1} = \mu_\pi + \phi_\pi \pi_t + \phi_e e_t + \varepsilon_{\pi,t+1}, \tag{1.3}$$

where $\Delta c_{t+1} = \log\left(C_{t+1}/C_t\right)$, $\varepsilon_{c,t+1}$ and $\varepsilon_{\pi,t+1}$ are normal shocks with standard deviations σ_c and σ_π, respectively. The variable e_t in Equation (1.3) is the exchange rate forward premium, which will be defined later in the paper. The inclusion of forward premium in the inflation process implies that there is one-period lagged exchange rate pass-through to inflation. Following Bansal and Shaliastovich (2013), I allow inflation to directly feed into consumption growth to capture the interaction between the real and nominal variables.

Following Gallmeyer, Hollifield, and Zin (2005) and Kısacıkoğlu (2016), I model the growth rate of the preference shock as a linear function of the innovations in consumption growth and inflation with time varying coefficients:

$$\Delta q_{t+1} = -\frac{1}{2}\operatorname{var}_t\left(\Delta q_{t+1}\right) - \kappa_c \nu_t \left(\Delta c_{t+1} - E_t \Delta c_{t+1}\right) - \kappa_\pi \nu_t \left(\pi_{t+1} - E_t \pi_{t+1}\right), \tag{1.4}$$

where $\Delta q_{t+1} = \log\left(Q_{t+1}/Q_t\right)$ and ν_t is an exogenous AR(1) process:

$$\nu_{t+1} = \phi_\nu \nu_t + \varepsilon_{\nu,t+1}, \tag{1.5}$$

[1] Augmenting the utility function with a preference shock in this way is equivalent to adding external habit in consumption. See Creal and Wu (2017) for a discussion of this relationship.

where $\varepsilon_{\nu,t+1}$ is Gaussian with standard deviation σ_ν. The parameters κ_c and κ_π govern the sensitivity of the growth rate of the preference shock to consumption growth and inflation shocks, respectively. The first term on the right hand side of Equation (1.4) guarantees that the preference shock is a martingale:

$$E_t\left[\frac{Q_{t+1}}{Q_t}\right] = 1. \tag{1.6}$$

This assumption cancels out the Jensen's inequality term induced by the lognormal property of the preference shock.

The economies of home and foreign countries are linked through covered interest parity. It postulates an equilibrium relationship between the forward premium on the nominal exchange rate and the nominal interest rate differential of any two countries such that no arbitrage opportunities occur. To see why, consider two investment strategies. In the first strategy, the investor deposits 100 units of home currency to a bank for one month and earns domestic interest at maturity. In the second strategy, she converts 100 units of home currency into foreign currency from the spot rate, deposits it at the foreign interest rate for one month and enters a forward contract to get home currency back one month from today at a predetermined rate. These investment strategies should give the same rate of return by the no arbitrage principle. Any return imbalances are instantaneously wiped off by the forward rate.

Let i_t be the continuously compounded home country short rate, s_t be the logarithm of the spot exchange rate expressed as home currency per unit of foreign currency and f_t be the logarithm of the forward exchange rate of the same maturity with the short rate. Formally, the covered interest parity condition is

$$f_t - s_t = i_t - i_t^*. \tag{1.7}$$

The left hand side of Equation (1.7) is the forward premium. Following Backus, Foresi, and Telmer (2001), I can decompose the forward premium into expected rate of depreciation and risk premium components:

$$f_t - s_t = \underbrace{(E_t[s_{t+1}] - s_t)}_{\text{expected depreciation}} + \underbrace{(f_t - E_t[s_{t+1}])}_{\text{risk premium}}. \tag{1.8}$$

The risk premium in Equation (1.8) is a degree of bias in the forward rate. If the forward rate is an unbiased measure of expectations, then the risk premium would be zero. This means there are no unforeseen fluctuations in the exchange rate or no risk aversion and hence there is no exchange rate risk to be covered. In this case, the covered interest parity relationship would be equivalent to its uncovered counterpart. In this paper, I use the notation e_t to denote the forward premium and allow for deviations from the equilibrium[2]:

$$e_{t+1} = i_{t+1} - i_{t+1}^* + \varepsilon_{e,t+1}, \tag{1.9}$$

where $\varepsilon_{e,t+1}$ is normal with standard deviation σ_e. The forward premium might fail to match the interest rate differential when expectations, risk premium or both are hit by a shock. Therefore, the shock to the forward premium can

[2] See Du, Tepper, and Verdelhan (2018) for a recent analysis of the failures of the covered interest parity.

be interpreted as sum of shocks to the expected rate of depreciation and risk premium.

Equations (1.2), (1.3), (1.5) and (1.9) determine the state of the economy in the home country. All variables except the forward premium are country-specific. The latter is a common factor for both the home and the foreign country. Therefore, I isolate the loadings of the forward premium from those of the country-specific factors through the entire analysis. Let $X_t = \begin{bmatrix} \Delta c_t & \pi_t & \nu_t \end{bmatrix}'$ be the vector of home country-specific factors. Then, I can write the evolution of the state of the economy in the home country in compact form as follows:

$$X_{t+1} = \mu + \Phi X_t + \Phi_e e_t + \varepsilon_{t+1}, \tag{1.10}$$

where $\varepsilon_{t+1} \sim N\left(\mathbf{0}_{3\times 1}, \Sigma\right)$, Φ and Φ_e are 3×3 and 3×1 matrices, respectively.

So far I have described the agent's preferences and the macroeconomy. To study the behavior of the term structure in home and foreign countries, I now characterize the bond prices in both economies. Bonds are priced by imposing the no arbitrage restriction across maturities. The absence of arbitrage implies the existence of a strictly positive random variable, M_{t+1}, called the stochastic discount factor, such that the price of an n-period domestic bond is

$$P_t^{(n)} = E_t \left[M_{t+1} P_{t+1}^{(n-1)} \right]. \tag{1.11}$$

Equation (1.11) is called the bond pricing equation that holds for any time period. Since I am pricing nominal bonds, the stochastic discount factor is also nominal. The logarithm of the nominal stochastic discount factor implied by the preferences in (1.1) is given by

$$m_{t+1} = \log \beta - \gamma \Delta c_{t+1} + \Delta q_{t+1} - \pi_{t+1}. \tag{1.12}$$

Shocks to consumption growth and inflation are two fundamental sources of uncertainty that matter for bond pricing. Duffee (2013) shows that the marginal utility in standard power utility models is not volatile enough to explain the average term premium. The inclusion of the preference shock growth with time-varying sensitivity parameters provides a solution to this problem.

The mechanism is as follows. Given a one standard deviation inflation shock, the marginal utility shifts by $(1 + \kappa_\pi \nu_t)$ standard deviations. The additional shift comes from the Δq_{t+1} term. The change in the marginal utility is amplified but the rise in the volatility comes from the variation in the exogenous shock, ν_t. Any shocks to ν_t alter the response of the preference shock growth to the inflation shock, leading to an augmented shift in the marginal utility. This variation in the volatility of marginal utility makes the conditional covariance between m_{t+1} and the bond price time-varying, implying a time-varying term premium. Since ν_t is the key variable in determining the term premium, it can be interpreted as a *valuation* shock.[3]

The payoff of an n-period zero coupon domestic bond is equal to 1 unit of home currency at maturity. Then the price of that bond at time $t + n - 1$ is

$$P^{(1)}_{t+n-1} = E_{t+n-1} \left[M_{t+n} \right]. \tag{1.13}$$

[3]Gallmeyer et al. (2017) call it a taste shock.

Using (1.13) and the fact that M_t is lognormally distributed, m_{t+1} can be written in a general form:

$$m_{t+1} = -i_t - \frac{1}{2}\lambda_t' \Sigma \lambda_t - \lambda_t' \varepsilon_{t+1}, \tag{1.14}$$

where λ_t is the time-varying price of risk. The forward premium shock does not show up in the stochastic discount factor. It will propagate through inflation with a one-period delay. Then the price of risk is affine in the country-specific factors:

$$\lambda_t = \lambda_0 + \lambda_1 X_t. \tag{1.15}$$

The total compensation for risk equals the innovation in the stochastic discount factor. In other words, what is priced is the the unexpected change in the marginal utility. Using (1.14) and (1.15), I can write:

$$\begin{aligned} m_{t+1} - E_t\left[m_{t+1}\right] &= -\lambda_t' \varepsilon_{t+1} \\ &= -\left(\lambda_0 + \lambda_1 X_t\right)' \varepsilon_{t+1}. \end{aligned} \tag{1.16}$$

Using the model implied m_{t+1} in (1.12), I can express the left hand side of (1.16) in terms of model parameters:

$$\begin{aligned} m_{t+1} - E_t\left[m_{t+1}\right] &= -\gamma\left(\Delta c_{t+1} - E_t\left[\Delta c_{t+1}\right]\right) - \left(\pi_{t+1} - E_t\left[\pi_{t+1}\right]\right) \\ &\quad - \left(\Delta q_{t+1} - E_t\left[\Delta q_{t+1}\right]\right) \\ &= -\left(\gamma + \kappa_c \nu_t\right) \varepsilon_{c,t+1} - \left(1 + \kappa_\pi \nu_t\right) \varepsilon_{\pi,t+1} \\ &= -\left(H + K X_t\right)' \varepsilon_{t+1}, \end{aligned} \tag{1.17}$$

where

$$H = \begin{bmatrix} \gamma \\ 1 \\ 0 \end{bmatrix} \qquad \text{and} \qquad K = \begin{bmatrix} 0 & 0 & \kappa_c \\ 0 & 0 & \kappa_\pi \\ 0 & 0 & 0 \end{bmatrix}.$$

Matching the coefficients in (1.16) and (1.17) yields $\lambda_0 = H$ and $\lambda_1 = K$. To complete the components for bond pricing, I need a process for the short rate. I assume that the short rate is affine in the state of the economy:

$$i_t = \delta_0 + \delta_1' X_t + \delta_2 e_t. \tag{1.18}$$

Using Equations (1.12), (1.14) and (1.15) and matching the coefficients in (1.18) I get the model implied loadings for the short rate:

$$\delta_0 = -\log\beta + \lambda_0'\mu - \frac{1}{2}\lambda_0'\Sigma\lambda_0 \tag{1.19}$$

$$\delta_1' = \lambda_0'\left(\Phi - \Sigma\lambda_1\right) \tag{1.20}$$

$$\delta_2 = \phi_e. \tag{1.21}$$

Now, I can rewrite the covered interest parity condition in (1.9) in terms of the state variables:

$$e_{t+1} = \frac{\delta_0 - \delta_0^*}{1 - \delta_2 + \delta_2^*} + \frac{\delta_1'}{1 - \delta_2 + \delta_2^*} X_{t+1} - \frac{\delta_1^{*\prime}}{1 - \delta_2 + \delta_2^*} X_{t+1}^* + \frac{1}{1 - \delta_2 + \delta_2^*} \varepsilon_{e,t+1}. \tag{1.22}$$

I treat e_t as a separate state variable and therefore put it into a VAR form. To do this, I iterate the right hand side of (1.22) using Equation (1.10) and its foreign country counterpart. Then Equation (1.22) becomes

$$
\begin{aligned}
e_{t+1} = \mu_e + V'\Phi X_t - V^{*\prime}\Phi^* X_t^* + \left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) e_t \\
+V'\varepsilon_{t+1} - V^{*\prime}\varepsilon_{t+1}^* + V_e\varepsilon_{e,t+1},
\end{aligned}
\tag{1.23}
$$

where

$$
V = \frac{\delta_1}{1-\delta_2+\delta_2^*}, \quad V^* = \frac{\delta_1^*}{1-\delta_2+\delta_2^*}, \quad V_e = \frac{1}{1-\delta_2+\delta_2^*}
$$

and

$$
\mu_e = \frac{\delta_0-\delta_0^*}{1-\delta_2+\delta_2^*} + V'\mu - V^{*\prime}\mu^*.
$$

I assume that bond prices are exponentially affine in all states of the economy:

$$
P_t^{(n)} = \exp\left(A_n + B_n' X_t + D_n' X_t^* + G_n e_t\right), \tag{1.24}
$$

where A_n and G_n are scalars, B_n and D_n are 3×1 vectors that satisfy the bond pricing recursions. Then the zero coupon bond yields are given by

$$
y_t^{(n)} = -\frac{A_n}{n} - \frac{B_n'}{n}X_t - \frac{D_n'}{n}X_t^* - \frac{G_n}{n}e_t. \tag{1.25}
$$

The derivations of the bond pricing recursions are provided in the Appendix. In the following sections, I will do an application of this model.

1.3 Empirical Application

In this section, I will estimate the model using quarterly data from the United States and the United Kingdom. I treat the former as the home country and the latter as the foreign country. I use three sets of data. The first data set is from OECD Main Economic Indicators and includes consumption growth and inflation. In particular, I use the annualized growth rate of the seasonally adjusted private final consumption expenditures and the annualized growth rate of the consumer price index. The second data set is from Bloomberg and contains the dollar/pound spot exchange rate and the associated 3-month forward points. The third data set is the set of annualized nominal zero coupon bond yields from Wright (2011). I use the yields of maturities 3-month, 6-month, 1-year, 2-year, 5-year and 10-year. The 3-month yield is the short rate. The sample covers the period from 1987-Q1 to 2007-Q4. All observations are end-of-quarter values.

The growth rate of aggregate consumption and the headline inflation are too volatile to be used for fitting affine term structure models. Following Wright (2011), I smooth those series by applying an exponential weighted moving average filter with a smoothing parameter of 0.75. The valuation shock in each country is an unobservable state variable. I extract them using a standard Kalman filter. That requires a measurement equation that links the observable variables to the state vector and a transition equation that describes the evolution of the state variables. There are 2 macroeconomic and 6 yield series for each country. Hence, the total number of observable variables is 17 including the forward premium. As discussed in the previous section, there are 7 state variables. The measurement equation is

$$\mathcal{Z}_{t+1} = \tilde{\Psi} + \tilde{\Gamma}\mathcal{X}_{t+1} + \tilde{\eta}_{t+1}, \tag{1.26}$$

$$\tilde{\eta}_{t+1} \sim N\left(\mathbf{0}_{17\times 1}, \tilde{\Omega}\right)$$

where $\mathcal{Z}_{t+1}$ is the vector of observable variables, $\tilde{\Psi}$ is a 17×1 matrix, $\tilde{\Gamma}$ is a 17×7 matrix, $\mathcal{X}_{t+1}$ is the vector of state variables and $\tilde{\eta}_{t+1}$ is the vector of measurement errors. The transition equation is

$$\mathcal{X}_{t+1} = \tilde{\mu} + \tilde{\Phi}\mathcal{X}_t + \mathcal{V}\tilde{\varepsilon}_{t+1}, \tag{1.27}$$

$$\tilde{\varepsilon}_{t+1} \sim N\left(\mathbf{0}_{7\times 1}, \tilde{\Sigma}\right)$$

where $\tilde{\mu}$ is a 7×1 matrix, $\tilde{\Phi}$ is a 7×7 matrix, $\mathcal{V}$ is the 7×7 impact matrix and $\tilde{\varepsilon}_{t+1}$ is the vector of state shocks. Equations (1.26) and (1.27) are written in the compact form. The detailed state space representation is provided in the Appendix.

I demean all the variables before estimating the model. This procedure reduces the number of parameters to be estimated. In particular, I do not estimate the As in Equation (1.25). I add the sample averages after the estimation. The dimension of the problem remains large even after dropping the means. There are 40 parameters to be estimated. The estimation results are sensitive to the initial values of the parameters. The likelihood function does not admit a unique optimum. Therefore, the initial parameter vector must be carefully chosen to ensure a convergence to a local maximum that is consistent with economic theory. Most of the parameters are initialized with values that are estimated from ordinary least squares regressions. The persistence parameters and the conditional variances of the valuation shocks are calibrated to roughly match those of the associated macroeconomic variables. The sensitivity parameters of the growth rate of the preference shock are set with arbitrary values such that the initial value of the likelihood is at maximum.

1.4 Results

In this section, I will discuss the term structure implications of the model. The estimation results are reported in Table 1.1. Consumption growth and inflation are highly persistent in both countries. The negative covariance between consumption growth and inflation renders the nominal bonds risky. They are not a good hedge against inflation. This relationship is more prominent is the United States. Any shock to macroeconomic variables will lead to a larger shift in the marginal utility of the agent in the United states since the risk aversion there is higher compared to that in the United Kingdom. The valuation shocks are the only latent variables in the model and are fairly persistent in both countries. They work like the level factor described in Litterman and Scheinkman (1991) to fit the yield curves. The forward premium loads to inflation in each country with opposite signs, as expected. An increase in the forward premium means depreciation of the dollar against pound, which then puts a downward pressure on inflation in the United States.

The model fits of the yields, macroeconomic variables and the forward premium are shown in Figures 1.1, 1.2 and 1.3, respectively. The fit of the yields is excellent across all maturities in both countries. The fit of the forward premium is also perfect since it equals the short rate differentials. The model is successful in fitting the consumption growth and inflation. Although the fitting errors are larger compared to those of the yields, the model is able to track the variations in these macroeconomic series. The divergence between the fitting performances in yields and the macroeconomic variables is a consequence of the utility function. The model requires a certain level of risk aversion to fit the yields. The implied elasticity of intertemporal substitution is not large enough to fit the macroeconomic variables.

The main theme of this exercise is to quantify the extent to which economic dynamics in the United States and in the United Kingdom explain each other's term structure. I do this by looking at impulse responses and variance decompositions. The impulse responses of selected yields to a one standard deviation shock to the macroeconomic variables in respective countries are displayed in Figures 1.4 and 1.5. The key to interpret the impulse responses is to understand the response of the short rate at $t = 0$. In the left panel of Figure 1.4, a one standard deviation shock to the U.S. consumption growth leads to a 1.9 standard deviation increase in the U.S. short rate.

The mechanism is as follows. When the shock hits, consumption growth increases by 1 unit. The transition to the short rate operates through two channels. First, consumption growth directly enters into the short rate process. Second, it enters indirectly through the forward premium in Equation (1.22). The net effect is determined by the sign and the magnitude of the associated factor loadings. All factor loadings are shown in Figure 1.6. In pricing of the U.S. bonds, U.S. consumption growth dominates all other factors and the effect of forward premium is almost zero. The economic interpretation is as follows. After the shock arrives, since consumption growth is persistent, the agent knows that consumption will keep growing and demand for bonds will decrease. Bond prices go down and yields rise. The short rate and other yields gradually come to a new steady state around 0.6 units in 100 periods.

Inflation enters into the short rate process through the same channels. In the right panel of Figure 1.4, a one standard deviation shock to the U.S. inflation leads to a 0.4 standard deviation increase in the U.S. short rate initially. In the next period, consumption growth falls as a response to inflation. Then the short rate plummets because of the dominance of consumption growth in determining the yields. The intuition is as follows. When the shock hits, the agent knows that the growth rate of her consumption will fall in the following period. That is, her marginal utility will be higher. Then the demand for bonds will increase to smooth consumption. This leads to a drop in the yields. The new steady state occurs around 0.7 units for all yields.

The impulse responses of the U.K. yields to a one standard deviation shock to the U.K. factors are weaker compared to the U.S. case. This is mainly due to the lower sensitivity of the U.K. consumption growth to U.K. inflation compared to the U.S. counterpart.

The impulse responses are similar across maturities. The dashed lines represent the cross-country effects. The impact of the U.S. factors in pricing of the U.K. bonds is near zero. Conversely, the U.K. factors have a substantial effect on the U.S. bond yields. In the left panel of Figure 1.5, a one standard deviation shock to the U.K. consumption growth leads to a 0.3 standard deviation decrease in the U.S. short rate in 20 periods. This level is achieved in 5 periods for the 10-year U.S. yields. In the right panel of Figure 1.5, a one standard deviation shock to the U.K. inflation leads to a steady state of 0.4 standard deviation increase in the U.S. short rate. The 10-year U.S. yields increase up to 0.5 units. The reason behind this interaction is the dominance of the U.K. consumption growth in pricing of the U.S. bonds.

A caveat of the model is that any shocks to the macroeconomic variables are reflected in the expected short rates. Only the shocks to the latent variables, ν_t and ν_t^*, move the term premium. The reason is that the valuation shocks are exogenous to the model, and thus they do not respond to any of the macroeconomic variables.

The variance decompositions of selected U.S. and U.K. yields are presented in Tables 1.2 and 1.3. The variation in the U.S. short rate is explained mostly by the U.S. consumption growth in the short run. In the long run, the U.S. inflation explains 38.8 percent of that variation. The dominance of the U.S. consumption growth declines as maturity increases. The U.S. inflation retains its explanatory power and the U.S. valuation shock have a mild contribution to the variation in the 2-year and 10-year U.S. yields. The U.K. consumption growth explains a significant portion of the variation in the U.S. yields in the long run at all maturities reaching up to 8.4 percentage points. The variation in the U.S. yields can be roughly attributed to the U.S. macroeconomic factors in general. This is not the case for the U.K. bonds. The U.K. consumption growth is dominant at the short end of the U.K. yield curve whereas the U.K. valuation shock explains almost all the variation in the long end.

1.5 Conclusion

In this paper, I proposed a two-country affine term structure model enriched with macroeconomic factors to analyze the nominal bond yield dynamics in each country. The countries are connected through covered interest parity. This joint framework allows me to figure out the cross-country factors in determination of the yields. The model is applicable to any two countries that have similar characteristics. I estimated the model using data from the United States and the United Kingdom. I found that the U.S. yields are mainly determined by the U.S. macroeconomic factors. The short end of the U.K. yield curve is explained mostly by the U.K. consumption growth and the long end is controlled by the U.K. latent factor. The effect of the U.K. consumption growth is notable in determination of the U.S. yields.

The model can be improved in several directions. The limitations posed by reduced form economic dynamics could be overcome by adopting a structural model incorporating capital flows. Expectations could be modeled accordingly. Furthermore, the computational issues arising in the estimation process would make a Bayesian approach more reliable. I leave them for future research.

Table 1.1: Estimates of model parameters.

United States			United Kingdom		
	Initial	Estimated		Initial	Estimated
γ	2	1.996	γ^*	2	1.437
ϕ_c	0.8324	0.9643	ϕ_{c^*}	0.9069	0.9494
$\phi_{c,\pi}$	-0.2012	-0.2118	ϕ_{c^*,π^*}	-0.0674	-0.0562
ϕ_π	0.9043	0.8104	ϕ_{π^*}	0.9763	0.9962
ϕ_e	-0.0127	-0.01212	ϕ_e^*	0.002043	0.00195
ϕ_ν	0.9	0.9202	ϕ_{ν^*}	0.9	0.9906
$\kappa_c \times 10^{-5}$	1	1.064	$\kappa_{c^*} \times 10^{-5}$	1	0.9126
$\kappa_\pi \times 10^{-5}$	1	0.8938	$\kappa_{\pi^*} \times 10^{-5}$	1	0.9707
$\sigma_c \times 10^3$	1.184	1.288	$\sigma_{c^*} \times 10^3$	1.866	1.878
$\sigma_\pi \times 10^3$	1.006	1.105	$\sigma_{\pi^*} \times 10^3$	1.036	1.137
$\sigma_\nu \times 10^3$	1	0.8815	$\sigma_{\nu^*} \times 10^3$	1	0.9939
$\sigma_e \times 10^3$	1.225	1.042	(common parameter)		

Table 1.2: Variance decompositions of selected U.S. yields at 3-month and 10-year horizons.

	U.S. 3-Month Yield		U.S. 2-Year Yield		U.S. 10-Year Yield	
Shocks	Q1	Q40	Q1	Q40	Q1	Q40
U.S. Consumption	95.9%	55.6%	72.3%	50.6%	47.9%	44.6%
U.S. Inflation	1.6%	38.8%	12.7%	40.4%	32.5%	40.8%
U.S. Latent	2.5%	0.6%	15.0%	3.3%	16.5%	4.4%
U.K. Consumption	0.0%	4.2%	0.0%	4.9%	2.7%	8.4%
U.K. Inflation	0.0%	0.2%	0.0%	0.2%	0.1%	0.1%
U.K. Latent	0.0%	0.5%	0.0%	0.7%	0.3%	1.7%
Forward Premium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 1.3: Variance decompositions of selected U.K. yields at 3-month and 10-year horizons.

	U.K. 3-Month Yield		U.K. 2-Year Yield		U.K. 10-Year Yield	
Shocks	Q1	Q40	Q1	Q40	Q1	Q40
U.S. Consumption	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
U.S. Inflation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
U.S. Latent	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
U.K. Consumption	82.4%	78.8%	44.2%	23.1%	4.0%	1.5%
U.K. Inflation	13.1%	9.4%	5.2%	2.8%	0.0%	0.8%
U.K. Latent	4.5%	11.8%	50.6%	74.0%	96.0%	97.7%
Forward Premium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

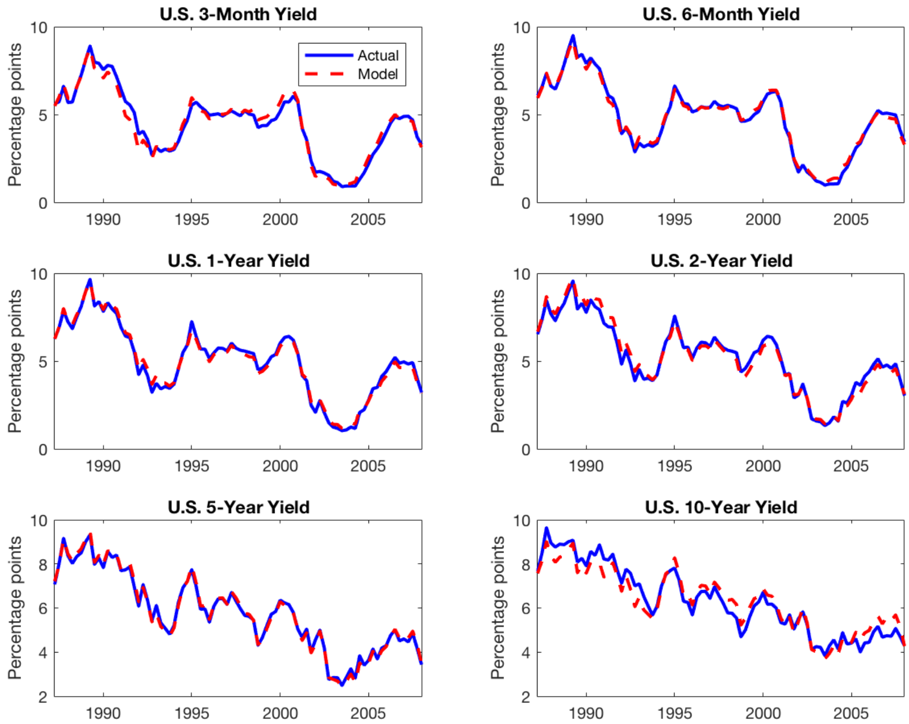

Figure 1.1: Model fit of the U.S. yields.

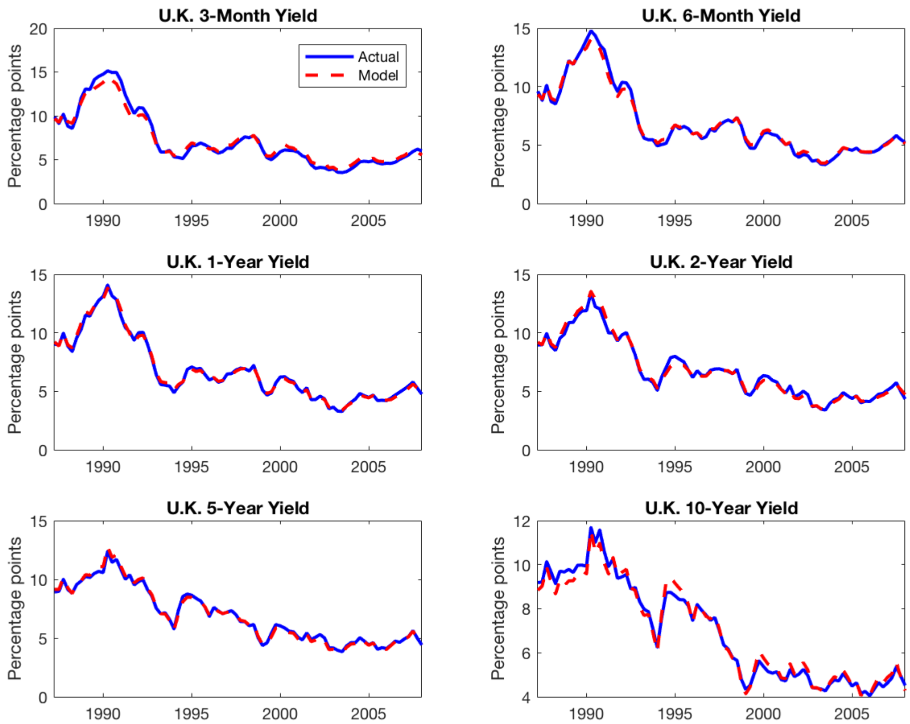

Figure 1.2: Model fit of the U.K. yields.

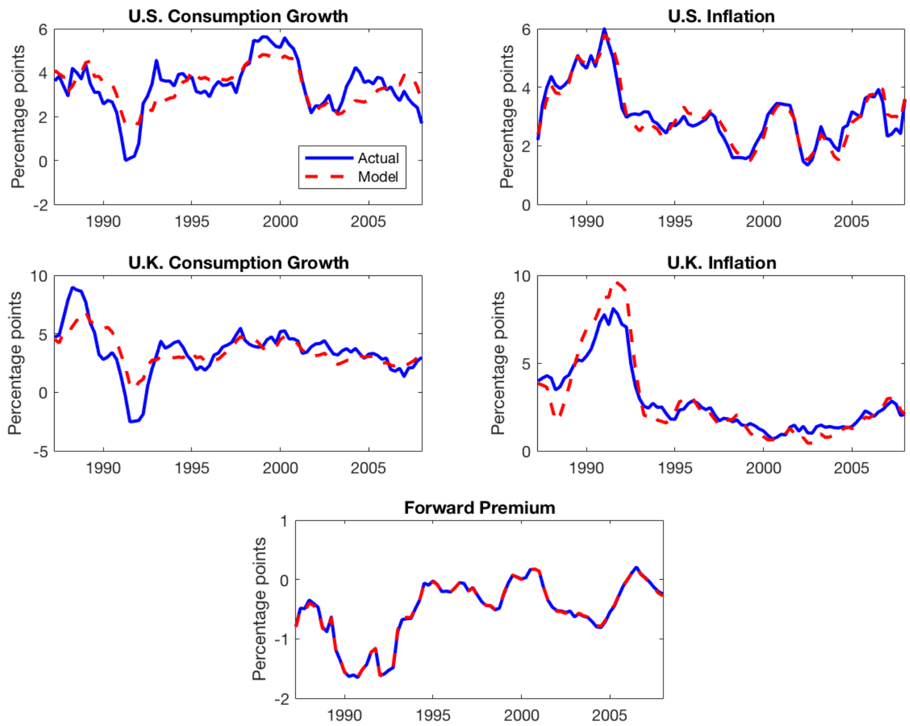

Figure 1.3: Model fit of the macroeconomic variables and the forward premium.

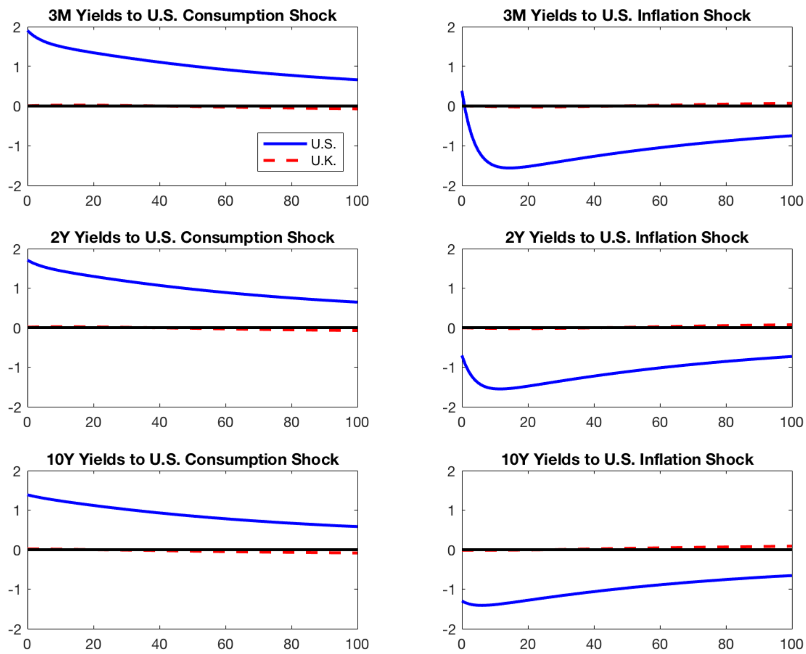

Figure 1.4: Impulse responses of selected yields to a one standard deviation shock to the U.S. consumption growth and inflation. The responses are in terms of the standard deviation of the associated shock.

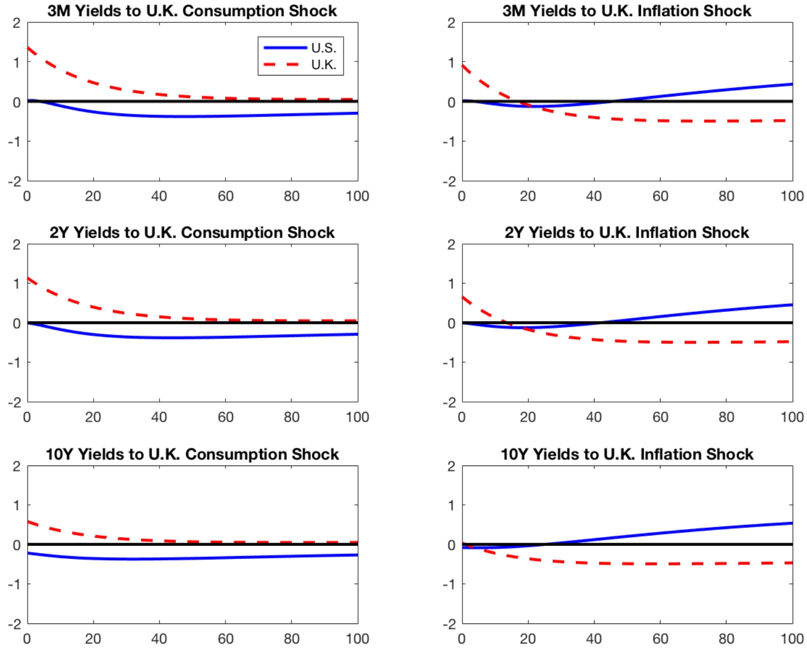

Figure 1.5: Impulse responses of selected yields to a one standard deviation shock to the U.K. consumption growth and inflation. The responses are in terms of the standard deviation of the associated shock.

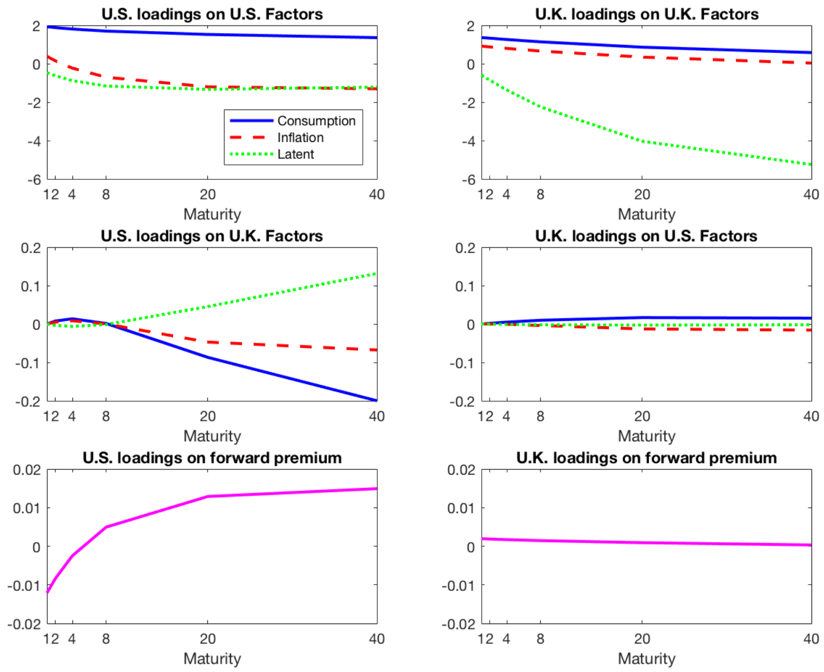

Figure 1.6: Yield factor loadings.

CHAPTER 2

ESTIMATING THE POTENTIAL GROWTH RATE OF THE TURKISH ECONOMY

2.1 Introduction

Turkish economy has grown by 7.3 percent year-on-year in the first quarter of 2018. This paper evaluates the stance of this number after calculating the potential growth rate according to which it can be judged. The conventional definition of potential growth is the growth rate of output that is consistent with stable inflation. I depart from this usual definition by using other measures of imbalances instead of inflation.

From the production function perspective, potential growth is the growth rate attained with normal use of the factors of production. The normal levels of some of these factors, such as capital and total factor productivity, are usually proxied with their respective Hodrick-Prescott trends. Calculation of the normal level of labor may include the estimation of a Phillips curve. Trend is a statistical concept, whereas potential is an economic term. Economists believe that in the long run, potential output will converge to the trend. They do not have to follow the same path. Using the Hodrick-Prescott filter at any stage of the potential output or potential growth calculation will result in an unreliable estimate. My definition of potential growth has an influence not only on the labor but also on the other components of a production function.

I employ a bivariate filter that accounts for certain macroeconomic imbalances to estimate the potential output growth for Turkey. Since I merely ask a growth question, I confine my analysis to estimating the potential growth directly. There are a number of papers that have used multivariate filtering methods to estimate the potential output and potential growth in Turkey. Özbek and Özlale (2005), Kara et al. (2007), Öğünç and Sarıkaya (2011), Blagrave et al. (2015) and Andıç (2018) are some examples. All of these papers have considered inflation as the single imbalance indicator that identifies the output gap.

Figure 2.1 shows the annualized growth rate and selected imbalance indicators for Turkey. High growth rates are associated with high current account deficits and increased credit demand. Growth fueled by excessive borrowing cannot be sustainable. Therefore, any potential growth rate that is estimated by ignoring sustainability cannot be potential. My study renames the sustainable growth as the genuine potential growth and resembles the work of Alberola, Estrada, and Santabárbara (2014).

My findings suggest that the potential output growth in Turkey is much lower compared to the trend or the other estimates in existing studies, particularly after the Great Recession. Finally, my paper confirms the growth target published in the recently announced *new economic plan* of Turkey (Ministry of Treasury and Finance, 2018).

2.2 Model and Data

This study focuses particularly on estimating the potential growth rate of the Turkish economy subject to two macroeconomic stability constraints. Therefore, I do not model the output directly but work with growth rates. I build a bivariate system as in Kuttner (1994) such that the growth gap is identified through the imbalance indicators. I decompose the growth rate of output into trend and cycle components:

$$g_t = g_t^* + c_t, \tag{2.1}$$

where g_t^* is the potential growth rate and c_t is the growth gap. Following Andıç (2018), I model the potential growth rate as a first order random walk:

$$g_t^* = g_{t-1}^* + \varepsilon_{g,t}, \tag{2.2}$$

where $\varepsilon_{g,t}$ is the normal trend shock with standard deviation σ_g. This specification rules out the case of constant potential growth rate, which otherwise would be hard to justify for Turkey due to its developing economy. The growth gap follows an AR(1) process:

$$c_t = \rho c_{t-1} + \varepsilon_{c,t}, \tag{2.3}$$

where $\varepsilon_{c,t}$ is the normal cycle shock with standard deviation σ_c. I identify the cycle from the imbalance indicator with the following relationship:

$$\tilde{z}_t = \phi \tilde{z}_{t-1} + \gamma c_t + \eta_t, \tag{2.4}$$

where $\tilde{z}_t$ is the deviation of the imbalance indicator from its target and η_t is a white noise innovation with standard deviation ω_z. The lagged term on the right hand side accounts for the inertia effects.

Estimating (2.1) alone, possibly with the Hodrick-Prescott filter, is a pure statistical exercise. I estimate (2.1)–(2.4) jointly and hence add an economic content in trend and cycle components. I use the Kalman filter to estimate the model. This procedure requires a measurement equation that links the observable variables to the unknown state variables and a transition equation that determines the evolution of the latter. The system of measurement equations is

$$\begin{bmatrix} g_t \\ \tilde{z}_t \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & \phi \end{bmatrix} \begin{bmatrix} g_{t-1} \\ \tilde{z}_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 0 & \gamma \end{bmatrix} \begin{bmatrix} g_t^* \\ c_t \end{bmatrix} + \begin{bmatrix} 0 \\ \eta_t \end{bmatrix} \tag{2.5}$$

and the system of transition equations is

$$\begin{bmatrix} g_t^* \\ c_t \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & \rho \end{bmatrix} \begin{bmatrix} g_{t-1}^* \\ c_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{c,t} \end{bmatrix}. \tag{2.6}$$

Estimation of this bivariate model yields the trend and cycle growth rates consistent with the imbalance indicator subject to the smoothness conditions in (2.2) and (2.3). The estimated potential growth rate can be interpreted as the one that does not contribute to the divergence between the imbalance indicator and its target after controlling for inertia.

I use two imbalance indicators that are relevant for Turkey. The first one is the output share of the current account balance and the second one is the output share of the change in the credit stock.[1] I set the current account balance target at its historical average, −3.5 percent of output. Following Kara et al. (2013), I set the credit use target at 7.5 percent of output. I use quarterly data for the estimation to get more variation for a better identification. The estimation period is from 2003-Q4 to 2018-Q1 since the credit data start with the last quarter of 2002. I use data from three sources. The growth data is the annualized percentage change in the seasonally adjusted 2009 based real GDP and is from TurkStat. The data on current account balance is from the Central Bank of Turkey and the credit stock data is from the Banking Regulation and Supervision Board. The latter includes both domestic and foreign currency denominated loans. I use the 2009 based nominal GDP series from TurkStat to get the output share of these imbalance indicators. Finally, I adjust the nominal GDP and the current account balance for seasonality using the X-13ARIMA-SEATS program of the Census Bureau.

2.3 Results

I estimate the model with each imbalance indicator separately and report two implied potential growth rates. Estimation results are presented in Table 2.1. Both imbalance indicators are important in identifying the growth gap since all parameters are significant at 1 percent. A one percentage point change in the growth gap leads to 16 basis points deviation of the output share of current account balance from its target. The sign of the response is negative as expansionary periods are associated with higher current account deficits. The response of credit use to growth fluctuations is stronger. A one percentage point change

[1]Using inflation as an imbalance indicator makes the cycle unidentified (insignificant γ) due to the weak correlation between inflation and output growth.

in the growth gap leads to 26 basis points deviation of the output share of the change in the credit stock from its target. The growth gap is highly persistent since I use the annualized growth rates. The model is successful in fitting the imbalance indicators.

Estimated potential growth rates are shown in Figure 2.2. The current account balance adjusted potential growth rate is below the Hodrick-Prescott trend at all quarters. The gap between the trend and potential growth rates widens after the Great Recession. For the period until 2008-Q4, the average gap between the trend and the current account balance adjusted potential growth rates is 2.1 percentage points but it increases to 3.3 percentage points for the remaining period. The credit use adjusted potential growth tracks the trend until the crisis but diverges afterwards. The average gap between them is 0.3 percentage points until 2008-Q4 and it subsequently jumps to 1.9 percentage points.

After the Great Recession, government spending in Turkey has not dwindled. This prolonged expansionary fiscal policy has exacerbated the current account deficit and has increased the demand for loans. The resulting output growth rates are not sustainable. The imbalance adjusted potential growth rates can thus be considered as the sustainable growth rates. Starting with the second quarter of 2013, the gap between the imbalance adjusted potential growth rates falls below one percentage point and stays there since then. That means both potential growth rates are close to each other for the last five years. This reduces the uncertainty around the unconditional potential growth rate. Both potential growth rates are, on average, 3 percentage points lower than the trend growth rate for the last five years.

In the first quarter of 2018, Turkish economy has grown by 7.3 percent year-on-year but at the cost of increasing the current account deficit and the annualized credit use to 7 percent and 11.3 percent of GDP, respectively. My model suggests that had Turkey grown 2.3 percent, the current account deficit would have been stabilized around 3.5 percent of GDP. The growth rate that keeps the credit use at 7.5 percent of GDP is 3.2 percent. My results support the target growth rates published in the recently announced economic plan of Turkey. The government targets an annual growth rate at 3–4 percent in the coming periods.[2] I uncover the result that the government aims at pushing the growth rate towards the potential.

2.4 Conclusion

In this paper, I have estimated the potential output growth rate of Turkey using a bivariate filter. In general, we treat the trend of output growth as the growth path the economy attains in the long run. The trend is extracted mostly using the Hodrick-Prescott filter, which is a univariate tool. The fact that potential is an economic concept allows it to diverge from the trend, which is a pure statistical term. I define the potential growth as the output growth rate that keeps certain macroeconomic indicators at sustainable levels.

The government spending in Turkey has remained high since the Great Recession. This continuing expansionary stance of fiscal policy has had grave repercussions for the current account balance and the credit demand. My model took

[2]The current account balance adjusted potential growth rate is consistent with this. The target current account deficit is 4 percent of GDP in the economic plan, which is 50 basis points above the target in my study. This allows for a higher potential growth rate.

these imbalances into account separately to determine two potential growth rates, each adjusted for one imbalance indicator. I found that for the last five years, the potential growth rates are close to each other and are much lower than the trend on average. My results are consistent with the target output growth rates in the newly announced economic plan of Turkey.

Table 2.1: Estimates of model parameters.

Imbalance Indicator	ϕ	γ	ρ	ω_z^2	σ_g^2	σ_c^2
Current Account Balance/GDP	0.65	-0.16	0.87	6.68×10^{-5}	1.78×10^{-5}	7.11×10^{-4}
	(0.08)	(0.03)	(0.07)			
Change in Credit Stock/GDP	0.72	0.26	0.82	1.59×10^{-4}	1.74×10^{-5}	6.96×10^{-4}
	(0.07)	(0.05)	(0.08)			

Notes: Standard errors are in parentheses. All coefficients are significant at 1 percent.

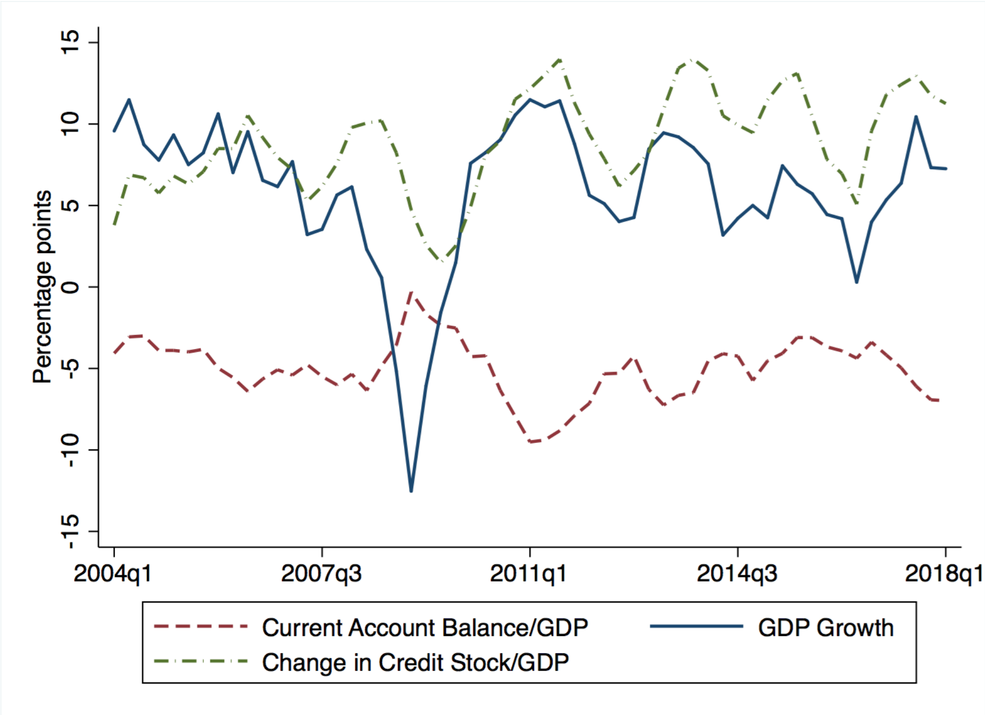

Figure 2.1: Annualized growth rate of output and selected macroeconomic imbalances. Source: TurkStat, Central Bank of Turkey, Banking Regulation and Supervision Board, and author's calculations.

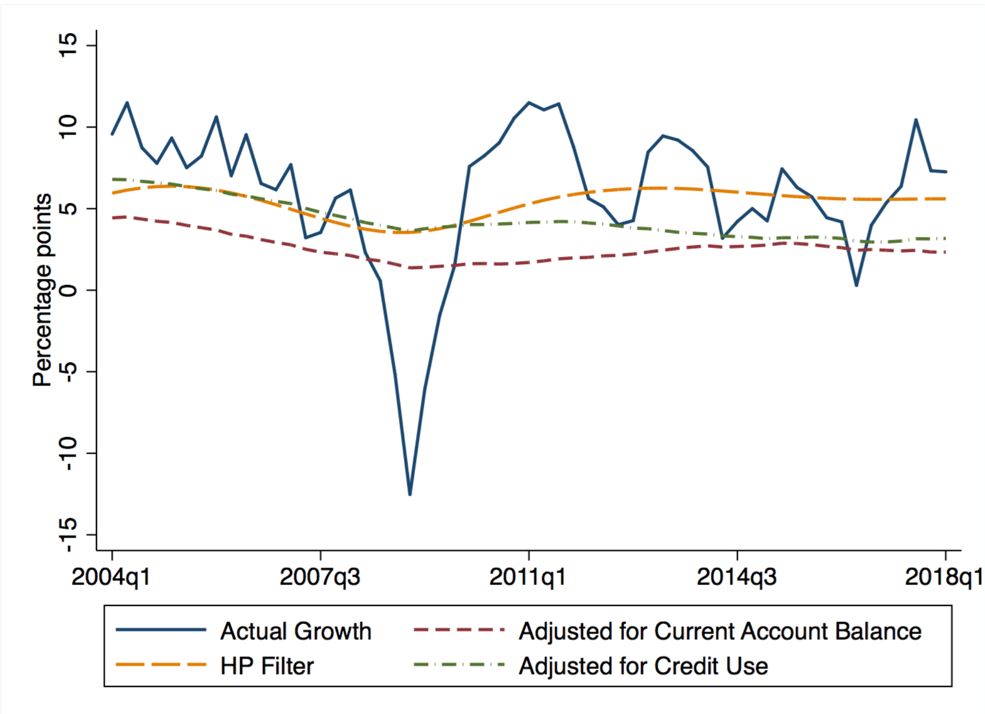

Figure 2.2: Actual growth rate, trend growth rate and estimated potential growth rates of output.

CHAPTER 3

MONETARY POLICY IN TURKEY AFTER CENTRAL BANK INDEPENDENCE*

3.1 Introduction

Turkey has had a fascinating 15 years after its 2001 crisis. That crisis proved to be a watershed moment for the country's economy as well as its politics. The disinflation and rapid growth that materialized early in the period marked the country as an economic success story. That story was not revised after growth tapered and disinflation came to a stop with inflation at high single digits.

In this paper we provide a coherent, accessible narrative of the Turkish macroeconomic policy and performance after the 2001 crisis with particular emphasis on monetary policy. To do so, we begin with an overview of Turkish economic history that glosses over all details and many salient points but touches on some vital statistics of the period. Here, we point out that the post-2001 period appears to have two sub-periods that should be studied separately.

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We then turn briefly to fiscal policy. The state of Turkish economy cannot be understood without observing that fiscal policy turned aggressively expansionary in 2009 in response to the Global Financial Crisis but never reversed course after the output gap in Turkey closed. The budget deficit does not reveal the increase in government spending because of a concurrent fall in interest rates which created an offsetting decline in interest expenditures.

Monetary policy is our main focus and in that domain the Central Bank has been missing its inflation target for several years now. We first argue that due to political pressures the Central Bank of Turkey (CBRT) began to let the market interest rate diverge from the official policy rate, essentially manipulating the market rate by rationing funds at the policy rate. Hence, the official policy rate is now a poor indicator of policy stance.

Using the one-week TRlibor rate as the policy rate measure, we show that monetary policy in Turkey did not follow a uniform Taylor-type rule in the post-2001 period. We find a structural break in all formulations of the policy rule in 2009. The pre-2009 rules are aggressive in controlling inflation. The post-2010 rules are weak and do not imply real rates rising in response to rising inflation.

Lastly, we present an event study of major jumps in the US dollar-Turkish lira exchange rate in the past couple of years, a period when jumps happened alarmingly often. We argue that while information about global liquidity conditions was certainly pertinent, discrete jumps in the exchange rate are explained better by domestic factors. Among those factors are policy decisions and announcements about the likely future course of policy by the CBRT.

While it is hard to see sizable effects of nonstandard policies of the CBRT on exchange rates (and, in general, on any variables of interest), interest rate decisions certainly had large effects. The overview presented in this paper suggests that as a high inflation country away from the zero lower bound, Turkey still has the interest rate as a proven and powerful policy tool. We argue that using it actively has had desirable effects and failing to utilize it has led to deterioration in inflation and in inflation outlook that was reflected in asset prices.

3.2 A Brief History

Turkey is a Latin American economy located at the corner of Europe. It has gone through all of the phases of emergingness, from import substitutionism to export-led growth to liberalized capital account and ensuing boom-bust cycles to inflation targeting.[1]

1990s for Turkey were a period of massive budget deficits which drove all other macroeconomic outcomes. The borrowing needs of the government meant banks only lent to the government and did not fund private investment at all, the current account deficit was driven by the budget deficit and periodically these twin deficits blew up (Özatay, 2015, elaborates). Banks took on unreasonable risks such as borrowing in foreign currency and lending in liras and the Central Bank, essentially, was tied to the Treasury and tried to minimize the borrowing costs of the government, sometimes by outright monetization sometimes by changing interest rates to (unsuccessfully) lower the Treasury's funding costs.

[1] This analogy between Turkey and Latin American countries by and large also holds true for politics as well but that is outside the scope of this paper.

The 2001 crisis was a watershed moment. It was the deepest crisis in a series of boom-bust episodes in Turkey in the 1990s and wiped out many of the banks as well as laying bare the structural deficiencies of the Turkish economy. The fixed exchange rate regime was abandoned and the lira was allowed to float after the attack on the currency. It is of great political economy interest how an already unstable three party government undertook a very painful but comprehensive stabilization program and why similar programs were undertaken around the emerging world at about the same time. We do not have insights to offer on this and will only report that a very successful stabilization program was undertaken.

The Turkish stabilization program was three-pronged. The budget was brought under control, the banking system was recapitalized and the central bank gained its independence with the new central bank law. This paper surveys the period after the central bank independence.

Post-2001 growth in Turkey was impressive but the "new regime" did not last long, as shown in Figure 3.1. The GDP growth rate in Turkey began to slow in 2006 and was already declining when the Global Financial Crisis led to a severe but short-lived contraction. Indeed, after the crisis slack was taken up in 2010 and 2011, growth settled on levels that were low even by the historical averages, let alone the 2002–2006 period, with the 2012–2014 average falling to 3%.

Figure 3.2 shows a simple estimate of potential GDP, based on an HP filtered trend, and actual GDP. While this is very rudimentary, it by and large dovetails with more elaborate estimates of potential GDP produced at the CBRT (Coşar, Kösem, and Sarıkaya, 2012). The salient fact is that while in the immediate aftermath of 2001 crisis and the 2008–09 global crisis there were significant output gaps, beginning with 2011 the output gap was essentially closed and therefore demand management would not have, and at this time cannot, lead to lasting output increases. This is an important feature that helps understand the consequences of continued expansionary policies.

Figure 3.3 shows what is, historically, an anomaly for Turkey but is now a new normal. Up to and including 2001, Turkey was a traditional twin deficits country where the budget deficit drove the current account deficit (CAD), which rarely exceeded three percent of GDP. In the post-2001 period, especially after 2010, the CAD worsened markedly while the budget deficit did not budge. This shift in borrowing to the private sector is new in Turkey and is an artefact of lower borrowing needs of the public sector due to better fiscal discipline, and to improved financial intermediation and access to funds, partially fueled by high global liquidity, as Rodrik (2015) also notes. Köymen-Özer and Sayek-Böke (2015) show that specializing in low value-added and low-tech products also contributed to this increase. High values of CAD became less sustainable after the recent Global Financial Crisis because the share of short term capital inflows for financing the CAD increased significantly from about 25% to 50% (Özmen, 2015). As a result, fragility of the Turkish economy increased in the post-2009 period.

The increase (and, for households even existence) of private borrowing is cause for concern. Due to lack of rigorous flow of funds numbers we do not yet know the exact dynamics of private borrowing and are mostly in the dark about who is borrowing, in which currency and from whom. However, it is clear that private leverage, while still low by international standards, has risen dramatically with household debt to GDP rates increasing to about 22 percent from about 2 percent since 2002.[2] Turkish firms are not used to being highly levered and households are not used to being levered at all. Indeed, and our historical experience only informs us about the consequences of government indebtedness increasing rapidly (not pleasant), making the private indebtedness a cause for concern partly simply due to the reason that these are uncharted waters.

While the political narrative has been one of glory, emphasizing that days of crises are over as government debt to GDP rate is low, it is important to remember that what are hopefully over are the days of twin deficits-driven crises. This tells us nothing about risks stemming from leverage in the private sector that we are now learning to live with.

For completeness of this snapshot of the Turkish economy, we also briefly look at employment and inflation here as well. We will not be covering employment in this paper but will turn to inflation in detail in Section 4 below.

Figure 3.4 shows the grave structural unemployment picture of the country. The unemployment rate oscillates around 10 percent and does not go much lower even during periods of high growth and low labor force participation. This is a complex but well understood story involving sectoral transition from agriculture to services and industry, skill mismatch due to weak public education and various institutional factors that make the labor market very rigid (Bakış, 2015).

Notice that the structural aspect of unemployment limits the effectiveness of monetary policy in helping lower it. We will return to this in our discussion of what can reasonably be expected of monetary policy in Turkey.

It is interesting to note that labor force participation has been rising since 2007. This is entirely due to the increased labor force participation of women,

[2]CBRT Financial Stability Reports.

which is still a very low 30 percent. The increased female labor force participation was due to the added worker effect (when the working spouse loses or is at risk of losing job the other spouse begins to look for a job) during the global crisis and its continued increase was a pleasant but surprising development.

Briefly turning to inflation, we show a favorite chart of the CBRT (available on the welcome screen of their web page) in Figure 3.5, showing the rapid disinflation in early 2000s and the period of low and stable inflation since 2005. While the very impressive disinflation and relative stabilization of the inflation rates are both real, the scale of the figure, owing to the very high inflation rate at the beginning of the period, distorts the current picture of inflation.

A better understanding of inflation is provided by Figure 3.6, which is the same as Figure 3.5 but omits the initial few years of runaway inflation. Here, it is clear that inflation has settled on an average of about eight percent, low by historical Turkish standards but very high by any definition of price stability, including the CBRT's inflation target. Inflation is also strikingly volatile, regularly breaching double digits but occasionally dipping below five percent, with a standard deviation of 1.7 percentage points. The figure also shows that the core inflation measure, which excludes energy, food, alcohol, tobacco, and gold, remained stubbornly high as well and had a high variance. The disappointing headline numbers were not driven exclusively by volatile non-core components.

We will return to the CBRT's loss of control over inflation in Section 4 but will first make a necessary detour into fiscal policy.

3.3 Fiscal Policy

Neither the Turkish macroeconomy nor the behavior of the Central Bank can be understood without at least a basic understanding of fiscal policy in the post-2001 period. Figure 3.7 shows that budget deficits, which had reached double digits, were rapidly brought under control in the post-crisis period. This was essential for any macroeconomic stabilization and was the backbone of the program that helped Turkey move away from twin deficits-twin crises cycles. We do not elaborate on the (fascinating) mechanics of how this was achieved but note that the strong fiscal situation at the onset of the Global Financial Crisis allowed Turkey to do expansionary fiscal policy and have a short-lived recession despite the depth of the initial contraction.

Figure 3.8 shows that primary spending (government spending excluding interest payments on outstanding debt) as a fraction of GDP increased by almost four percentage points in 2009, as the government undertook fiscal expansion to offset the fall in private demand. This is standard Keynesian response to demand shocks, which affected both external and internal demand at the time, and although the composition of spending was debatable (and debated at the time), the expansionary fiscal policy was not itself subject to debate unlike in the US and euro area.

Importantly, Figure 3.8 makes another point about the fiscal stance that most commentators of the Turkish economy miss. While Figure 3.7 showed that the budget deficit increased temporarily in 2009, Figure 3.8 shows that government spending increased permanently. The increased spending that was to prop up demand and help pick up slack was not undone once the growth rate of GDP increased and the output gap was closed. The government's fiscal stance has been very expansionary since 2009 as tax revenue did not increase at the rate of primary spending increase, as shown in Figure 3.9.

It is then natural to ask why the budget deficit was not ballooning. The answer is in Figure 3.10, which shows the decomposition of government revenues and expenditures. Increased government spending was effectively financed by the dramatic fall in interest spending as interest rates fell (led by lower policy rates of the Central Bank and supported by global liquidity) and mildly higher tax revenues also helped the headline budget deficit.

Direct government spending is more expansionary than government interest payments as recipients of these payments save some of the interest income. Also, as about a quarter of government debt is held by non-residents[3] shifting expenditure from interest spending to primary spending has mechanical expansionary effects on top of the balanced budget multiplier.

Without getting into a debate on the size of the multiplier for this change in the fiscal policy stance, we conclude that fiscal policy became strongly expansionary in 2009 as a response to the Global Financial Crisis but never returned to a neutral stance after the crisis induced output gap was closed. With that in mind, we can now focus on monetary policy.

[3] Ministry of Finance, Annual Report on the Economy 2014.

3.4 Monetary Policy

Monetary policy in Turkey has been fascinating in the past 15 years. The Central Bank gained its independence in 2001 and began to implement inflation targeting. Due to the IMF-backed stabilization program and its constraints on the central bank balance sheet,[4] early in the period the regime was labeled "implicit inflation targeting," as the inflation target was not the only policy objective. The regime became "inflation targeting" in 2006. In practice, CBRT was doing almost textbook inflation targeting before 2006 as well. The transition to independent central banking and the early periods of implicit and overt inflation targeting are covered in Kara (2008), who also suggests that despite the IMF constraints the CBRT was doing inflation targeting beginning in 2002.

In a broad sense, this early inflation targeting episode was extremely successful, bringing inflation down to single digits from high double (and even triple) digit rates. Figure 3.5 had shown this strikingly. Monetary policy also contributed to the recovery in 2009 by dramatically easing, but it is hard to quantify the magnitude of the recovery due to CBRT actions.

Before moving to the debate on cyclical stabilization in the post-2001 period it is worth noting that especially after 2010 when the output gap closed, monetary policy was not the proper tool to promote growth. Section 2 showed that growth had slowed *at potential*, hence further growth in Turkey will come from growth of the potential. That requires structural reforms to increase female labor force participation, improve education to increase human capital, and foster investment

[4] Some balance sheet items of the CBRT were limited by the performance criteria of the stand-by program.

by making the country less legally and politically risky. These are not central banking issues.

Especially since 2010 the Central Bank lost track of its inflation objective, while focusing on many other issues, including bank loan growth, capital flows, current account deficit, etc. Davig and Gürkaynak (2015) show that a central bank may lower welfare by trying to address too many inefficiencies if this causes other policymakers to care less about problems for which they have the appropriate tools. Turkey seems to fit the description.

Having noted the problems associated with delegating all economic policy to the CBRT and expecting it to somehow engineer permanently above potential growth rates, we turn to inflation stabilization, the core mandate of CBRT for which it possesses the right policy tool.

3.4.1 Monetary Policy and Inflation

The policy framework in Turkey became a monetary economist's dream beginning in 2010, with the CBRT first actively using reserve requirements to (unsuccessfully) control bank loan growth, then using the volatility of the overnight rate to increase the risk/return ratio and deter overnight currency flows (slightly extending currency flow duration), then allowing the interbank rate to systematically be above the policy rate to do back-door policy tightening. During this period CBRT also allowed banks to hold reserves in foreign currency at what amounted to a secondary exchange rate controlled by the CBRT for the purpose of calculating the reserve amounts, with the (unrealized) hope that this would have an effect on the market exchange rate. The papers by Akkaya and

Gürkaynak (2012), Kara (2012), Özatay (2012), Üçer (2011) delve into various aspects of these policies, and most of these papers are critical of the design and/or effectiveness of this long list of non-standard policies. Here, with the benefit of several more years of data, we take a broader perspective.

We begin by making the obvious point that inflation has been above the target and above the target band (called the uncertainty band by the CBRT) almost continuously since 2011. Figure 3.11 succinctly shows this. Not coincidentally, this is when the output gap closed (Figure 3.2) and fiscal policy continued to be expansionary (Figures 3.8–3.9).

This then begs the question what monetary policy was doing at this time. Figure 3.12, which plots inflation, primary spending and CBRT's policy rate together, suggests that the answer is "not much." The policy rate was constant as inflation was rising in 2011–2012 and was lowered as inflation came down afterwards even though it remained above the target. The notable increase in the policy rate came in early 2014, when a political corruption crisis led to a jump in the exchange rate and unhinged expectations. Figure 3.12, however, hides more than it reveals.

3.4.2 Policy Rate and Policy Stance

The "policy rate" has the connotation of a target rate of a central bank that is a point of attraction in the interbank market. This was indeed the case in Turkey up to 2010. But afterwards the policy rate and the market rate diverged (Figure 3.13). In essence, the policy rate became an empty signifier, uninformative about the stance of monetary policy. We think this was done by the CBRT at least in part to take advantage of the limited economic understanding of the politicians who were pressuring the institution for lower interest rates. Keeping the policy rate low and allowing the interbank rate to be much higher allowed a veiled policy tightening at the expense of policy transparency.[5]

The "policy rate" had switched from the overnight rate to a one week repo rate in 2010 and, as shown in Figure 3.13, that repo rate was not used to keep market rates close to the announced policy target rate. Indeed, the central bank often explicitly noted in its formal policy announcements that "interbank money market rates will materialize around [level much higher than policy rate]."[6] (CBRT 2013, inter alia). Thus, to assess the policy stance, estimate the reaction function, and to quantify Turkish monetary policy in any way, we need a policy measure distinct from the official policy rate. Alp et al. (2010) had shown that the interest rate in the one week Turkish Lira Libor (TRlibor) market is the best predictor of policy stance in Turkey. That argument continues to hold, so we use the TRlibor rate as our measure of effective policy rate.

Figure 3.14 shows that this measure of the policy rate was much more responsive to inflation than the official policy rate. Now, using the TRlibor rate as a realistic measure of the policy stance, and employing this measure for the whole period (before 2010 as well to keep sub-periods comparable) we can study the reaction function of the Central Bank of Turkey.

Before we turn to econometric analysis, notice that in Figure 3.14 the inflation line is above the policy rate line for long stretches of time, regardless of how the

[5]It was also the case that a wide corridor gave the CBRT the flexibility to almost continuously adjust the interbank rate, which the policymakers genuinely seemed to like.

[6]The statement read "... interbank money market rates will materialize around 7.75 percent" whereas the same statement had announced the policy rate (one week repo rate) to be 4.5 percent.

policy rate is measured. Turkey had negative real policy rates in 2012 and 2013 even when the policy rate is measured with TRlibor. Recall from Figure 3.2 that this period had no economic slack. It appears that the Central Bank was stimulating demand with negative real interest rates at a time when the output gap had closed, and that combined with the continued fiscal stimulus led to overheating. That overheating manifested itself in inflation much higher than the target and also in historically unprecedented levels of current account deficits.

3.4.3 The Regime Switch in Monetary Policy

The discussion above suggests that monetary policy in Turkey was different, likely weaker, towards the end of the period of our study compared to the immediate aftermath of Central Bank independence, during the great stabilization of Turkish economy. Gürkaynak and Sayek-Böke (2013) and Acemoğlu and Üçer (2015) also argue that there was a break in Turkish economic performance (as well as political and democratic performance) sometime after 2006. To study whether monetary policy was indeed different during part of the post-2001 crisis period we looked for a structural break in estimated Turkish monetary policy reaction functions.

The policy rules we estimated and checked for structural breaks were of the Taylor-type rules which allow the central bank to react to inflation as well as a measure of output, and perhaps to other variables. Starting from 2003 to avoid the large, discrete drop in inflation and interest rates in 2002, and using monthly data, we estimate three monetary policy rules. All policy rules we consider include the annual inflation in the previous year. One rule has the deviation of industrial production[7] (IP) from its trend, the second one has the growth rate of IP and the third one adds the depreciation of the lira to the second formulation.

Using a battery of structural break tests, not reported for brevity, we find a structural break in all policy rules somewhere in 2009. Where exactly the break is located depends on the particular test and rule but all combinations of tests and policy rules point to a break in 2009.[8] We therefore split the sample into two, with the first sub-period running from 2003M1 to 2009M12 and the second one from 2010M1 to 2014M12, but note that out qualitative results and argument do not depend on when in 2009 we locate the sample break.

Table 3.1 shows the estimated Taylor-type rules for the two sub-periods and the p-value of the Chow test for the structural break in 2009M12 for that specification of the rule. All three rules clearly show that the CBRT was targeting inflation strongly in the earlier period, with a reaction function that satisfied the Taylor principle and moved the nominal interest rate more than one-for-one in response to inflation. All three rules also show that in the latter period the CBRT's response to inflation was severely muted, with the inflation response coefficient only half as large and much below unity in this period.

This is statistical validation for the common observation that lately CBRT has not been the inflation targeter it used to be. This finding is also consistent with the immense and public pressure the Central Bank faced from the government to lower interest rates.[9] Although it was not easy to clearly see in an environment of

[7]We use industrial production rather than GDP because IP is available at a monthly frequency but GDP is only available quarterly.

[8]Some multiple break tests also suggest other breaks as well, such as in 2005, but 2009 shows up often as the sole break and always as the most likely break point even in multiple break tests.

[9]The Turkish press is full of examples of the prime minister and various cabinet members arguing that the CBRT has to cut interest rates, that high interest rates cause high inflation,

very complicated monetary policy actions and communication, the policy stance was too easy given the inflation rate in the 2010–2014 period.

Notice that the depreciation of the lira does not enter the Taylor rule with any statistical significance. CBRT was not targeting inflation in the recent period and it is not clear to us which variable it was targeting, if any.

A striking visual counterpart to Table 3.1 is Figure 3.15, which shows the relationship between the monetary policy stance and inflation rate in the two subperiods. The scatterplots and the slopes of the OLS regression lines (bivariate regression between interest rate and inflation) shown in the top panel for the early and in the bottom panel for the later periods depict a remarkable change in the relationship, as was suggested by Table 3.1.

The break in the reaction function we determine allows us to ask what monetary policy would have looked like in the recent period had the strong anti-inflation stance of the central bank continued. To find out we present a counterfactual exercise where we estimate the interest rate implied by the 2003–2009 reaction function using the post-2010 data. Figure 3.16 shows the result.

That the counterfactual interest rate path is above the realized path is not surprising. It is, however, striking how much higher the interest rate would have been had the CBRT continued to follow its earlier, strongly stabilizing policy rule. The average distance between the actual and counterfactual policy paths is about 7 percentage points. That is, the interest rate set by the CBRT was about 7 percentage points too low in 2010–2014 by its own earlier standards. Once

that the CBRT is a traitor for not vastly lowering the policy rates, etc. "Erdoğan: ..." (2011, 2014) are two examples among many.

again, it is no wonder that inflation was above the target band for long stretches during this period.

A natural follow up question is what would have happened to inflation had the CBRT continued to follow the strongly stabilizing rule. We had built a DSGE model anticipating this question but as these models produce indeterminacy under weak Taylor-type policy rule parameters[10] it was not possible to estimate the structural parameters in the latter period.[11]

3.4.4 A Narrative Event Study of Recent Past

Turkey did experience an episode in this period that makes us think indeterminacy may be more than an esoteric DSGE model feature. Figure 3.17 below shows the exchange value of the dollar against the lira between the beginning of 2013 and March 2015, when this paper was written.[12] Some key events that caused (and relieved) financial market distress are marked in the figure.

The so-called taper tantrum affected the lira along with other emerging market currencies. As shown in the figure, this marks the beginning of the secular depreciation of the lira. The figure also suggests that domestic political and economic policy developments were associated with the largest swings in the exchange rate.

[10]The intuitive reason of the indeterminacy is that if the central bank is not raising the real interest rate in response to higher inflation then aggregate demand is not reigned in. In this case there is no reason why the private sector should not expect arbitrary inflation rates, which will turn into self-fulfilling prophecies as expected inflation feeds into actual price setting. Raising the real interest rate requires raising the nominal rate more than one for one with respect to inflation.

[11]Inoue and Rossi (2011) caution against assuming that transmission parameters will remain the same in studies of structural breaks.

[12]The data are end of day exchange rate quotes. The vertical lines are drawn so that events affecting exchange rates on that day come before the data point is plotted. In most cases this means the vertical lines are placed one day before the actual day of the event. This properly deals with the discrete nature of the data shown.

The Gezi Park protests,[13] in retrospect, did not lead to notable changes in the exchange rate compared to the events that were to follow.[14]

The period we will especially focus on is between the last month of 2013 and the first month of 2014. Before delving deeper into an event study of this period, it is worth noting that the exchange rate movements were reflecting the value of the lira against other currencies, rather than changes in the value of the dollar against all currencies. The lower panel of the figure shows the value of the lira against an equally weighted currency basket of other emerging market currencies. Jumps in the two figures are essentially identical. Looking at a trade weighted currency basket and looking at the value of different currencies individually against the lira would have yielded the same result. Major jumps in the value of the lira were due to domestic factors although the initial trend of depreciation began with the taper tantrum. It is also noteworthy that Turkey was affected more by the prospect of tighter global liquidity than other emerging market economies, with the lira depreciating noticeably over this period against these currencies as well.

We now turn to the December 2013–January 2014 period as an event study. We will use this period to highlight the potency of CBRT in controlling expectations and expectation-driven asset prices. Econometric evidence suggests that while financial markets react to CBRT's monetary policy, especially in the case of the exchange rate, the effect is small (Aktaş et al., 2009). We verified (but do not report) this once again for the more recent sample. The events of this period suggest that the effect is nonlinear. While small changes in the policy

[13]Gezi Park protests were popular demonstrations that began as a response to planned demolition of a park in İstanbul and became country-wide demonstrations against the government which were met with very heavy-handed police responses.

[14]Also, Atalar (2014) shows using intraday data from this period, that a sizable part of the depreciation of the lira during the Gezi park events are in response to the prime minister's speeches rather than to the protests.

stance have almost negligible effects on the exchange rate, large changes have substantial effects.

Figure 3.18 shows that the lira began to depreciate rapidly following the corruption charges against members of the government and their families. At the time, the expectation was that the CBRT would not tolerate such rapid depreciation of the currency, both because of financial stability reasons and, more importantly, due to the depreciation's effects on elevating inflation by mechanical pass-through and by shifting up expectations. In the event, CBRT did not increase interest rates to defend the lira at its planned meeting.

The lira began to depreciate much faster after the CBRT kept policy rates intact, at negative real rate levels. One interpretation of this is that market participants lost their nominal anchor in lira when the CBRT did not raise interest rates, learning what Table 3.1 shows: monetary policy does not react strongly to inflation. Then, expectations of future price level and associated asset prices became unhinged. This was visible in the exchange value of the lira. While the data we show is consistent with this interpretation, it clearly does not rule out alternatives. Then again, it was clear that market participants' belief that there were some outcomes in inflation (preceded by some outcomes in exchange rates) that the CBRT would not tolerate was shaken.

A few days after its scheduled policy meeting, following the deep depreciation of the lira, CBRT announced that it was going to hold a new policy meeting. It is notable that the announcement that a meeting was to take place was sufficient to undo the jump in the exchange rate, before the meeting actually took place. The financial market response was large and showed that CBRT has the ability to strongly affect expectations and associated asset prices—the exchange rate in this case. Of course, this was also shown in the other direction a few days ago when the anticipated interest rate increase did not materialize at the scheduled meeting.

A similar episode took place about a year later (Figure 3.19), verifying our argument that the CBRT does have the ability to impose discipline on expectations but that it does not do so.[15] Once again at a time of great political pressure on the institution, Governor Başçı commented in a speech that interest rates may be cut in an intermeeting move if inflation, which was to be released in a few days' time, comes in below a threshold (which would have still remained much higher than the inflation target—see Figure 3.14). Inflation coming down as much was at the time seen as an almost sure bet and the belief that CBRT was to cut interest rates despite elevated inflation once again led to the anti-inflation commitment of the institution to be questioned, expectations to deteriorate and the lira to very rapidly lose value.

Given the expectations for the release surprisingly, inflation did not fall as much and the CBRT was saved from cutting interest rates. The fact that what would have been a policy mistake was averted led to an appreciation of the lira but because this happened due to a reason external to the CBRT (inflation falling a notch less than what was needed to fulfill the communicated condition for a rate cut) limited the extent of the gain.

Studies of these episodes help us make a number of observations. First, Turkey has had an inordinate number of large "events" in the recent past. This is a high

[15] Aktaş et al. (2009) shows the financial market impact of CBRT policies during the early period of our study and also argue that the Central Bank did have a strong effect on longer-term interest rates.

political and policy volatility country. Second, all eyes were on the Central Bank during that period. This is bad in the sense that, as we also argued at the beginning of this section, the CBRT looked like the only economic policymaker in the country. On the other hand, it is reassuring that markets still attribute sufficient credibility to the institution and perceive it to be potent enough to pin down expectations and asset prices, should it choose to do so.

The third observation we make is that CBRT's weak reaction function was evident in these large events as well as in run-of-the-mill policy responses to oscillating inflation. The Central Bank, more often than not, showed that it was very hesitant to raise interest rates and quick to lower them, regardless of the inflation outlook.

The last observation we make is on the potency of monetary policy. In the rare instance when the CBRT moved aggressively to control expectations of inflation and depreciation, and to stabilize financial markets, its policy actions produced the desired result. Similarly, when it signaled a lack of concern for inflation and (perceived) deference to political pressure, financial markets moved to signal that CBRT's strong presence is needed to have a nominal anchor. That is, CBRT's policy rates help anchor or unanchor expectations and affect financial markets in ways its myriad nonstandard policies do not. Interest rates remain the fundamental and effective tool of monetary policy.

3.5 Conclusion

Turkey has had two distinct periods of economic policy and activity after its post-2001 crisis. The first one, which ends sometime in 2006 to 2009 and we econometrically date to 2009 for the break in monetary policy, is a relatively successful period. We observe rapid disinflation and high growth rates in this period. This episode is well understood and is also well advertised by the government and policymakers. We argue that there is a second, low growth period that is characterized by expansionary fiscal policy and weak monetary policy that allowed inflation to rise and remain elevated, current account deficit to increase and financial markets to suffer high volatility. Our key finding, therefore, is of a structural break in monetary policy around 2009. Monetary policy after that time was characterized by weak responses to inflation, which not only allowed inflation to be above target for most of the recent period, it also added to volatility in expectations and financial markets by weakening the nominal anchor.

Using a succession of political and policymaking events and exchange rate responses to these, we argue that domestic factors played a large role in the recent depreciation of the lira. Importantly, we also observe that when the Central Bank used interest rates to offset inflationary pressures and stabilize financial markets it was successful in doing so. In the instances when the expected policy tightening did not come, or when the Central Bank signaled looser policy at times of political pressure for lower interest rates, we observe unhinged expectations that manifest themselves in exchange rates immediately.

While deflationary pressures made many central banks lower policy rates to zero and then try innovative monetary policy actions to further stimulate demand, Turkey never left the well understood world of inflation above target. The recent experience suggests that inflation and asset prices have responded in the textbook manner to monetary policy in Turkey. The behavior of inflation before and after the structural break in monetary policy shows using interest rates to control inflation had been successful and not doing so led to inflation persistently above target.

In Turkey old fashioned monetary policy works, when used.

Table 3.1: Taylor rule estimations for the periods before and after the break.

	Period 1 (2003/01–2009/12)	Period 2 (2010/01–2014/12)	Chow Test for Break F-statistic
	Interest Rate	Interest Rate	
1st Taylor Rule			
Constant	5.24***	2.88***	
	(0.70)	(1.16)	
Inflation rate	1.29***	0.64***	299.99***
	(0.05)	(0.14)	
% deviation of IP	0.12**	0.12**	
from its trend	(0.05)	(0.05)	
R^2	0.88	0.28	
2nd Taylor Rule			
Constant	5.71***	4.46***	
	(0.66)	(1.22)	
Inflation rate	1.24***	0.50***	342.48***
	(0.05)	(0.14)	
Annual growth of IP	0.10***	−0.07*	
	(0.02)	(0.04)	
R^2	0.89	0.25	
3rd Taylor Rule			
Constant	5.72***	4.16***	
	(0.67)	(1.23)	
Inflation rate	1.24***	0.52***	339.48***
	(0.05)	(0.14)	
Annual growth of IP	0.10***	−0.07*	
	(0.02)	(0.04)	
Change in USD/TRY	0.14	6.68	
rate	(5.62)	(5.09)	
R^2	0.89	0.27	

Notes: This table shows the Taylor rule estimation results. First column shows the estimation results for the first sub-period. Second column shows the estimation results for the second sub-period. Third column shows the F-statistic of the Chow test for break. In conducting the Chow test, inflation rate is used as a time varying regressor. Critical F-value is 11.38 for p-value = 0.001.

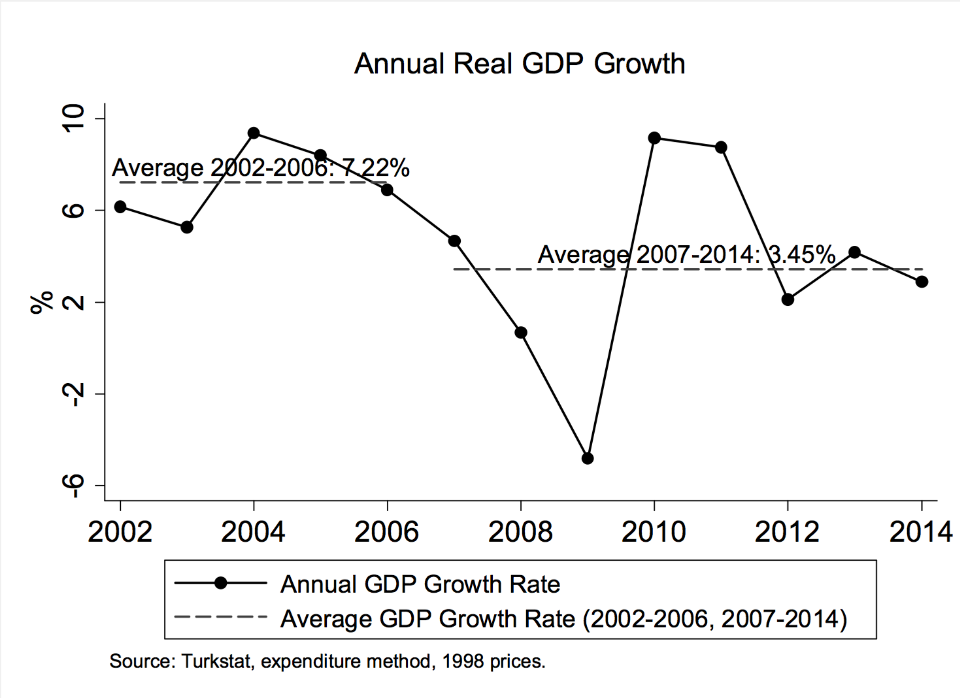


Figure 3.1: GDP growth rates.

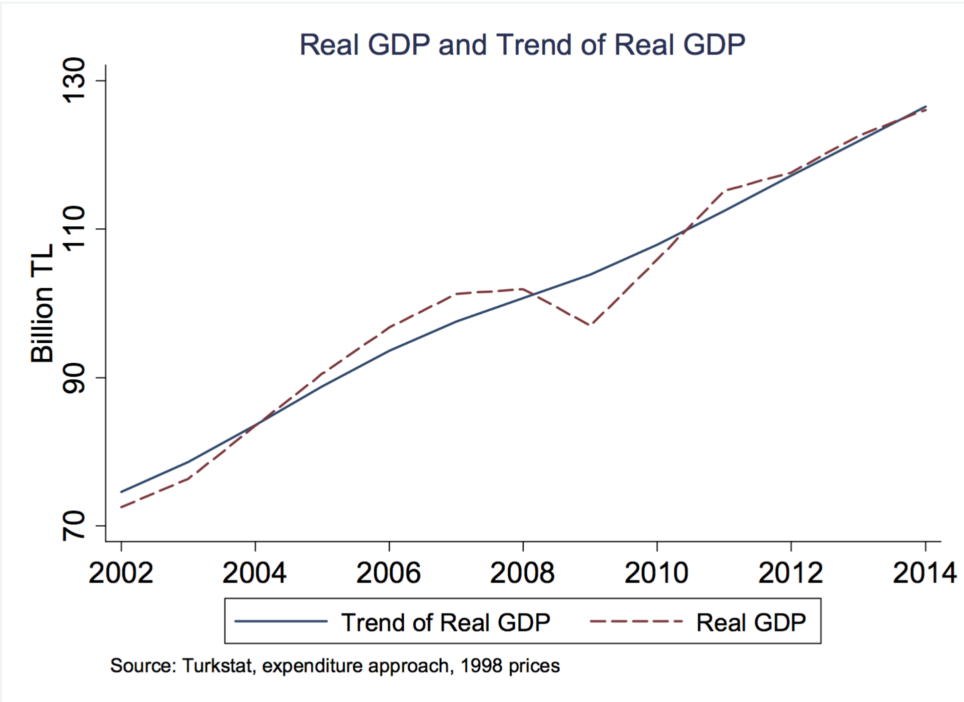


Figure 3.2: Trend of real GDP is estimated with HP filter.

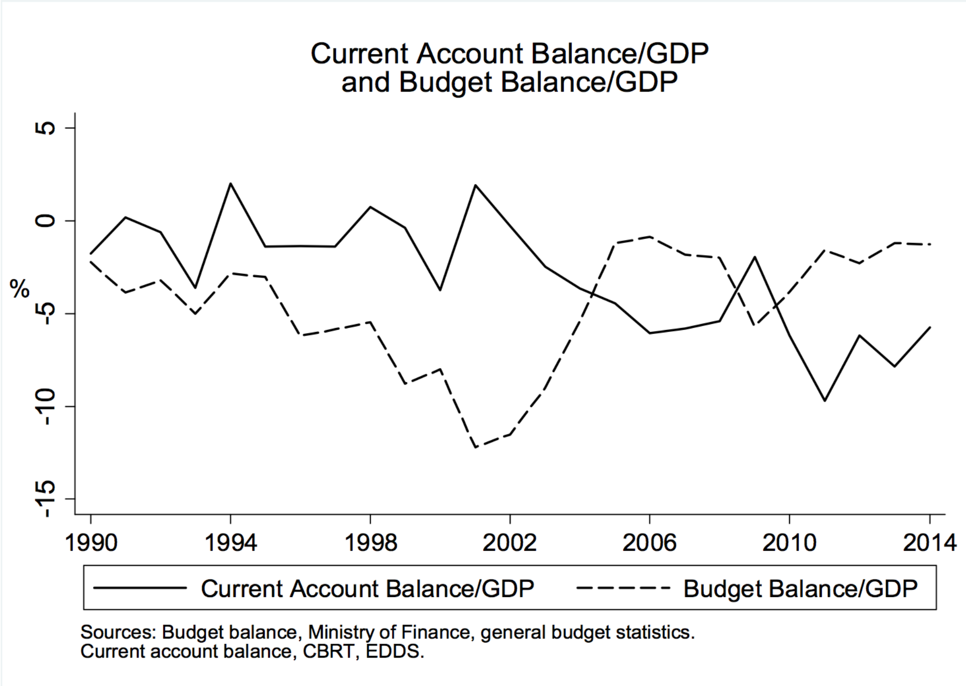


Figure 3.3: Current account and budget deficits.

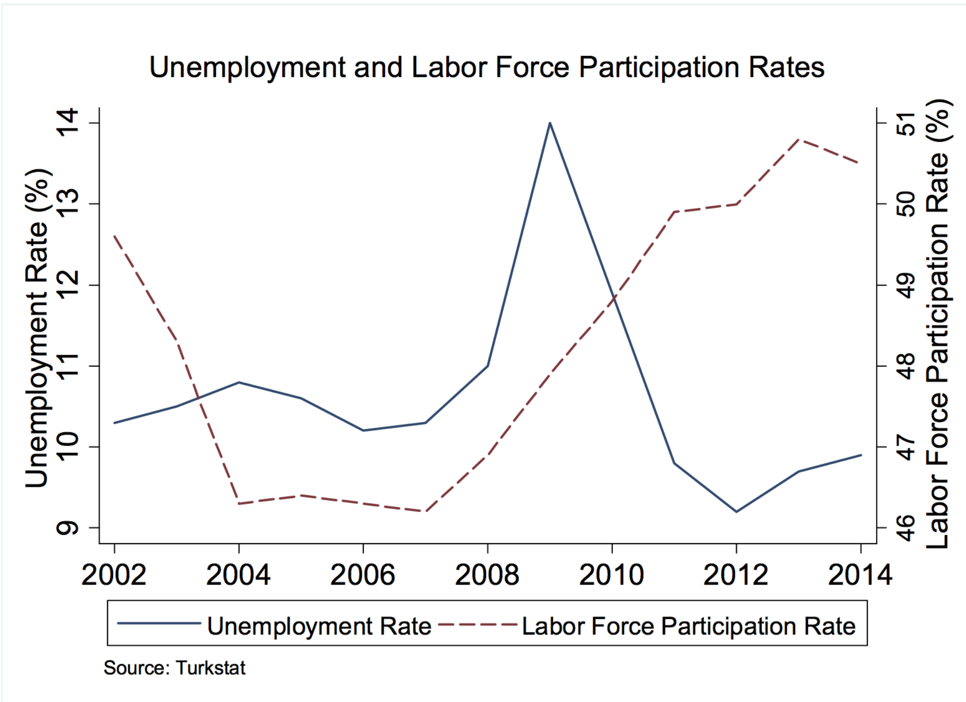


Figure 3.4: Unemployment and labor force participation.

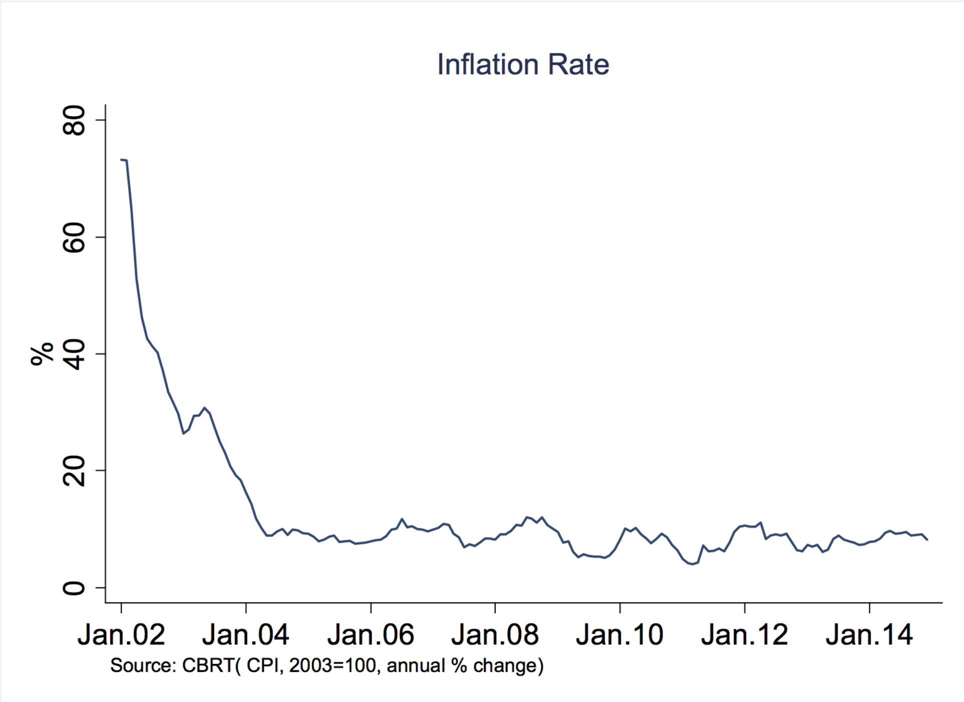


Figure 3.5: Inflation, 2002–2014.

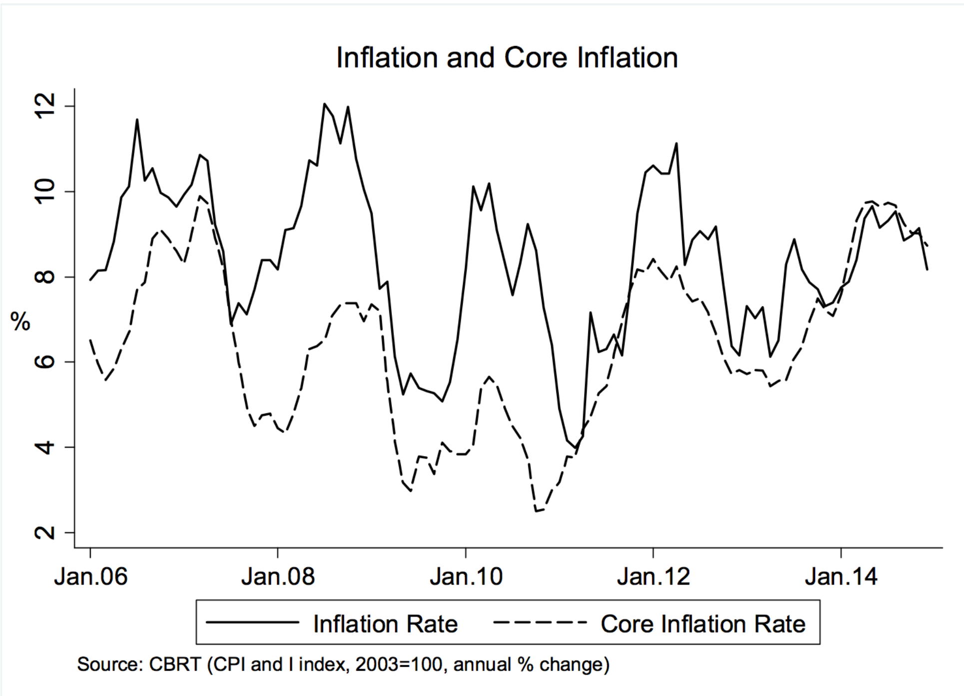


Figure 3.6: Inflation, 2006–2014.

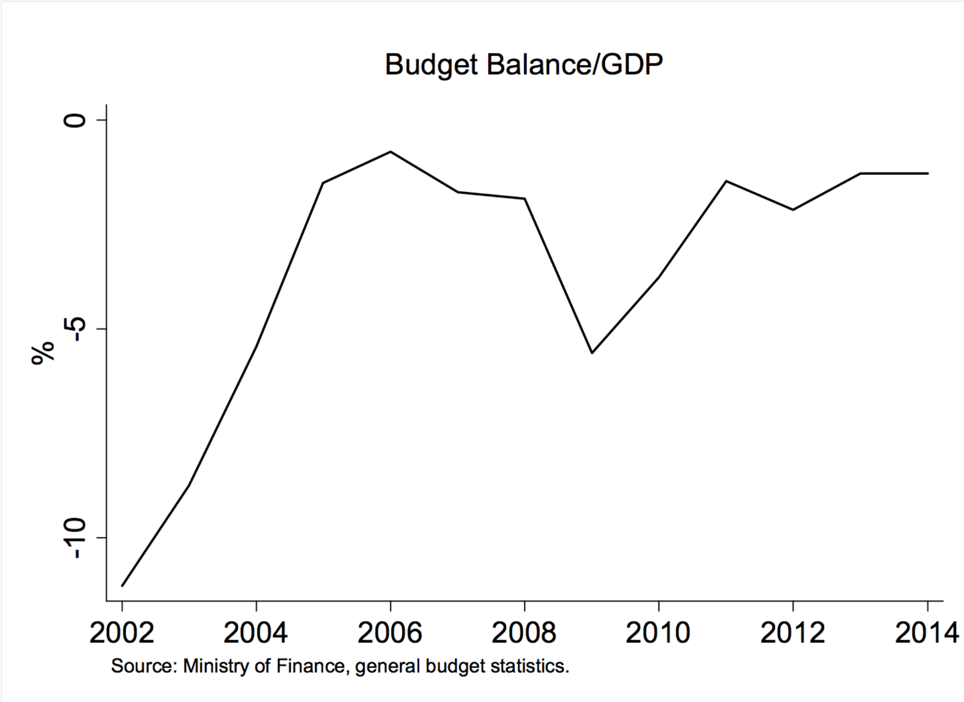


Figure 3.7: Decreasing budget deficit.

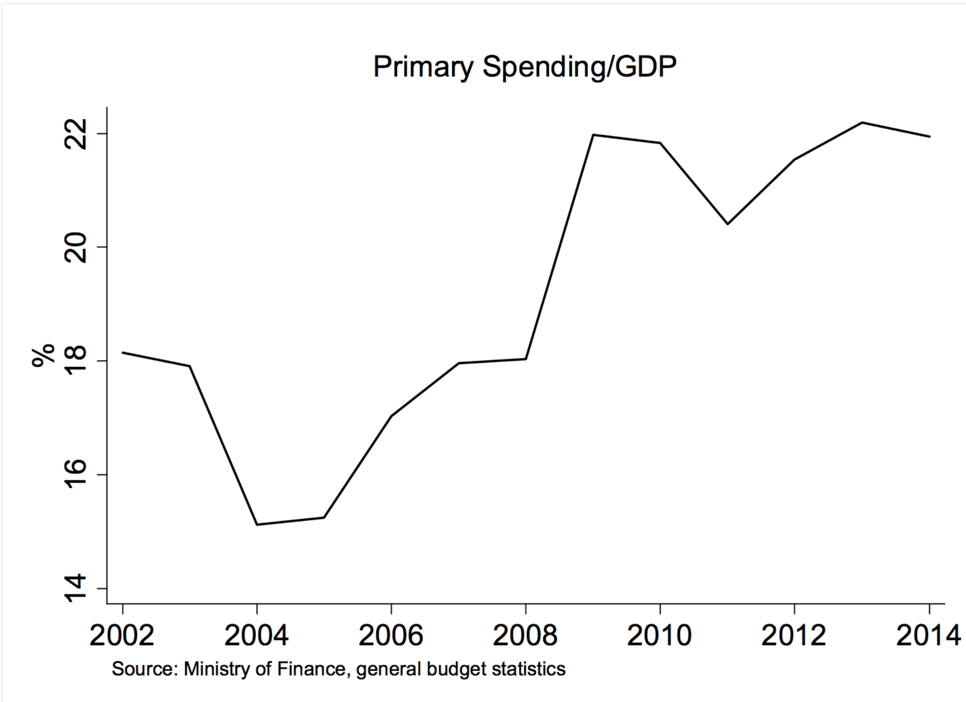


Figure 3.8: Increasing primary spending.

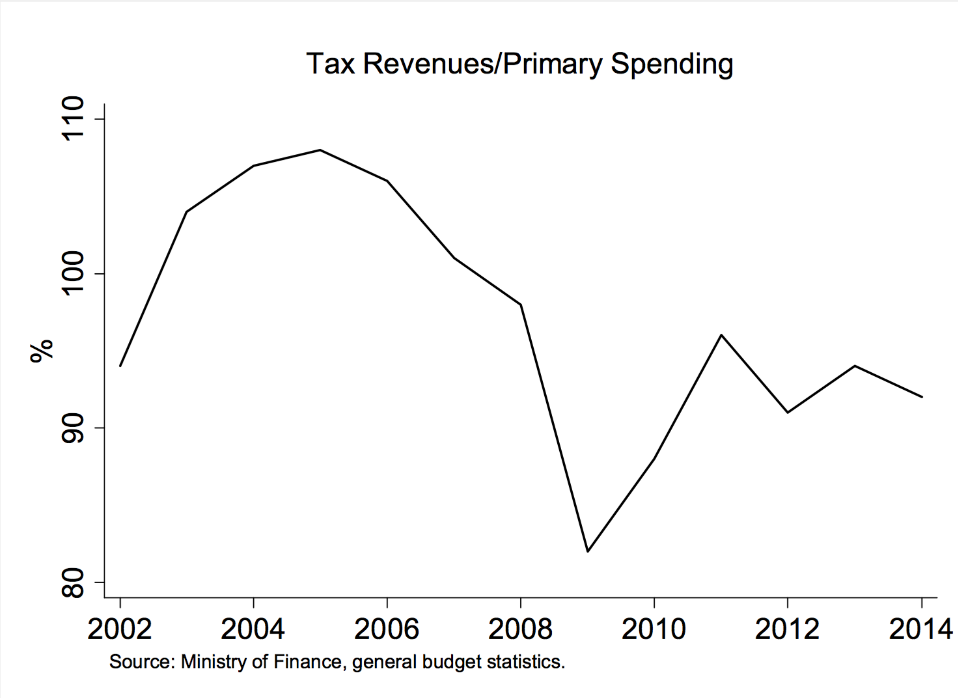


Figure 3.9: Taxes and spending.

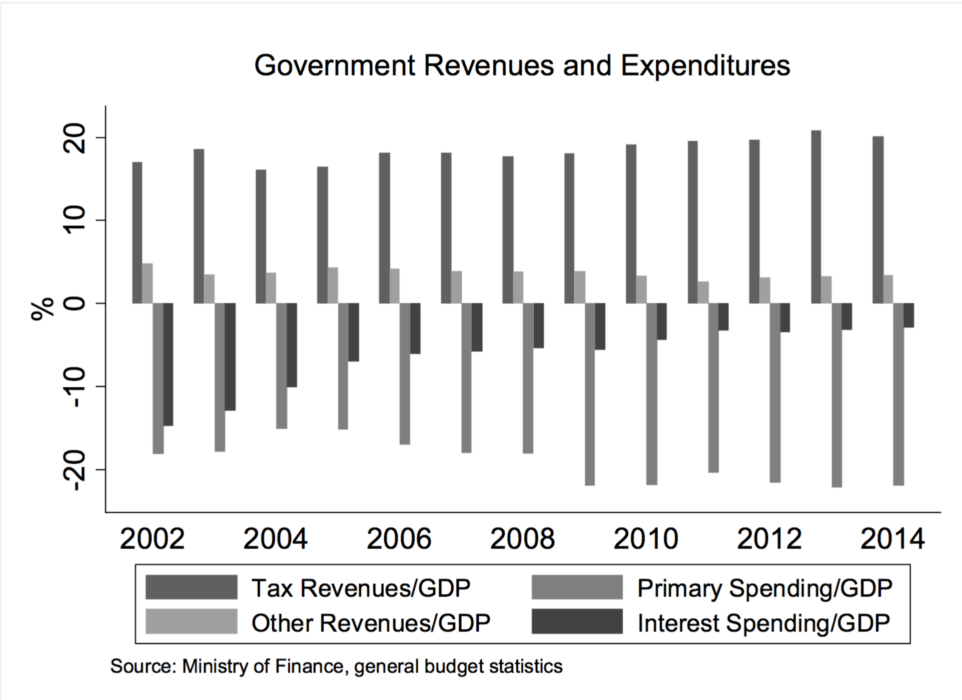


Figure 3.10: Increasing spending, decreasing interest payments.

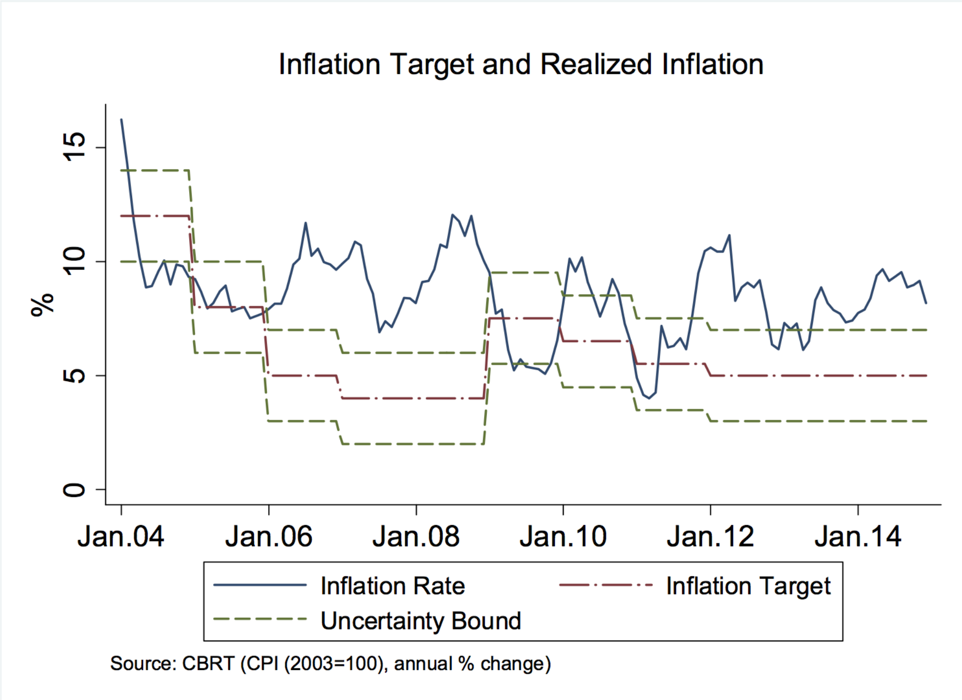


Figure 3.11: Inflation and the target.

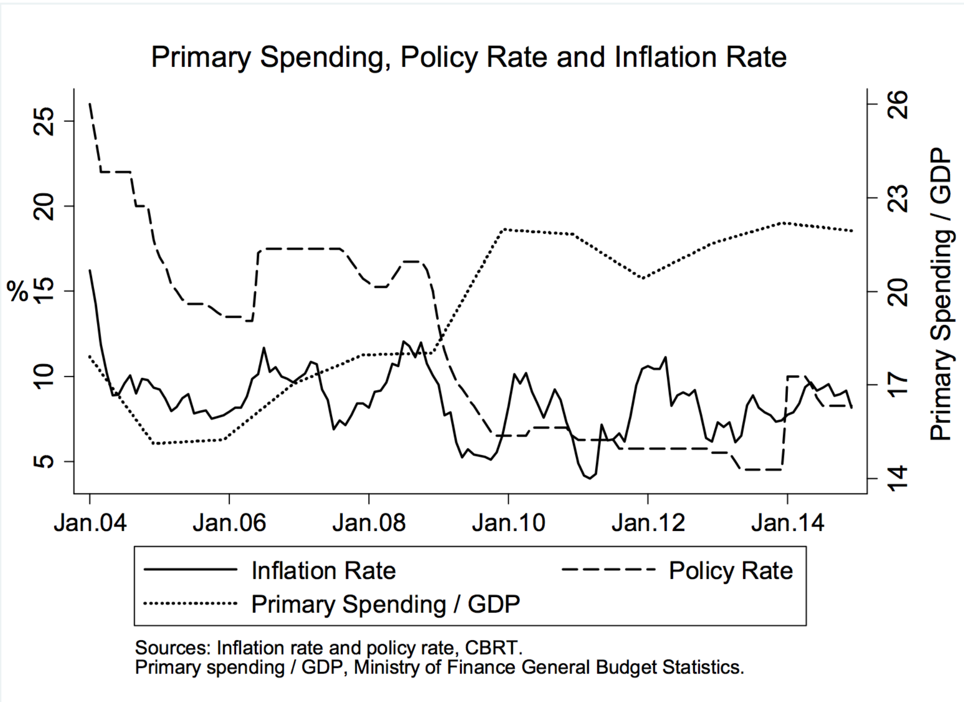


Figure 3.12: Fiscal and monetary policies, and inflation.

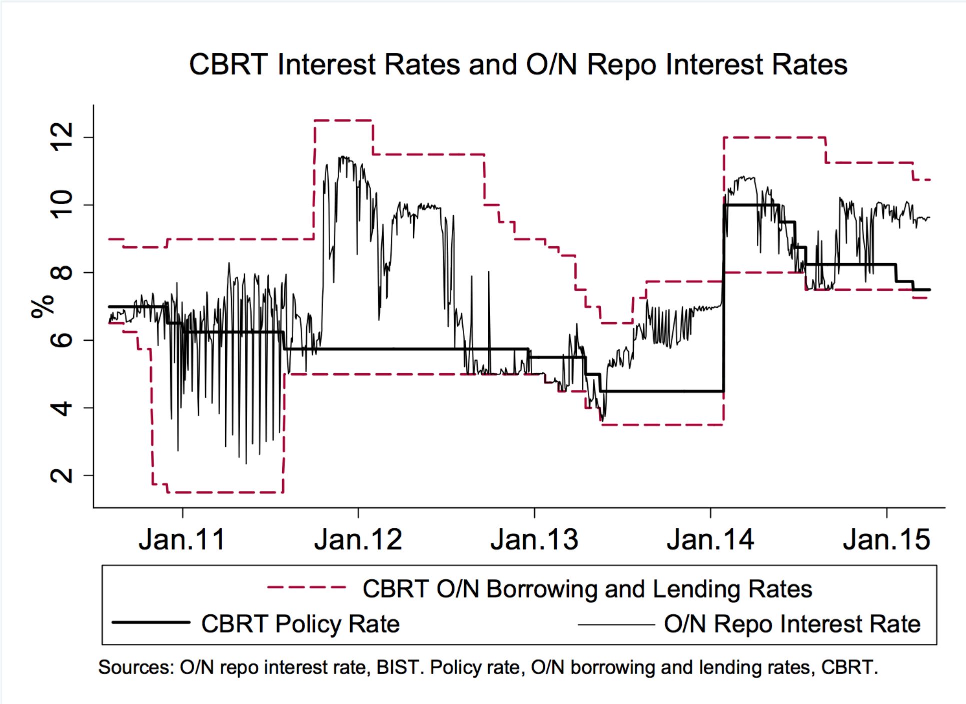


Figure 3.13: Plethora of policy rates.

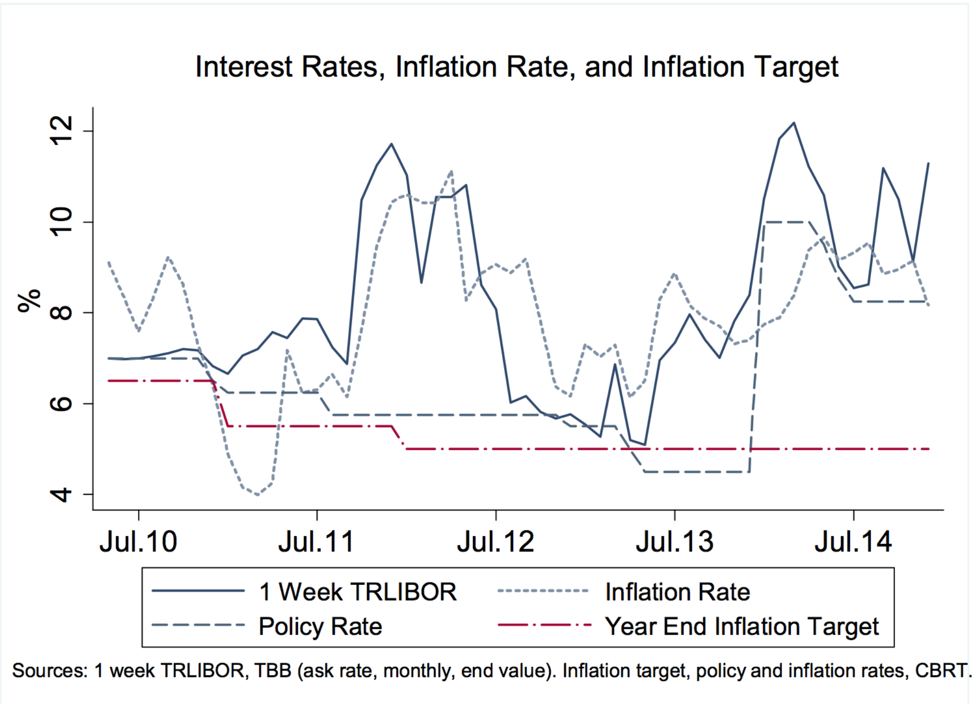
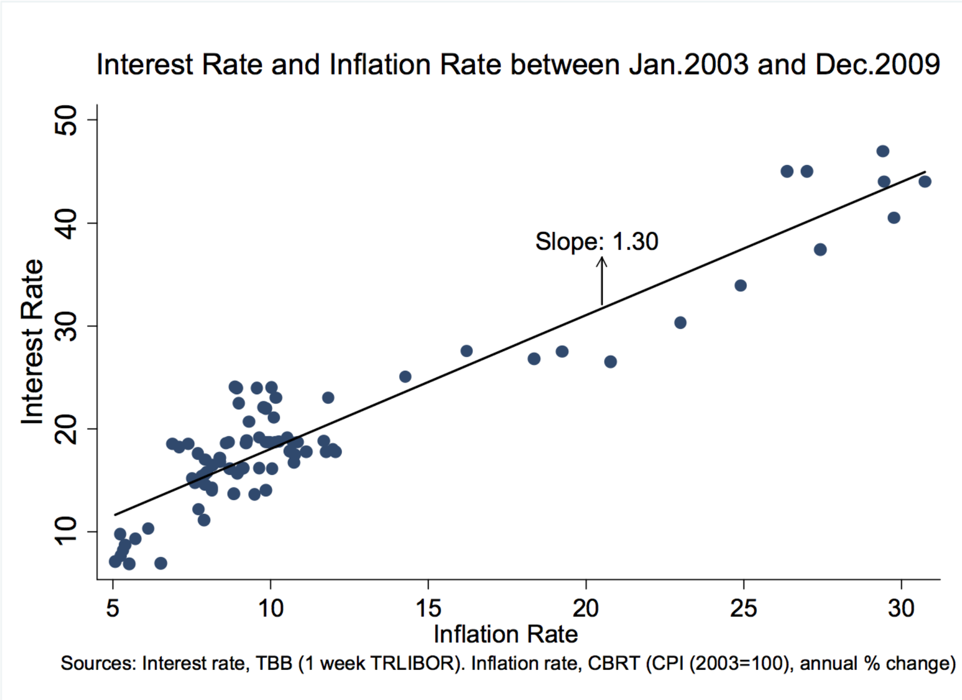
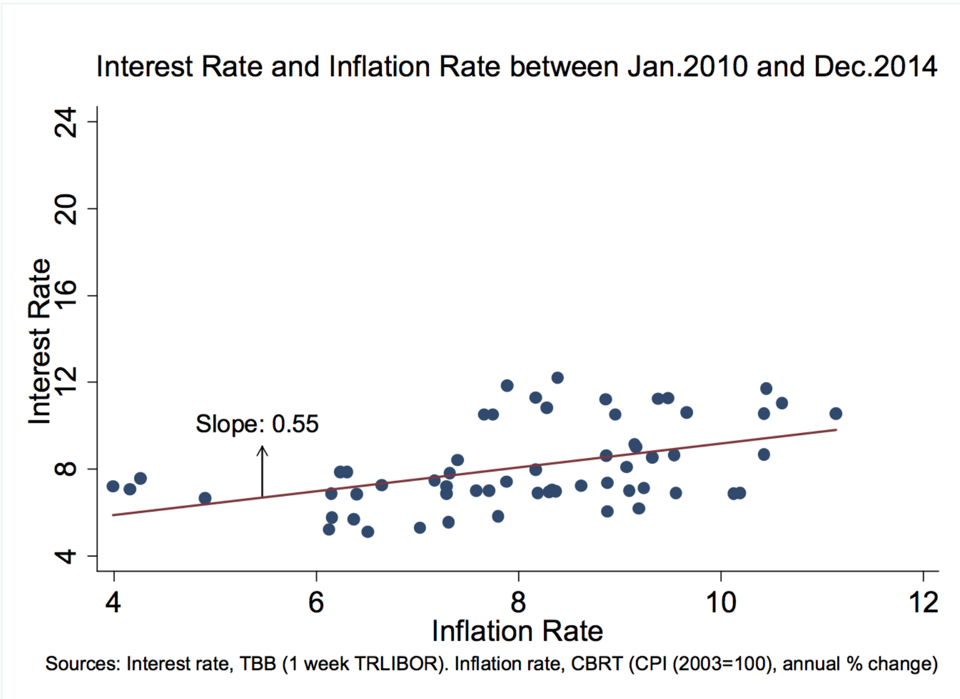


Figure 3.14: Inflation, target, and interest rates.



(a) Relationship between the interest rate and inflation rate, 2003–2009.



(b) Relationship between the interest rate and inflation rate, 2010–2014.

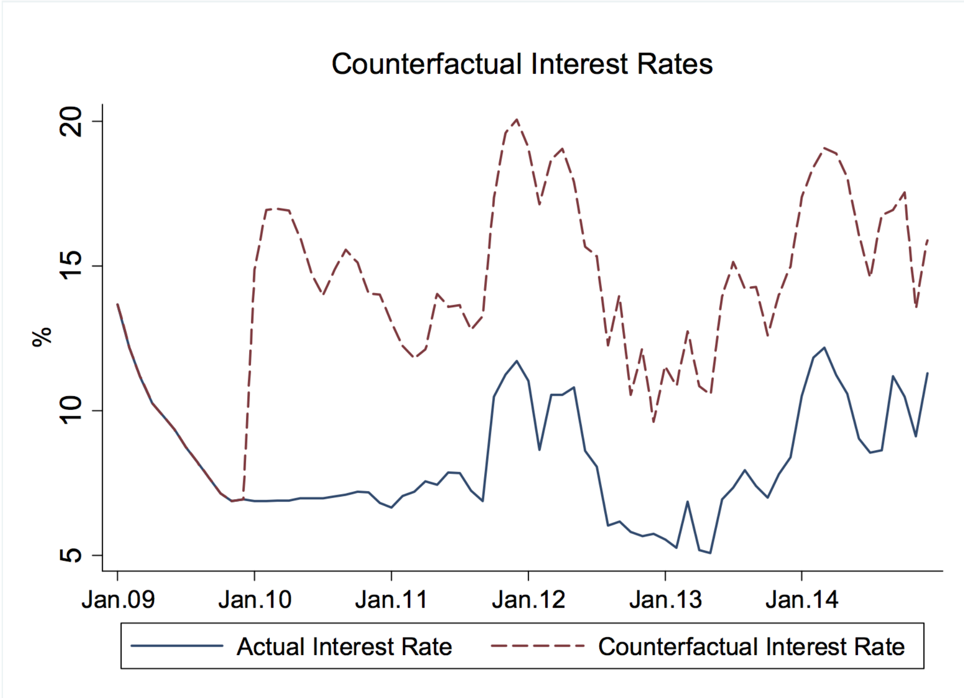


Figure 3.16: Counterfactual interest rate is the rate we would have had if first period's Taylor rule had been implemented in the second period. Estimation is done using the second specification of Taylor rule presented in Table 3.1.

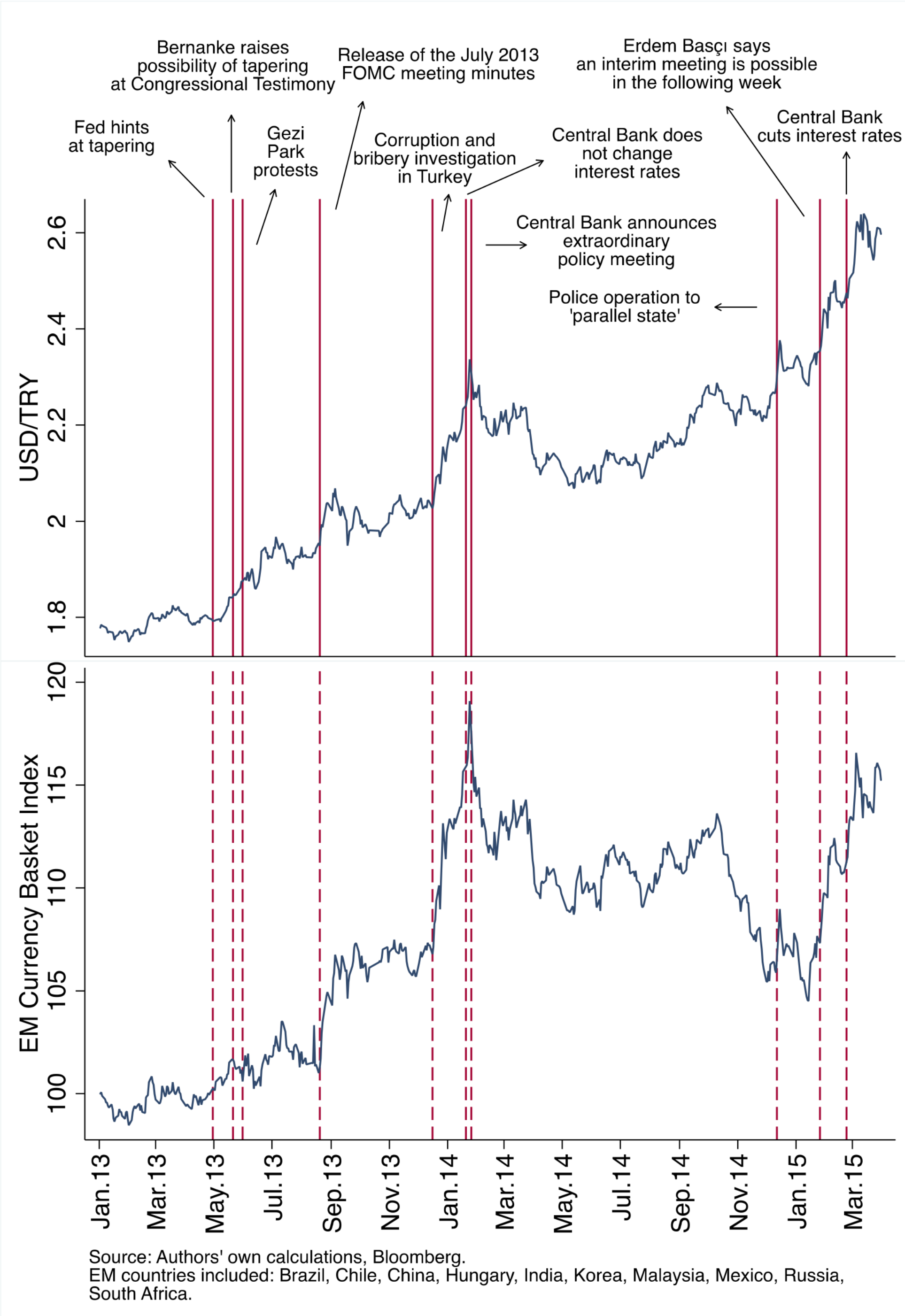


Figure 3.17: Events and exchange rate responses.

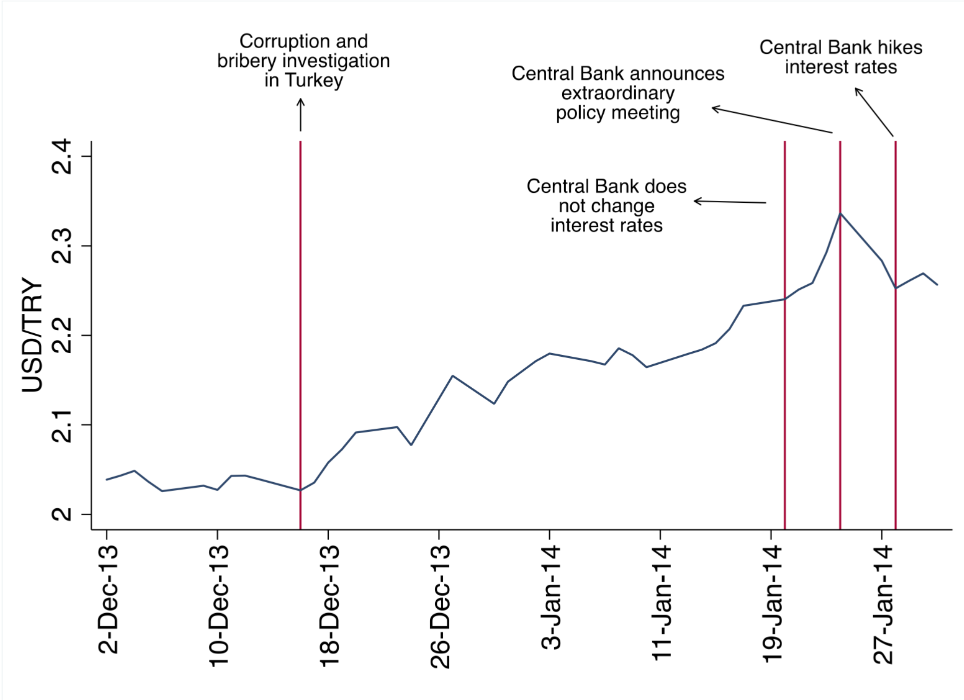


Figure 3.18: A closer look at December 2013–January 2014.

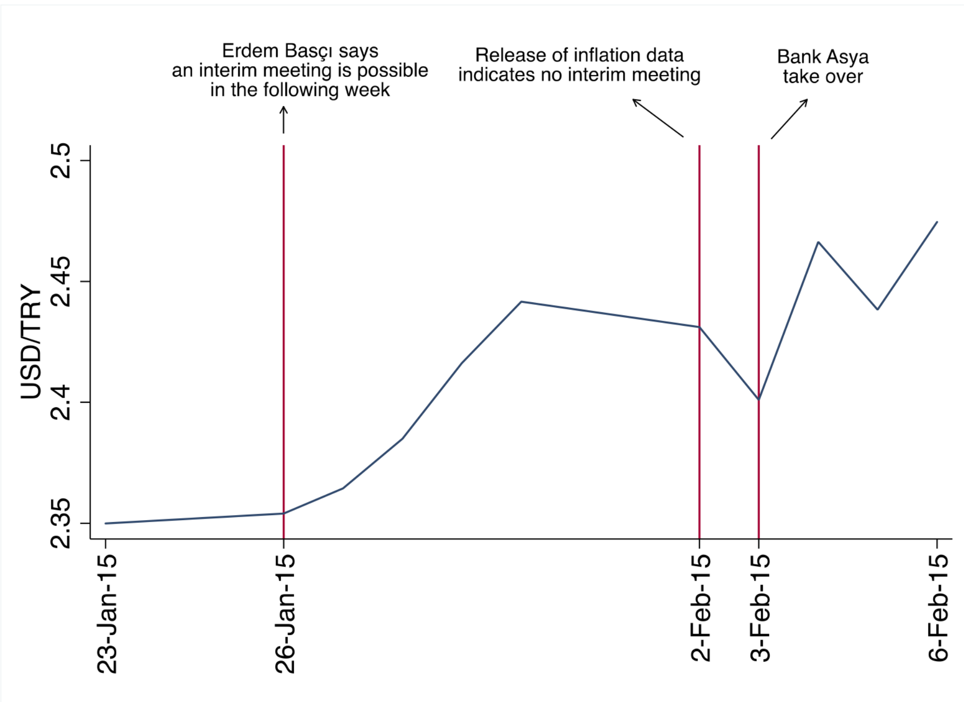


Figure 3.19: A closer look at January–February 2015.

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APPENDICES

A Bond Pricing Recursions

Home Country

The price of the one-period bond satisfies

$$P_t^{(1)} = E_t\left[M_{t+1}\right] = \exp\left(-i_t\right) = \exp\left(-\delta_0 - \delta_1' X_t - \delta_2 e_t\right)$$

Suppose that $P_t^{(n)} = \exp\left(A_n + B_n' X_t + D_n' X_t^* + G_n e_t\right)$. Then,

$$\begin{aligned}
P_t^{(n+1)} &= E_t\left[M_{t+1} P_{t+1}^{(n)}\right] \\
&= E_t\left[\exp\left(-i_t - \frac{1}{2}\lambda_t'\Sigma\lambda_t - \lambda_t'\varepsilon_{t+1} + A_n + B_n' X_{t+1} + D_n' X_{t+1}^* + G_n e_{t+1}\right)\right] \\
&= \exp\left(-i_t - \frac{1}{2}\lambda_t'\Sigma\lambda_t + A_n\right) E_t\left[\exp\left(-\lambda_t'\varepsilon_{t+1} + B_n'\left(\mu + \Phi X_t + \Phi_e e_t + \varepsilon_{t+1}\right)\right.\right. \\
&\quad + D_n'\left(\mu^* + \Phi^* X_t^* + \Phi_e^* e_t + \varepsilon_{t+1}^*\right) + G_n\left(\mu_e + V'\Phi X_t - V^{*\prime}\Phi^* X_t^*\right. \\
&\quad \left.\left.\left. + \left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) e_t + V'\varepsilon_{t+1} - V^{*\prime}\varepsilon_{t+1}^* + V_e\varepsilon_{e,t+1}\right)\right)\right] \\
&= \exp\Big(- \delta_0 + A_n + B_n'\mu + D_n'\mu^* + G_n\mu_e + \left(B_n'\Phi + G_n V'\Phi - \delta_1'\right) X_t \\
&\quad + \left(D_n'\Phi^* - G_n V^{*\prime}\Phi^*\right) X_t^* + \left(B_n'\Phi_e + D_n'\Phi_e^* + G_n\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2\right) e_t \\
&\quad - \frac{1}{2}\lambda_t'\Sigma\lambda_t\Big) E_t\left[\exp\left(B_n' + G_n V' - \lambda_t'\right)\varepsilon_{t+1} + \left(D_n' - G_n V^{*\prime}\right)\varepsilon_{t+1}^* + G_n V_e \varepsilon_{e,t+1}\right] \\
&= \exp\Big(- \delta_0 + A_n + B_n'\mu + D_n'\mu^* + G_n\mu_e + \left(B_n'\Phi + G_n V'\Phi - \delta_1'\right) X_t
\end{aligned}$$

$$
\begin{aligned}
&+\left(D_n'\Phi^* - G_n V^{*\prime}\Phi^*\right) X_t^* + \left(B_n'\Phi_e + D_n'\Phi_e^* + G_n\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2\right) e_t \\
&+\frac{1}{2}B_n'\Sigma B_n + \frac{1}{2}G_n^2 V'\Sigma V + \frac{1}{2}D_n'\Sigma^* D_n + \frac{1}{2}G_n^2 V^{*\prime}\Sigma^* V^* + \frac{1}{2}G_n^2 V_e^2\sigma_e^2 \\
&+G_n B_n'\Sigma V - G_n V'\Sigma\lambda_t - B_n'\Sigma\lambda_t - G_n D_n'\Sigma^* V^*\Bigg) \\
= \exp\Bigg(&-\delta_0 + A_n + B_n'\left(\mu + G_n\Sigma V - \Sigma\lambda_0\right) + D_n'\left(\mu^* - G_n\Sigma^* V^*\right) \\
&+G_n\left(\mu_e - V'\Sigma\lambda_0\right) + \frac{1}{2}\left(B_n'\Sigma B_n + D_n'\Sigma^* D_n + G_n^2\left(V'\Sigma V + V^{*\prime}\Sigma^* V^* + V_e^2\sigma_e^2\right)\right) \\
&+B_n'\left(\Phi - \Sigma\lambda_1\right) X_t + G_n V'\left(\Phi - \Sigma\lambda_1\right) X_t - \delta_1' X_t + D_n'\Phi^* X_t^* - G_n V^{*\prime}\Phi^* X_t^* \\
&+B_n'\Phi_e e_t + D_n'\Phi_e^* e_t + G_n\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2 e_t\Bigg)
\end{aligned}
$$

Setting $A_1 = -\delta_0$, $B_1 = -\delta_1$, $D_1 = \mathbf{0}_{3\times 1}$ and $G_1 = -\delta_2$ yields the recursive relations

$$
\begin{aligned}
A_{n+1} &= A_n + B_n'\left(\mu + G_n\Sigma V - \Sigma\lambda_0\right) + D_n'\left(\mu^* - G_n\Sigma^* V^*\right) + G_n\left(\mu_e - V'\Sigma\lambda_0\right) \\
&\quad + \frac{1}{2}\left(B_n'\Sigma B_n + D_n'\Sigma^* D_n + G_n^2\left(V'\Sigma V + V^{*\prime}\Sigma^* V^* + V_e^2\sigma_e^2\right)\right) \\
B_{n+1}' &= B_n'\left(\Phi - \Sigma\lambda_1\right) + G_n V'\left(\Phi - \Sigma\lambda_1\right) - \delta_1' \\
D_{n+1}' &= D_n'\Phi^* - G_n V^{*\prime}\Phi^* \\
G_{n+1} &= G_n\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) + B_n'\Phi_e + D_n'\Phi_e^* - \delta_2 \qquad \text{(A.1)}
\end{aligned}
$$

Foreign Country

The price of the one-period bond satisfies

$$P_t^{*(1)} = E_t\left[M_{t+1}^*\right] = \exp\left(-i_t^*\right) = \exp\left(-\delta_0^* - \delta_1^{*\prime} X_t^* - \delta_2^* e_t\right)$$

Suppose that $P_t^{*(n)} = \exp\left(A_n^* + B_n^{*\prime} X_t^* + D_n^{*\prime} X_t + G_n^* e_t\right)$. Then,

$$\begin{aligned}
P_t^{*(n+1)} &= E_t\left[M_{t+1}^* P_{t+1}^{*(n)}\right] \\
&= E_t\left[\exp\left(-i_t^* - \frac{1}{2}\lambda_t^{*\prime}\Sigma^*\lambda_t^* - \lambda_t^{*\prime}\varepsilon_{t+1}^* + A_n^* + B_n^{*\prime} X_{t+1}^* + D_n^{*\prime} X_{t+1} + G_n^* e_{t+1}\right)\right] \\
&= \exp\left(-i_t^* - \frac{1}{2}\lambda_t^{*\prime}\Sigma^*\lambda_t^* + A_n^*\right) E_t\left[\exp\left(-\lambda_t^{*\prime}\varepsilon_{t+1}^* + B_n^{*\prime}\left(\mu^* + \Phi^* X_t^* + \Phi_e^* e_t + \varepsilon_{t+1}^*\right)\right.\right. \\
&\quad + D_n^{*\prime}\left(\mu + \Phi X_t + \Phi_e e_t + \varepsilon_{t+1}\right) + G_n^*\left(\mu_e + V'\Phi X_t - V^{*\prime}\Phi^* X_t^*\right. \\
&\quad \left.\left.\left. + \left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) e_t + V'\varepsilon_{t+1} - V^{*\prime}\varepsilon_{t+1}^* + V_e\varepsilon_{e,t+1}\right)\right)\right] \\
&= \exp\left(-\delta_0^* + A_n^* + B_n^{*\prime}\mu^* + D_n^{*\prime}\mu + G_n^*\mu_e + \left(B_n^{*\prime}\Phi^* - G_n^* V^{*\prime}\Phi^* - \delta_1^{*\prime}\right) X_t^*\right. \\
&\quad + \left(D_n^{*\prime}\Phi + G_n^* V'\Phi\right) X_t + \left(B_n^{*\prime}\Phi_e^* + D_n^{*\prime}\Phi_e + G_n^*\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2^*\right) e_t \\
&\quad \left. - \frac{1}{2}\lambda_t^{*\prime}\Sigma^*\lambda_t^*\right) E_t\left[\exp\left(B_n^{*\prime} + G_n^* V^{*\prime} - \lambda_t^{*\prime}\right)\varepsilon_{t+1}^* + \left(D_n^{*\prime} - G_n^* V'\right)\varepsilon_{t+1} + G_n^* V_e\varepsilon_{e,t+1}\right] \\
&= \exp\left(-\delta_0^* + A_n^* + B_n^{*\prime}\mu^* + D_n^{*\prime}\mu + G_n^*\mu_e + \left(B_n^{*\prime}\Phi^* - G_n^* V^{*\prime}\Phi^* - \delta_1^{*\prime}\right) X_t^*\right. \\
&\quad + \left(D_n^{*\prime}\Phi + G_n^* V'\Phi\right) X_t + \left(B_n^{*\prime}\Phi_e^* + D_n^{*\prime}\Phi_e + G_n^*\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2^*\right) e_t \\
&\quad + \frac{1}{2}B_n^{*\prime}\Sigma^* B_n^* + \frac{1}{2}G_n^{*2} V^{*\prime}\Sigma^* V^* + \frac{1}{2}D_n^{*\prime}\Sigma D_n^* + \frac{1}{2}G_n^{*2} V'\Sigma V + \frac{1}{2}G_n^{*2} V_e^2\sigma_e^2 \\
&\quad \left. - G_n^* B_n^{*\prime}\Sigma^* V^* + G_n^* V^{*\prime}\Sigma^*\lambda_t^* - B_n^{*\prime}\Sigma^*\lambda_t^* + G_n^* D_n^{*\prime}\Sigma V\right) \\
&= \exp\left(-\delta_0^* + A_n^* + B_n^{*\prime}\left(\mu^* - G_n^*\Sigma^* V^* - \Sigma^*\lambda_0^*\right) + D_n^{*\prime}\left(\mu + G_n^*\Sigma V\right)\right. \\
&\quad + G_n^*\left(\mu_e + V^{*\prime}\Sigma^*\lambda_0^*\right) + \frac{1}{2}\left(B_n^{*\prime}\Sigma^* B_n^* + D_n^{*\prime}\Sigma D_n^* + G_n^{*2}\left(V'\Sigma V + V^{*\prime}\Sigma^* V^* + V_e^2\sigma_e^2\right)\right) \\
&\quad + B_n^{*\prime}\left(\Phi^* - \Sigma^*\lambda_1^*\right) X_t^* - G_n^* V^{*\prime}\left(\Phi^* - \Sigma^*\lambda_1^*\right) X_t^* - \delta_1^{*\prime} X_t^* + D_n^{*\prime}\Phi X_t + G_n^* V'\Phi X_t \\
&\quad \left. + B_n^{*\prime}\Phi_e^* e_t + D_n^{*\prime}\Phi_e e_t + G_n^*\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) - \delta_2^* e_t\right)
\end{aligned}$$

Setting $A_1^* = -\delta_0^*$, $B_1^* = -\delta_1^*$, $D_1^* = \mathbf{0}_{3\times 1}$ and $G_1^* = -\delta_2^*$ yields the recursive relations

$$\begin{aligned}
A_{n+1}^* &= A_n^* + B_n^{*\prime}\left(\mu^* + G_n^*\Sigma^* V^* - \Sigma^*\lambda_0^*\right) + D_n^{*\prime}\left(\mu + G_n^*\Sigma V\right) + G_n^*\left(\mu_e + V^{*\prime}\Sigma^*\lambda_0^*\right) \\
&\quad + \frac{1}{2}\left(B_n^{*\prime}\Sigma^* B_n^* + D_n^{*\prime}\Sigma D_n^* + G_n^{*2}\left(V'\Sigma V + V^{*\prime}\Sigma^* V^* + V_e^2\sigma_e^2\right)\right) \\
B_{n+1}^{*\prime} &= B_n^{*\prime}\left(\Phi^* - \Sigma^*\lambda_1^*\right) - G_n^* V^{*\prime}\left(\Phi^* - \Sigma^*\lambda_1^*\right) - \delta_1^{*\prime} \\
D_{n+1}^{*\prime} &= D_n^{*\prime}\Phi + G_n^* V'\Phi \\
G_{n+1}^* &= G_n^*\left(V'\Phi_e - V^{*\prime}\Phi_e^*\right) + B_n^{*\prime}\Phi_e^* + D_n^{*\prime}\Phi_e - \delta_2^* \qquad \text{(A.2)}
\end{aligned}$$

B The State Space System

I categorize the observable and the state variables into three groups. The first two groups include the home and the foreign country variables, respectively. The third one contains the common variable, forward premium. I denote the observable variables with hats. To simplify the notation, I collect the yields into a vector:

$$\hat{Y}_t = \begin{bmatrix} \hat{i}_t & \hat{y}_t^{(2)} & \hat{y}_t^{(4)} & \hat{y}_t^{(8)} & \hat{y}_t^{(20)} & \hat{y}_t^{(40)} \end{bmatrix}'$$

Let $Z_t = \begin{bmatrix} \Delta\hat{c}_t & \hat{\pi}_t & \hat{Y}_t \end{bmatrix}'$ be the vector of home country observable variables. Then, I can write measurement equation in (1.26) as a system of equations as follows:

$$\begin{bmatrix} Z_{t+1} \\ Z^*_{t+1} \\ \hat{e}_{t+1} \end{bmatrix} = \begin{bmatrix} \Psi \\ \Psi^* \\ 0 \end{bmatrix} + \begin{bmatrix} \Gamma \\ \Gamma^* \\ \Gamma_e \end{bmatrix} \begin{bmatrix} X_{t+1} \\ X^*_{t+1} \\ e_{t+1} \end{bmatrix} + \begin{bmatrix} \eta_{t+1} \\ \eta^*_{t+1} \\ \eta_{e,t+1} \end{bmatrix} \tag{B.1}$$

$$\begin{bmatrix} \eta_{t+1} \\ \eta^*_{t+1} \\ \eta_{e,t+1} \end{bmatrix} \sim N\left(\begin{bmatrix} \mathbf{0}_{8\times1} \\ \mathbf{0}_{8\times1} \\ 0 \end{bmatrix}, \begin{bmatrix} \Omega & \mathbf{0}_{8\times8} & \mathbf{0}_{8\times1} \\ \mathbf{0}_{8\times8} & \Omega^* & \mathbf{0}_{8\times1} \\ \mathbf{0}_{1\times8} & \mathbf{0}_{1\times8} & \omega_e^2 \end{bmatrix} \right)$$

where Ω and Ω^* are diagonal. Now, I define the multivariate yield factor loadings:

$$A = \begin{bmatrix} -\delta_0 & \frac{A_2}{2} & \frac{A_4}{4} & \frac{A_8}{8} & \frac{A_{20}}{20} & \frac{A_{40}}{40} \end{bmatrix}$$

$$B = \begin{bmatrix} -\delta_1 & \frac{B_2}{2} & \frac{B_4}{4} & \frac{B_8}{8} & \frac{B_{20}}{20} & \frac{B_{40}}{40} \end{bmatrix}$$

$$D = \begin{bmatrix} 0 & \frac{D_2}{2} & \frac{D_4}{4} & \frac{D_8}{8} & \frac{D_{20}}{20} & \frac{D_{40}}{40} \end{bmatrix}$$

$$G = \begin{bmatrix} -\delta_2 & \frac{G_2}{2} & \frac{G_4}{4} & \frac{G_8}{8} & \frac{G_{20}}{20} & \frac{G_{40}}{40} \end{bmatrix}$$

The vectors for the foreign country are denoted with asterisks. Then, the zero coupon bond yields in (1.25) can be written as

$$Y_t = -A' - B'X_t - D'X_t^* - G'e_t \tag{B.2}$$

The matrices in (B.1) are

$$\Psi = \begin{bmatrix} \mathbf{0}_{2\times1} \\ -A' \end{bmatrix}, \quad \Gamma = \begin{bmatrix} W & \mathbf{0}_{2\times3} & \mathbf{0}_{2\times1} \\ -B' & -D' & -G' \end{bmatrix}$$

$$\Gamma_e = \begin{bmatrix} \mathbf{0}_{6\times1} \\ 1 \end{bmatrix}', \quad \Gamma^* = \begin{bmatrix} \mathbf{0}_{2\times3} & W & \mathbf{0}_{2\times1} \\ -D^{*\prime} & -B^{*\prime} & -G^{*\prime} \end{bmatrix}$$

where $W = \begin{bmatrix} I_2 & \mathbf{0}_{2\times1} \end{bmatrix}$ and Ψ^* is defined analogously to Ψ. The system of transition equations is

$$\begin{bmatrix} X_{t+1} \\ X_{t+1}^* \\ e_{t+1} \end{bmatrix} = \begin{bmatrix} \mu \\ \mu^* \\ \mu_e \end{bmatrix} + \begin{bmatrix} \Phi & \mathbf{0}_{3\times3} & \Phi_e \\ \mathbf{0}_{3\times3} & \Phi^* & \Phi_e^* \\ V'\Phi & -V^{*\prime}\Phi^* & V'\Phi_e - V^{*\prime}\Phi_e^* \end{bmatrix} \begin{bmatrix} X_t \\ X_t^* \\ e_t \end{bmatrix}$$
$$+ \begin{bmatrix} I_3 & \mathbf{0}_{3\times3} & \mathbf{0}_{3\times1} \\ \mathbf{0}_{3\times3} & I_3 & \mathbf{0}_{3\times1} \\ V' & -V^{*\prime} & V_e \end{bmatrix} \begin{bmatrix} \varepsilon_{t+1} \\ \varepsilon_{t+1}^* \\ \varepsilon_{e,t+1} \end{bmatrix} \tag{B.3}$$

$$\begin{bmatrix} \varepsilon_{t+1} \\ \varepsilon_{t+1}^* \\ \varepsilon_{e,t+1} \end{bmatrix} \sim N\left(\begin{bmatrix} \mathbf{0}_{3\times1} \\ \mathbf{0}_{3\times1} \\ 0 \end{bmatrix}, \begin{bmatrix} \Sigma & \mathbf{0}_{3\times3} & \mathbf{0}_{3\times1} \\ \mathbf{0}_{3\times3} & \Sigma^* & \mathbf{0}_{3\times1} \\ \mathbf{0}_{1\times3} & \mathbf{0}_{1\times3} & \sigma_e^2 \end{bmatrix} \right)$$

where Σ and Σ^* are diagonal. The matrices in (B.3) are

$$\mu = \begin{bmatrix} \mu_c \\ \mu_\pi \\ 0 \end{bmatrix}, \quad \Phi = \begin{bmatrix} \phi_c & \phi_{c,\pi} & 0 \\ 0 & \phi_\pi & 0 \\ 0 & 0 & \phi_\nu \end{bmatrix}, \quad \Phi_e = \begin{bmatrix} 0 \\ \phi_e \\ 0 \end{bmatrix}$$

and μ^*, Φ^*, Φ_e^* are defined correspondingly.

C Data Sources for Chapter 3

Budget Balance: Ministry of Finance, General Directorate of Public Accounts, General Budget Statistics.

CBRT Overnight Borrowing and Lending Rates: CBRT.

CBRT Policy Rate: CBRT (before 20.05.2010 overnight borrowing rate is used, after 20.05.2010 1-week repo rate is used).

Current Account Balance: CBRT, Electronic Data Delivery System.

Emerging Market Country Spot Rates: Bloomberg (Tickers: BRLTRY, INRTRY, ZARTRY, RUBTRY, CNYTRY, MXNTRY, KRWTRY, HUFTRY, MYRTRY, TRYCLP).

Industrial Production Index: Turkish Statistical Institute (1997 = 100).

Inflation Rate: CBRT (CPI, 2003 = 100, annual % change).

Inflation Target: CBRT.

Inflation and USD/TRY Expectations: CBRT.

Interest Spending of the Government: Ministry of Finance, General Directorate of Public Accounts, General Budget Statistics.

Labor Force Participation Rate: Turkish Statistical Institute, Labor Force Statistics.

Overnight Repo Interest Rate: Borsa İstanbul.

Other Revenues of the Government: Ministry of Finance, General Directorate of Public Accounts, General Budget Statistics.

Primary Spending: Ministry of Finance, General Directorate of Public Accounts, General Budget Statistics.

Real GDP: Turkish Statistical Institute, Expenditure Approach, 1998 prices.

Tax Revenues: Ministry of Finance, General Directorate of Public Accounts, General Budget Statistics.

TRLIBOR (1-Week): The Banks Association of Turkey, Turkish Lira Reference Interest Rate.

Unemployment Rate: Turkish Statistical Institute, Labor Force Statistics.

USD/TRY Spot Rate: Bloomberg (Ticker: USDTRY).