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Monetary policy implications of short-term capital flows in Turkey

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Abstract The advent of global financial crisis in 2008, unleashed volatile short term capital flows to the emerging markets. This has forced many central banks in the developing world to adopt innovative policy measures to address concerns related to financial instability caused by the volatile nature of capital flows. In 2010 Turkish Central Bank included financial stability in addition to price stability as one of primary goals of its monetary policy. Several macro-prudential measures had been taken and 'corridor system' of setting the short-term policy rates had been introduced. In this paper, we have estimated an extended Taylor rule, using error correction model, to examine the impact of global financial factors in impacting the setting up of the policy rate in the pre and post 2010 periods in Turkey. It has been found that in the post-2010 period, global financial factors and monetary policy stance of the core economy, USA, have become major factor(s) in shaping up the monetary policy. Particularly our results of variance decomposition show that global financial indicators such as, VIX and EMBI have taken prominence in the setting of the short-term policy rate. This has not only made the domestic monetary more dependent on external factors but has also made pro-cyclical in nature.

Keywords Monetary policy · Taylor rule · Short-term capital flows · Inflation targeting · Financial stability · Vector autoregression model

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1 Introduction

The global financial crisis that ensued after the collapse of Lehman Brothers in 2008, continues to pose challenges and confront policy makers both in the developed and developing world. The US Federal Reserve and EU Central Bank, embarked on massive rounds of quantitative easing in implementing radical and unprecedented measures in response to balance sheet repair and deleveraging by the firms and households that followed the crisis. These exceptional responses from the central banks of the advanced economies also ignited the short-term waves of 'hot money' flowing into the emerging markets in pursuits of higher yields. The volatile nature of these flows has prompted debate on whether monetary policies, in emerging economies, should also include financial stability as one of its objectives. Particularly inflation targeting (IT) regimes, adopted by many central banks around the world, are reconsidering role of monetary policy in addressing the financial stability in the aftermath of the global financial crisis (Agénor and da Silva 2013). As a consequence many central banks of the developing world to implement innovate measures to confront sudden reversals in these flows and their bearing on the financial stability of domestic financial markets.

Before the advent of the crisis, many developing economies had increasingly opened up their borders to capital flows in recent decades, coupled with adopting flexible exchange rate regime(s). One of the reasons for choosing flexible exchange rate regime had been based on the notion that small open economies in a financially integrated world are being constraint by 'Trilemma'. Accordingly a flexible rate regime confers central banks in setting their short-term policy rate to address domestic macroeconomic concerns (Obstfeld and Taylor 2002). Furthermore, many central banks had also embarked in pursuing monetary policies based on 'inflation targeting', since early 2000. It had been contended that prudential policy measures should only be pursued and implemented by the regulatory and supervisory institutions at the micro level, and the central bank should primarily focus on ensuring price stability (Akçelik et al. 2015). It had been generally maintained that central banks with an inflation target need not to be too concerned about the financial developments, except to the extent that it may have significant bearing to inflation (Agénor and da Silva 2013).

The trilemma argument is based on the arbitrage condition(s), which equates the returns of the bond markets under perfect capital mobility conditions. Under fixed exchange rate regime with perfect capital mobility, the monetary authorities have no independence in setting up the short-term interest rate. With flexible exchange rate, on the other hand, central banks do have some independence in setting up these rates (Rey 2014). However, the academic literature lacks consensus on this issue (Ricci and Shi 2016). For example, Obstfeld (2015) argues in favor of the existence of an international policy trilemma, when a country can insulate itself from changes in the foreign monetary policy either by capital controls or choosing a floating exchange rate regime. Mundell–Fleming have argued that flexible exchange rate regime allows exchange rates to respond to foreign influences and hence the domestic interest rate(s) can be employed to address the internal policy target(s). This has also

prompted many to test the empirical validity of the existence of 'trilemma' by examining the co-movements of domestic policy rates with the policy rates of the core economies across different exchange rate regimes. A weak relationship would suggest monetary policy independence.

Several papers by Obstfeld et al. (2005), Klein and Shambough (2013), Goldberg (2013) and Obstfeld (2015) have found strong evidence that short rates are less correlated to the base country rate for flexible exchange rate countries than for fixed exchange rate countries (Rey 2014). Obstfeld (2015) also finds significant interest rate spillovers in long-term rates, but not in short-term rates. However, Gray (2013), Edwards (2015) and Takáts and Vela (2014) have reported evidence of significant spillovers in policy rates.

On the other hand, Rey (2013, 2014) argues that a global credit cycle operates like a tsunami in affecting countries, independent of exchange rate regime opted by the country (Ricci and Shi 2016).

Rey (2013) found strong common movements of cross-border capital flows, the international financial cycle, and argued that these capital flows, together with the leverage of global financial institutions, transmit the changes in the monetary conditions of the core economies (such as the US) into other economies (Ricci and Shi 2016).

In most advanced markets monetary policy facilitates in smoothing the cycles. However, for emerging markets, procyclical monetary policy (i.e., that US policy rates affect policy rates in other countries) can be problematic, with macroeconomic policies amplifying economic upswings and deepening downturns (McGettigan et al. 2013; Vegh and Vuletin 2012; Montoro et al. 2012; Takáts 2012; Hofmann and Takáts 2015; Ricci and Shi 2016).

Turkey is one of the few developing economies that not only adopted IT policy in 2006 but also introduced the corridor system of setting policy interest rates in 2010. One of the stated objectives of introducing the 'corridor system' by the Turkish Central Bank was to achieve financial stability in addition to price stability. Furthermore we also observe a marked increase in short term external flows, as compared to long-term, to Turkey since 2010. In pre-2010 period most of external portfolio investments were long-term in nature. This shift in the nature of capital flows has also made Turkey more vulnerable to sudden stop and reversal of the flows. It is in this background that we estimate an 'Extended Taylor Rule' for the Turkish economy both for Pre-2010 and post-2010 period. Our empirical model allows us to examine the impact of changes in global financial indicators on the determination of short-term policy rates in Turkey and how these may have impacted the effectiveness of monetary policy in addressing the domestic concerns, in particular, the pro-cyclical nature of monetary policy. In Sect. 2 we make an extended review of the literature. In Sect. 3 we present our model and details of data employed. In Sect. 4, we provide discussion of results and in Sect. 5 we make our conclusions.

2 Literature review

The notion of cyclicality of policy interventions refers to actions either emulating the business cycles or those countering to the business cycles. The primary aim of macroeconomic policies is to minimize output volatility around its potential level and to bring price stability. A monetary policy that aims to stabilize both output and inflation to some desired level is referred as counter-cyclical.

Procyclical policy has been a problem for emerging markets (EMs). It contrasts sharply with advanced markets (AMs), where policies tend to be countercyclical. Much attention has been given to the cyclical nature of fiscal policies in emerging markets. The literature provides ample evidence that fiscal policy in emerging markets has been procyclical, but the findings of recent work suggest that it has become less pro-cyclical due to stronger institutions (Gavin and Perotti 1997; Lane 2003; Akitoby and Thomas 2006; Kaminsky et al. 2004; Talvi and Vegh 2005; Alesina et al. 2008; Ethan and Végh 2008; Jeffrey et al. 2011).

By contrast, the literature on monetary policy cyclicality in emerging markets is sparse. Kaminsky et al. (2004) present the first systematic analysis to document the cyclical properties of monetary policy in emerging markets using data for 104 countries from 1960 to 2003. They show a clear contrast between countercyclical monetary policy in advanced markets and a procyclical stance in emerging markets. In a more recent paper, Coulibaly (2012) analyzes the behavior of monetary policy during the crisis periods using, data for 188 countries from 1970 to 2009 and found similar results. He also found that stronger macroeconomic fundamentals, lower vulnerabilities, greater openness, and, most importantly, financial reforms and inflation targeting, helped implementation of countercyclical monetary policy among emerging markets. Likewise, Vegh and Vuletin (2012) found evidence of emerging markets "graduation" on the monetary policy side. In a study covering 68 countries for the period 1960–2009, they showed that more than a third of emerging markets graduated to counter-cyclical monetary policy in the 2000s (only 7% of them reverted to procyclical monetary policy). One of the explanations for this success had been attributed to the overcoming of what they termed as the "fear of free falling." Takáts (2012) also looks at monetary policy from 2000 to 2011 for 14 emerging markets that have adopted inflation targeting and found that most emerging markets were able to pursue countercyclical monetary policy during the recent decade.[1] However, Coulibaly (2012) has found that institutional deficiencies and internal economic vulnerabilities are major factors in explaining the pro-cyclical behavior of monetary policies in some of the developing economies. The policy makers in both developing and emerging economies are often being more concerned with restraining capital outflows, in maintaining the credibility of policy and reducing exchange rate volatility. Fraga et al. (2003), Mishkin (2004, pp. 2–3) and Jeffrey et al. (2011) argue that developing economies are institutionally and economically different from industrialized economies. In developing countries, such

[1] In the literature, the studies focus mostly on the cyclicality of fiscal policies being implemented in emerging market economies (Calderón et al. 2003; Talvi and Vegh 2005; Kaminsky et al. 2004). However, there are few studies on the procyclicality of monetary policies being implemented in emerging market economies (Takáts 2012; Coulibaly 2012; Vegh and Vuletin 2012; McGettigan et al. 2013).

as Turkey, central banks are unable to implement an independent countercyclical monetary policy under perfect capital mobility due to 'fear of floating' (Calvo and Reinhart 2000).[2]

In evaluating the cyclical behavior of monetary policy, the stance of the central banks can be modeled by estimating the Taylor Rule (Takáts 2012). The standard Taylor Rule offers a linkage between policy interest rates and deviations of inflation and real output from its potential (Taylor 1993).

A central bank following the Taylor Rule reacts to the increases in inflation outturn and output gap by raising interest rates directly to ensure that monetary policy is countercyclical and vice versa (Takáts 2012, pp. 26–27; Hofmann and Takáts 2015). The policy rates, both in the developed and developing countries, have been in line with the Taylor Rule during the Great Moderation. However, since the year 2000, the policy rates have been persistently falling short of the rates particularly in the developed economies. Kahn (2010) has maintained that one of the potential factors in the built-up of imbalances in the period before and after the financial crisis is due to the monetary accommodation implied by these deviations. Furthermore, central banks in the developing countries may need to decrease policy rate during the periods with profound capital inflows when the stock markets are globally flat with low risk perception and high risk appetite (risk-on). In order to describe the policy implications for the developing countries, the standard Taylor can be extended to incorporate global financial environment in explaining the underlying implications for the setting(s) of the policy rates in the developing countries. For example, VIX index is one of the most important indicators of global risk appetite. It is also an alternative scale for global risk pricing (Rozada and Yeyati 2006, pp. 14–15; Özatay et al. 2008a; McCauley 2012; Rey 2013, 2014).

In this paper we estimate an extended version of Taylor Rule in which we include several e global liquidity indicators, including VIX, to test empirically the significance and implications of these indicators in the determination of short term policy rate in Turkey, both post and pre-2010 period.[3] Several other papers have also examined the empirical validity of Taylor Rule for Turkey. For example, Aklan and Nargelecekenler (2008) estimated both a backward-looking and forward-looking monetary policy reaction functions for Turkey. They found that between 2001 and 2006 period, monetary policy was not very accommodative to increases in expected inflation. Çiçek (2013) investigated the non-linear behavior of the policy reaction function of the Central Bank of Turkey (CBRT). They found that monetary policy behavior was more consistent with a non-linear forward-looking Taylor rule. Ege Yazgan and Yilmazkuday (2007) also estimated a forward-looking monetary policy rules both for Turkey and Israel. Their empirical findings also supported a forward-looking Taylor rule. However, none of these studies have examined the role of global financial conditions in shaping the short-term policy rate(s) set by the

[2] Velasco (2001), Calderón et al. (2003), Mishkin (2004), Zoli (2005), Kaminsky et al. (2004), Hakan and Orak (2008), Jeffrey et al. (2011), Montoro et al. (2012), Takáts (2012), Vegh and Vuletin (2012) and McGettigan et al. (2013).

[3] As indicated earlier, the Central bank of Turkey had adopted a new monetary policy framework in 2010 to address the issue of financial stability in addition to maintaining the inflation targeting regime.

monetary authorities in Turkey and this may cause a pro-cyclical response of the monetary policy.

3 Model and data set

3.1 Model

We have employed an extended Taylor rule, incorporating some of the standard global financial indicators to the standard rule. The standard Taylor-type reaction function had been developed by Taylor (1993). According to this function, a central bank will adjust its interest rates to the changes in inflation and output gaps. The standard Taylor Rule is described as follows:

$$i_t = \alpha + \beta\pi_t + \delta y_t + \zeta r \tag{1}$$

i_t denotes short-term nominal policy rate. π_t is current inflation gap and y_t is output gap. A central bank according with the Taylor Rule reacts to the increases in inflation outturn and output gap by raising interest rates directly. For example, central bank raises short-term nominal interest rates in case of an increase in output gap for bringing actual output to the level of potential output and vice versa (Takáts 2012, pp. 26–27). A significant and positive value of parameter δ in (1) would indicate countercyclical monetary policy of a central bank.[4]

In this paper we employ an extended version of the standard rule in (1) which would allow us to examine the effects of both domestic and external factors on the short-term policy rates in Turkey. Following Leiderman et al. (2006) and Özatay et al. (2008b), we propose the following Taylor-type reaction function:

$$i_t = \alpha + \beta\pi_t + \delta y_t + \phi\Delta REER_t + \eta\Delta NIR_t + +\gamma i_{t-1} + \lambda Spread_t + \kappa US2Y_t + \varphi US10Y_t + \Omega VIX \tag{2}$$

The inclusion of i_{t-1} in (2), to capture the interest rate smoothing behavior by the central banks in the developing countries (Carare and Tchaidze 2005, p. 6). $REER_t$ denotes cpi-weighted real exchange rate in the equation. We have obtained real effective exchange rate from CBT's Electronic Data Delivery System (EVDS). The original form of the series is annual and non-purified from seasonality. In the economic literature, the Taylor Rule do not incorporate the structural characteristics of emerging market economies and exclude exchange rate from the equation. However, the changes in exchange rate may have macroeconomic bearing in in small open economies. Laurence (1999) and Svensson (2000) suggest that changes in exchange rate should be has an impact on inflation rates. However, Taylor (2010) argued the impact of the inclusion of exchange rate in central bank reaction function is highly limited, suggesting that it is unnecessary for central bank to change interest in response to the fluctuations in exchange rate, it may generate a temporary imbalance, however, these fluctuations have no effect inflationary expectations. On

[4] Countercyclical policy can be explained as the case when central bank raises interest rates in the expansion period and decreases it in the shrinkage period (Vegh and Vuletin 2012, p. 10).

the other hand, Richard et al. (2001), and Laxton and Pesenti (2003) suggest that exchange rate inclusion in the rule can have a significant bearing on inflation and output although indirectly. Smets and Wouters (2004) have also concluded that the incorporation of exchange rate into the monetary policy rule is highly advantageous, particularly for the economies with open capital markets. In developing countries, such as Turkey, households and private companies do have foreign debts liabilities and volatility in exchange rates can lead to balance-sheet-based fragility. Borio and Lowe (2002), and Gourinchas and Obstfeld (2011) have found the overvaluation of domestic currency will ruin financial stability in emerging market economies. They recommended adding exchange rate to the Taylor-type reaction function (Céspedes et al. 2002, 2004; Roger et al. 2009).

NIR_t denotes central bank's net international foreign exchange reserves. CBT's net international reserves are on monthly basis and in million US dollar. This series has also obtained from EVDS. We have included this variable in the model, as these reserves can be used by the central bank to intervene in the forex markets in case of sudden stop (Leiderman et al. 2006, p. 14).

The risk premiums developing countries can increase as a result of a negative shock in the financial markets, it is called systemic sudden stop. For example, the capital outflows from the developing countries that resulted due to the Bank of Japan's interest rate hikes in May 2006, is an example of such systemic sudden stop. We have incorporated the risk premium covering of all emerging market economies that also covers Turkey. There are two indices that have been employed to quantify risk premium in the present study: one of them is JP Morgan Emerging Market Bond Index plus Turkey[5] (EMBI+), the other is Credit Default Swap Spread (CDS). One of the most important cited factors in the failure of central banks to implement a countercyclical monetary policy in the developing economies is 'risk premium'. An increase in the risk premium devalues domestic currency and contributes to inflation by exchange rate pass through. Furthermore, such an increase also affects economic growth negatively as it raises the cost of borrowing. Thus, we have included risk premium in the model is to account for the fiscal dominance problem. The data on this series has been collected from Thomson Reuters Datastream.

Developed countries, such as USA, use 2 years ($USA2Y_t$) and 10-year ($USA10Y_t$) bond yields in the formulation of the monetary policy. The interest rates of developed countries are also important determinants of the capital flows toward the

[5] The presence of risk premium at the center of economy is a prominent reason why the central banks of developing countries fail to implement countercyclical monetary policies. The increase in risk premium devaluates the domestic currency and raises the rate of inflation due to the transitivity from exchange rate to inflation. Furthermore, such an increase affects economic growth negatively by raising the cost of borrowing. Thus, we have incorporated risk premium into the model for showing fiscal dominance. We have used JP Morgan Emerging Market Bond Index for both composite index and Turkey's index. Composite index has been included in the model for showing the importance of systemic sudden stop and of external dominance for Turkey. Eichengreen and Hausmann (1999, p. 15) have examined 11 emerging countries for the 1960–1998 period and analyzed the impact of the shocks in JP Morgan Emerging Market Bond Index on domestic interest rates. The authors suggest that anti-risk investors demand for higher interests for compensating the devaluation that is due to the fluctuations in risk premium. Furthermore, they conclude the rise in risk premium has increased domestic interest rates in Mexico in the 1960–1998 period, calling this 'the peso problem'.

developing countries, such as Turkey. (Takáts and Vela 2014; Cho and Rhee 2013). There are some findings showing that US long-term interest rates have statistically significant effects on emerging economies (EMEs) long-term interest rates. In other words, EMEs long-term interest rates are synchronized with those of US rates (Takáts and Vela 2014; Ahmed and Zlate 2014; Dahlhaus and Vasishtha 2014; Robin 2015; IMF 2015). The data on these series have been collected from Bloomberg.

The VIX volatility index is one of stock indices in the US. It is an indicator of global risk appetite and shows the Volatility in S&P 500 index. This has also been included in the extended version of our Taylor Rule equation. VIX is both an indicator of the risk appetite of international investors and also an alternative measure of risk pricing. (Rozada and Yeyati 2006, pp. 14–15; Özatay et al. 2008b; Utlaut and Van Roye 2010; IMF 2013, 2015; Ahmed and Zlate 2014; Dahlhaus and Vasishtha 2014; Robin 2015). VIX is one of the most important determinants of risk premium (IMF 2013). Risk premium has a bearing on exchange rates, domestic interest rates, inflation and output. Furthermore, VIX is regarded as the a good proxy variable reflecting changes in US 2- and 10-year interest rates and Fed-based monetary policy (Cho and Rhee 2013).

The sample period of this study is 2002–2015 period and we have used quarterly data. We had argued earlier that global factors may have stronger effects on CBT (Central Bank of Turkey)'s policy rates in the post-2010 period after it adopted of new monetary policy to include financial stability as an additional objective of their monetary policy. Thus, we have divided the 2002–2015 period into two sub-samples, 2002–2010 (first three quarters) and 2010–2015 (first quarter). Based on our specification of the extended Taylor Rule in (2), we have analyzed the relationship between policy rate and domestic and global factors. We have used CBT's overnight interest rate for policy rate. The data on this series has been collected from the Thomson Reuters Datastream.

In our estimation of this extended version of the Taylor rule, both inflation and output gaps are calculated by taking the difference between actual values and Hodrick–Prescott (HP) filters measuring trends (Leiderman et al. 2006). The Turkish Central Bank has adopted "Inflation Targeting" regime in 2006. However, the inflation targets have normally been based on targeted bands of values. Therefore, assigning a single target value in each period was not possible for most of the years in our sample. It is primarily this reason that we followed Leiderman et al. (2006) in using HP trend values in place of the targeted values of inflation.[6]

Furthermore, we have used the Tramo/Seats Method for removing the seasonal effects on the series of (y_t) output gap and used the Hodrick–Prescott filter for calculating y_t's deviations from potential levels. For calculating the inflationary gap, we have taken

[6] Inflation gap also has been measured using expected inflation and actual inflation. For example see Çiçek and Akar (2014), Akar and Çiçek (2016) and Özcan (2016) have recently used expected inflation to measure the inflation gap for the Turkish economy. Similarly Aklan and Nargelecekenler (2008) and Ege Yazgan and Yilmazkuday (2007) have estimated forward looking Taylor Rule. In order to test the robustness of the results reported in this paper, we have also used the difference between expected and targeted inflation as an alternative measure of inflation gap. Results were robust to different measures of inflation gap.

the median of the 12-month CPI index obtained from CBT's survey and subtracted it from actual inflation figures. In the present study, consumer price index is the measure of inflation and real GDP is the measure of output. The original form of the series is annual and non-purified from seasonality. The 1998 base year data has been collected from Turkish Statistical Institute.

4 Discussion of results

One of the concerns in any time-series-based analysis is the issue of non-stationarity. The series must be tested for stationarity to avoid any spurious regression problem. The results of Augmented Dickey–Fuller test (ADF), for testing the stationary of the variables, are presented in Table 1.

The results are similar for the two sub-samples of our data. The variables are non-stationary at the level but their first differences are stationary. Johansen and Juselius (1990) have developed a cointegration analysis method for testing the long-term relationship between variables. The cointegration analysis is dependent on the condition that variables are non-stationary at the level. Johansen and Juselius (1990) have also developed trace and maximum likelihood estimations for testing the cointegration hypothesis. Both tests give information about the presence or absence of cointegration relationship. The results in Table 1 are useful in testing for the presence of cointegration or long-term relationship in the two analyzed periods.

The presence of cointegration is verified if test values are above the critical values. However, trace test is more preferable for examining the cointegration relationship for more than 2 variables (Lüutkepohl et al. 2001). Table 2a, b show the Johansen cointegration test results.

Our cointegration tests show that there is a conintegrating relationship between all variables in the 2002–2010 and 2010–2015 periods. The variables in cointegration relationship are also accepted to have long-term correlation.

The vector error correction model (VECM) is used for testing the short-term relationship between the long-term-correlated variables.[7] The VECM also provides information about the possibility of re-establishing stability by the short-term deviations. In line with the Taylor Rule, an error term obtained from Eq. (2) has been added as follows:

$$\Delta i_t = \alpha_0 + \alpha_1 \Delta \pi_{t-i} + \alpha_2 \Delta y_{t-i} + \alpha_3 \Delta REER_{t-i} + \alpha_4 \Delta NIR_{t-i} + \alpha_5 \Delta Spreads(EMBI)_{t-i} + \alpha_6 \Delta USA10y_{t-i} + \alpha_7 \Delta USA2y_{t-i} + \alpha_8 \Delta VIX_{t-i} + ecm_{t-1} + \varepsilon_t \quad (3)$$

Here, Δ is first difference equation, $\alpha_0 \ldots \alpha_8$ are parameters, ECM is error correction model term and ε is error term. The VECM is used for discriminating between short- and long-term relationships and for determining the short-term

[7] Both actual and expected inflation have been used in measuring the inflation gap in our estimation. Results were robust to the choice of inflation variable used, we therefore only report the results based on the actual inflation rates.

Table 1 Unit root test results

Variables	Level	Dif.
First period (2010–2015)		
I	−1.77	−7.23***
Π	−2.44	−7.22***
Y	−2.19	−10.28***
REER	−0.51	−7.66***
NIR	−0.85	−6.06***
Spreads (CDS)	−2.41	−7.39***
USA10Y	−2.21	−5.90***
USA2Y	−2.69	−9.41***
VIX	−2.36	−11.06***
Second period (2002–2010)		
I	−2.00	−2.77*
Π	−2.03	−3.36**
Y	−2.52	−3.32**
REER	−2.38	−5.26***
NIR	−0.56	−4.01***
Spreads (EMBI)	−0.21	−6.85***
USA10Y	−2.21	−5.58***
USA2Y	−0.95	−3.30**
VIX	−1.93	−6.60***

*, ** and *** 10, 5 and 1% significance level, respectively

dynamics. In the present model, ECM is used for linking the short-term behaviors of the variables with the long-term behaviors. Table 3 shows the error correction model results of the two periods.

In Table 3, R^2 and Durbin–Watson statistics for the two periods show the explanatory power is sufficient and there is no problem of auto-correlation problem. We have also found 'ecm' is statistically insignificant in the two periods. This result shows there is unstable equilibrium after the short-term imbalances in these two periods, and, some additional policy instruments (Macro-prudential policy instruments) will be necessarily to remove finance-based risks or imbalances.

All independent variables are statistically significant in the 2010–2015 period. The directions of the relationships are as expected in line with the literature. There is a positive correlation between inflationary gap and monetary policy rate. However, the relationship is negative between output gap and policy rate, showing pro-cyclical nature of monetary policy. Policy rate increases when inflation wanders from the target and it decreases when output gap rises or in case of economic shrinkage. There is negative correlation between policy rate and reserves. The relationship between real exchange rate and policy rate is positive. An increase in exchange rate will raise the policy rate. CDSs are positively related with the policy rate. A rise in country risk will expectedly increase policy rate since capital flows may reverse.

For the global factors, we have found positive correlation between policy rate and USA10Y, USA2Y, and VIX. The rise in USA2Y bond returns can be interpreted as

Table 2 Cointegration test results

Hypothesized No. of CE(s)	Trace Statistic	Hypothesized No. of CE(s)	Max-Eigen Statistic
(a) 2002–2010			
$r \leq 0$	371.7616**	$r = 0$	119.2758**
$r \leq 1$	252.4858**	$r = 1$	76.10320**
$r \leq 2$	176.3826**	$r = 2$	60.63560**
$r \leq 3$	115.7470**	$r = 3$	37.89911*
$r \leq 4$	77.84786**	$r = 4$	27.67701
$r \leq 5$	50.17084**	$r = 5$	22.69082
$r \leq 6$	27.48002*	$r = 6$	14.56674
$r \leq 7$	12.91328	$r = 7$	9.370316
$r \leq 8$	3.542966*	$r = 8$	3.542966*
(b) 2010–2015			
$r \leq 0$	860.7628**	$r = 0$	298.9191**
$r \leq 1$	561.8437**	$r = 1$	166.5235**
$r \leq 2$	395.3203**	$r = 2$	113.4942**
$r \leq 3$	281.8260**	$r = 3$	85.36296**
$r \leq 4$	196.4631**	$r = 4$	75.83865**
$r \leq 5$	120.6244**	$r = 5$	62.72783**
$r \leq 6$	57.89661**	$r = 6$	33.85991**
$r \leq 7$	24.03670**	$r = 7$	20.17697**
$r \leq 8$	3.859737**	$r = 8$	3.859737**

r shows cointegration vectors

*, and ** the null hypothesis that there is no cointegration in the series is rejected at 10 and 5% significance level, respectively. Critical values vary by assumptions (e.g. linear trend, constant value). The VAR lag number has been assigned as 1 before the Johansen test

an increase in expectations of the Fed's monetary policy exchange rates, which is also expected to raise CBT's policy rates, since capital flows may be reversed. USA10Y provides information about the course of the US inflation whereas VIX reflects global risk appetite. The increases in the two variables are expected to raise the CBT's policy rates because they may lead either to capital inflows toward or to outflows from Turkey.

For the 2002–2010 sample period, we have found statistically significant relationship between policy rate and all variables except for output gap. The statistically insignificant relationship between output gap and policy rate can be interpreted that CBT has been more focused on inflation targeting in this period. The correlation between inflationary gap and policy rate is positive as expected. We have found the relation between real exchange rate and policy rate is also positive as expected. There is a negative relationship between reserve changes and policy rate. The correlation between global factors and policy rate is positive as one would have expected. EMBI is employed to capture country risk for this period. There is a positive relationship between EMBI and policy rate. CBT is expected to raise policy rate for preventing capital outflows and incenting investment in Turkish Lira in case of country risk increase. We have found positive relation between policy rate and USA10Y, USA2Y, and VIX. In other words, the increases in global risks and US interests will be responded by an increase in CBT's policy rate, indicative of lack of independence by the Turkish authorities to set up their own policy rates. This is

Table 3 Results of error correction model

Period (2010–2015)			Period (2002–2010)		
Variable	Coefficient	SE	Variable	Coefficient	SE
α_0	0.04	0.05	α_0	−0.65	0.80
$\Delta\pi_{-4}$	0.14*	0.07	$\Delta\pi_{-1}$	0.45**	0.16
Δy_{-6}	−0.001***	0.001	Δy_{-5}	−0.001	0.001
$\Delta REER_{-1}$	4.02***	1.48	$\Delta REER_{-1}$	12.58**	4.45
ΔNIR_{-7}	−0.001***	0.001	ΔNIR_{-6}	−0.001*	0.001
ΔCDS_{-5}	0.02***	0.004	$\Delta EMBI_{-1}$	0.08***	0.01
ΔVIX_{-5}	33.29***	10.94	ΔVIX_{-3}	0.17***	0.04
$\Delta USA10Y_{-4}$	1.02***	0.31	$\Delta USA10Y_{-1}$	2.63***	0.66
$\Delta USA2Y$	7.82**	3.16	$\Delta USA2Y_{-5}$	2.22***	0.65
ECM_{-1}	0.20	0.13	ECM_{-1}	−0.03	0.23
AR_1	−0.51***	0.15	AR_1	0.63**	0.21
R-squared	0.56		R-squared	0.68	
Adjusted R-squared	0.45		Adjusted R-squared	0.48	
Prob (F-statistic)	0.00		Prob (F-statistic)	0.01	
Durbin–Watson stat	2.06		Durbin–Watson stat	1.80	

Eviews 8.0 has been used for the error correction model

*, ** and *** 10, 5 and 1% significance level, respectively

important, since by adopting a flexible exchange rate regime with open capital markets, one would expect that monetary authorities would gain more independence in setting their policy rates. However, factors like 'fear of floating' and financial stability may prevent authorities to set an independent rate.

The most striking findings of the regression analysis across two sub-samples is the relationship between exchange rate, global factors and domestic monetary policy. REER has the strongest correlation with monetary policy in the 2002–2010 period. However, the parameter value of REER is much lower in the 2010–2015 period.

Global factors have also stronger relationship with policy rate than any other variable in these two periods. However, there is a highly strong correlation between USA2Y, which is a signal for policy rate increase, and monetary policy interest rate in the 2010–2015 period (Adler et al. 2014). These results may suggest that by focusing on financial stability in the post 2010 era, when there has been a surge of capital movements to the developing countries after the Fed's 2010 expansionary policy, USA2Y became an important global factor in determining the policy rates by CBT (Capital Flows and FED; Dahlhaus and Vasishtha 2014).

In short, we think that CBT has had attached more importance to the process of dollarization in 2002–2010 period and to financial stability in the 2010–2015 period. CBT has also attached some value to country-risk variables in the two periods, however, they were not as prominent as exchange rates and global factors.

4.1 Variance decomposition results

In search for further understanding of the above results we have also analyzed the VAR-based Variance Decomposition results. The variables must be stationary for the variance decomposition calculations. Thus, we have taken the first differences before estimating variance decompositions. In order to make a better and effective analysis we have used graphical technique to describe our results.

The results in the two graphs (Fig. 1a, b) clearly demonstrate the dominance shocks of global indicators in post-2010 period. VIX-induced shocks have the highest explanatory power. USA2Y and USA10Y are the other two factors in prominence. Again, suggesting that the global factors significantly influenced the short-term policy rates in the post 2010 era, while they may also have been responsible in inducing a 'pro-cyclical' monetary policy response in Turkey. In pre-

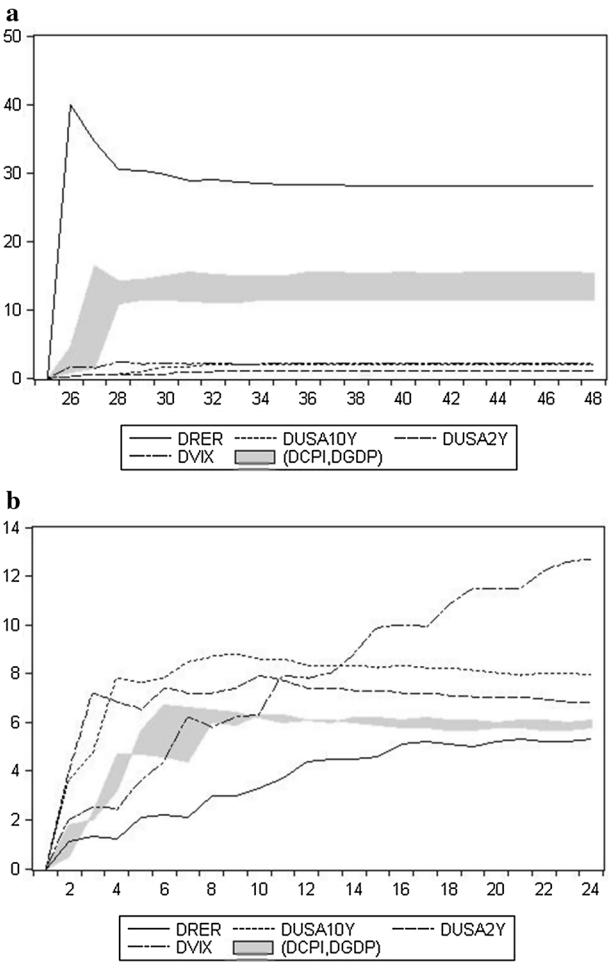

Fig. 1 Variance decomposition: **a** 2002–2010, **b** 2010–2015

2010 period, however, exchange rate shocks were more prominent while the results of cyclical movements were not found statistically significant.

5 Conclusions

Many developing economies, in recent decades, have increasingly opened their borders to capital flows together with adopting flexible exchange rate regime(s). In theory choosing flexible exchange rate regime for a small open economy in a financially integrated world allows central banks to set their short-term policy rates more independently to address domestic policy concerns. However, the exceptional measures taken by the central banks of the developed world in the post-2008 period of crisis have posed new challenges to the policy makers. These measures have contributed to short-term waves of 'hot money' into the emerging markets in pursuits of higher yields. Many central banks in the developing that had embraced inflation targeting to bring price stability before the crisis, are now reconsidering the role of monetary policy in achieving financial stability in the aftermath of the global financial crisis.

In this paper, we have examined the pro-cyclical nature of monetary policy for the Turkish economy by empirically estimating 'Extended Taylor Rule'. Our work has been motivated by observing a significant increase in short-termed capital flows into Turkey since 2010. The Turkish Central Bank had also responded by taking new macro-prudential measures and introduced 'corridor system' of setting up the policy rates to achieve financial stability. In the pre-2010 period, with inflation targeting regime, price stability had been the primary concern of the monetary authorities.

Our results are based on two samples of data, pre and post 2010 periods. The extended Taylor rule has been estimated for both the periods. The empirical modelling of the Taylor rule not includes the traditional measure of output and inflation gaps, it also allows to examine the role of global financial indicators in determining the short-term policy rates. These indicators include measures such as USA short-term and long-term policy rates, VIX, EMBI and other global liquidity measures. Our empirically estimated vector-error correction model (VECM) for the two periods have revealed several noteworthy interesting outcomes. First, in the pre-2010 era we could not find any statistically significant evidence of pro-cyclical stance of monetary policy, however, in post-2010 period the average behavior of monetary policy has been pro-cyclical in nature. Second, most of the global financial indicators were significant in both the periods, however, they become highly significant and important determinants of short-term policy rates in Turkey in post-2010 period. Fluctuations in real exchange rate(s) were the most important determinant of policy rate(s) in pre-2010 period. Third, strong positive relationship(s) between policy rates and USA10Y, USA2Y and VIX, clearly indicate the dependence of domestic policy rates on monetary policy stances in the core economy. Finally, we may also cautiously conclude that the volatile nature of short-terms flows of hot money into the Turkish economy has made monetary policy pro-cyclical.

Our work can be extended by including other emerging economies into the framework of analysis and panel data analysis may further reveal intrinsic dependence of monetary policies in these economies on the global financial factors and the developments in monetary policies in the core economies.

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