Macroprudential Policies as Buffer Against Volatile Cross-border Capital Flows

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Abstract

This paper investigates the effectiveness of macroprudential policies introduced by Turkey in late 2010. The unprecedented quantitative easing policies of advanced countries after the global financial crisis have presented serious financial stability concerns for most emerging countries including Turkey. To cope with these challenges, Turkey has devised new policy tools such as asymmetric interest rate corridor and reserve option mechanism. From the perspective of capital flows, the interest rate corridor works mainly through stabilizing supply of foreign funds, and the reserve option mechanism through decreasing the sensitivity of equilibrium exchange rate to shifts in the demand for foreign funds. Using a large panel of 46 countries and employing Bruno and Shin (2013a,b)'s methodology, we investigate whether the new policy framework in Turkey has been successful in cushioning the economy from volatile cross-border capital flows from a comparative perspective. The results show that, after controlling for a set of domestic and external variables and relative to a group of advanced and emerging countries, cross-border capital flows to Turkey have been less sensitive to global factors after the implementation of macroprudential policies.

Keywords: Capital Flows, Macroprudential Policies.

JEL Codes: E58; F32, F34.

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*The views expressed here are those of the authors and do not necessarily reflect the views of the Central Bank of the Republic of Turkey.

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1. Introduction

In response to large scale of quantitative easing policies in advanced economies, global capital flows have increased substantially during the recent era. Moreover, sluggish recovery and prevailing policy uncertainties in advanced economies have further paved way to a more volatile global environment. Accordingly, emerging market economies with sound fundamentals have faced large and volatile capital flows, in response to which they have implemented various macroprudential policies to ease the effects of such flows on domestic business cycles. Turkey stands out as an interesting example in this regard, implementing novel market-friendly policy tools, the interest rate corridor and the reserve option mechanism, as well as loan-to-value ceilings, augmented risk weights for certain loans, among others. In this paper, using a large panel data set of 46 advanced and emerging countries, we empirically assess whether and to what extent macroprudential policy tools in Turkey have been effective in restraining the effect of global banking activities on cross-border capital flows to Turkey.

The need for macroprudential policies, in addition to microprudential policies, has been recognized after the global financial crisis unfolded in 2008 onwards. Existing prudential regulations at the time were focused too much on resilience of individual financial institutions rather than managing the risk of the system as a whole. Yet, as emphasized in early papers such as Allen and Gale (2000) and Borio (2003), and later by Brunnermeier (2009), Krishnamurthy (2009), Acharya *et al.* (2010), Korinek (2011), Claessens and Ghosh (2012), and Galati and Moessner (2012) among others, markets do not price externalities, the externality that an individual institution puts on others in the system. Existence of such externalities, if not managed properly, may feed a financial amplification cycle, e.g. declining asset prices leading to tighter credit conditions, a crunch in economic activity, and a further decline in asset prices, and so forth. Facing such a feedback cycle, many advanced economies have resorted to unprecedented expansionary policies.[1] Coupled with policy uncertainties, however, such expansionary policies have led to a very volatile global financial environment.

Emerging economies, particularly the ones with relatively sound macroeconomic fundamentals, have in turn experienced large and very volatile short-term capital flows. As analyzed more in detail by Mendoza and Terrones (2008) and Bruno and Shin (2013a,b), such volatile capital flows can

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[1]See Gambacorta *et al.* (2012) and IMF (2013a,b) for effectiveness of such policies.

trigger a financial instability cycle for a small open economy, e.g. a surge in capital flows leading to a currency appreciation, an improved balance sheet of borrowers, easier credit conditions, increase in non-tradable prices and overall inflation, a further appreciation of the currency, and further capital inflows; or vice versa.[2] To cushion the economy from such a feedback cycle, emerging market economies have recently implemented various macroprudential policies, reserve requirement policies, quantity-based restrictions of capital flows, caps on loan-to-value ratio, limits on foreign exchange lending, to name a few.

Such global nature of capital flows can be traced by cross-border activities of 'global' banks, as emphasized by a recent growing literature (Giannetti and Laeven, 2012; Cetorelli and Goldberg, 2011, 2012; Jeon *et al.*, 2013; BIS, 2011). This literature has investigated the role played by global banks in the transmission of shocks on parent country banking systems across subsidiary banks in other regions/countries. This phenomenon has recently been investigated further theoretically by Bruno and Shin (2013a) who constructs a model of global banking, centralized funding, and credit allocation of international banks. Their model in particular points out the importance of leverage cycle of global banks and its interaction with regional banks and recipient country characteristics. Their model highlights key variables in driving global capital flows: net assets of foreign bank branches in the US vis-a-vis their headquarters and the balance sheet capacity of global banks. Setting the stage for econometric analysis of the nature of global capital flows, in an accompanying paper, Bruno and Shin (2013b) empirically test whether macroprudential policies in Korea have been effective in containing such bank-based cross-border capital flows in the recent era.

In this paper, we essentially follow a similar strategy: Using a similar panel data set and methodology, we assess the effectiveness of macroprudential policies in Turkey. Our results suggest that, after controlling for a set of domestic and global variables, capital flows to Turkey has become less sensitive to cross-border global banking activities after the implementation of macroprudential policies. Moreover, although many economies in our data set have introduced macroprudential policies of various sorts as well, our results suggest that Turkey has become less sensitive to global factors compared to the rest of the economies, suggesting that price-based macroprudential policies are equally effective if not more in containing cross-border capital flows compared to quantity-based

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[2]See also Aysan, Fendoğlu, Kılınç (2013), IMF(2013a,b), Turner (2012), Blueschke *et al.* (2012), Moreno (2011), Lim *et al.* (2011) for practical challenges and empirical assessment of macroprudential tools from an emerging market economy perspective.

capital controls.

The contribution of this paper is that we empirically evaluate the effectiveness of the recent policy framework in Turkey. There have been numerous studies that provide an overview on the recent policy framework and present supportive anecdotal evidence, e.g. Başçı and Kara (2011); Kılınç, Kılınç, Turhan (2012); Akçelik, Başçı, Ermişoğlu, Oduncu (2013); Akçelik, Aysan, Oduncu (2013); and Aysan, Fendoğlu, Kılınç (2013); as well as empirical works that focus on a single prudential policy tool, e.g. Binici *et al.* (2013); Değerli and Fendoğlu (2013); Küçüksaraç and Özel (2012); and Oduncu, Akçelik, Ermişoğlu (2013). In this paper, we take an empirical stand, and study the policy framework in general with a focus on its role in containing cross-border capital flows. Second, we use a large panel data set which enables us to shed light on the relative performance of macroprudential policies in Turkey.

The paper proceeds as follows: Section 2 provides a summary on macroprudential policies in Turkey. Section 3 presents the data set and the econometric methodology. Section 4 provides the empirical results, and Section 5 concludes.

2. Macroprudential Policies in Turkey

2.1. Capital Flows and Financial Stability Problems

During the abundant global liquidity conditions in early 2000s, capital flows to emerging countries increased significantly until 2007. Then, during the global financial crisis of 2008 capital flows have dropped by almost half and have stayed very volatile since then (Figure 1). After the global financial crisis, main source of surge in capital flows to emerging countries has been the quantitative easing policies of advanced countries, while fluctuations in capital flows have been mostly due to the problems and policy actions in these countries. Therefore one can think that, from the perspective of an emerging country, supply of foreign exchange has been very volatile in this period (Figure 2).

In Figure 3, we therefore hypothesize volatile capital flows as movements in the supply of foreign exchange resulting from factors exogenous to the emerging economy (i.e. advanced country dynamics). On the horizontal axis, we have the amount of US dollars, and on the vertical axis, the price e (domestic currency, Turkish lira (TL), per US dollar). For the sake of analysis, we can assume that supply is fixed from the perspective of the emerging country. Factors like global risk appetite (e.g. the VIX), quantitative easing by advanced countries, foreign interest rates,

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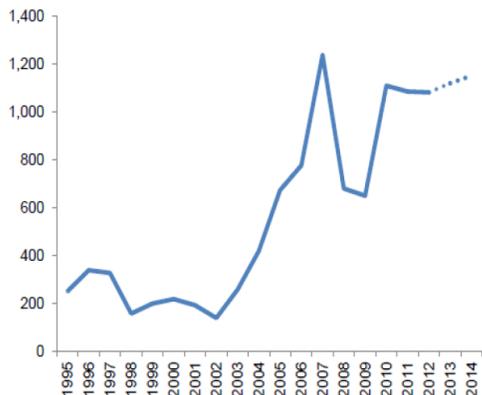
FIGURE 1. Private Capital Flows to Emerging
Countries (Billion US Dollar).
Source: IIF.
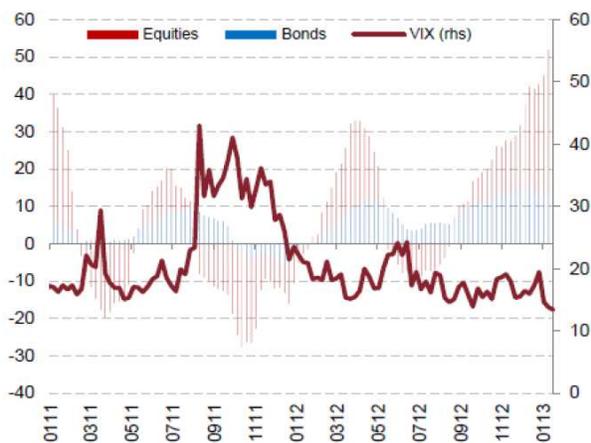
FIGURE 2. Capital Flows to Emerging Countries
(13-week Sum, Billion US Dollar).
Source: EPFR, Bloomberg.

risk-adjusted interest rate differential between domestic and foreign interest rates, domestic fundamentals, and other risk factors could be thought as effective in the level of supply. For example, a new round of quantitative easing, an increase in global risk appetite, market expectations about advanced countries taking decisive actions about sovereign debt problems might shift the supply line to the right, generating capital inflows to domestic economy and appreciating the domestic currency. Reverse developments then might cause capital outflows and a depreciation. One important effect of volatile capital flows then would be the resulting high volatility in the exchange rate, σ_e.
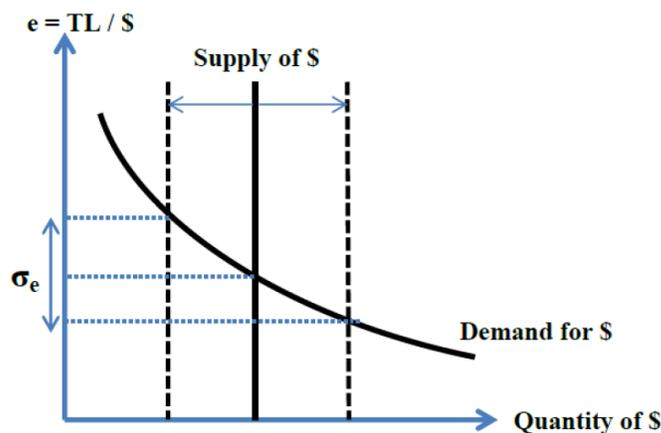

FIGURE 3. Supply and Demand of Foreign Exchange ($)

If capital flows are mostly short-term and very volatile due to external factors, then it is likely

that there are frequent exogenous shocks to the supply of foreign exchange. Such fluctuations, if not managed properly by related policy tools, may lead to large cycles in domestic credit and in turn impede domestic financial stability for emerging countries. Accordingly, many emerging market economies have recently utilized a set of unconventional policy tools such as active use of reserve requirements and other macroprudential policies to mitigate adverse effects of such fluctuations in capital flows.

The amplification of business cycles fed by capital flows might be very problematic if these flows are large, short term and volatile. After all, the flows might suddenly got reversed and push the economy into a reversed amplified cycle. Another facet of such amplification cycles is that private agents might not be fully taking into account these amplification effects or not internalizing the related externalities. Several papers including Caballero and Krishnamurthy (2004), Lorenzoni (2008), Bianchi (2011) and Korinek (2011) show that when private agents do not internalize such pecuniary externalities of external borrowing stemming from financial market imperfections, private external borrowing might be sub-optimally high. They propose policies to contain both the amplification due to capital flows and possible private overborrowing to improve aggregate welfare.

2.2. Financial Concerns and Macroprudential Policies in Turkey

With the low interest rates and quantitative easing policies in advanced countries after the global financial crises of 2008, there were important push factors for capital flows to the emerging countries. Also strong domestic fundamentals in the emerging countries presented strong pull factors for these flows. However, these capital inflows have brought important challenges for the financial stability in the emerging countries as in Turkey.

Figure 4 shows that the current account balance worsened quickly in 2010. Moreover, as Figure 5 shows, almost all of the capital inflows were portfolio and short-term flows unlike the pre-crisis period. So, not only the level but also the composition of current account deficit has been the risk factors for the domestic economy. Also in the same period, the nominal exchange rate appreciated significantly along with other emerging countries and a strong credit boom followed (Figure 6 and 7).

Casting from the supply and demand analysis in Figure 3, there was large increase in the supply of foreign exchange which generated a large current account deficit, an overvalued currency and a
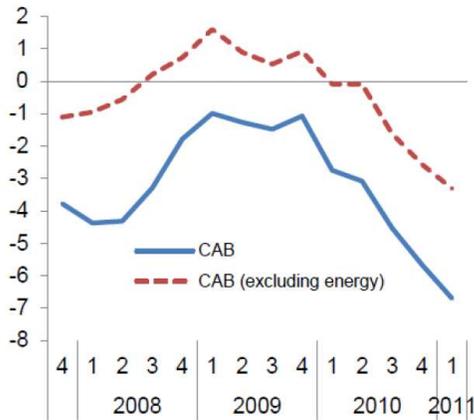
FIGURE 4. Current Account Balance (Seasonally Adjusted, Quarterly Average, Billion USD). Source: CBRT.
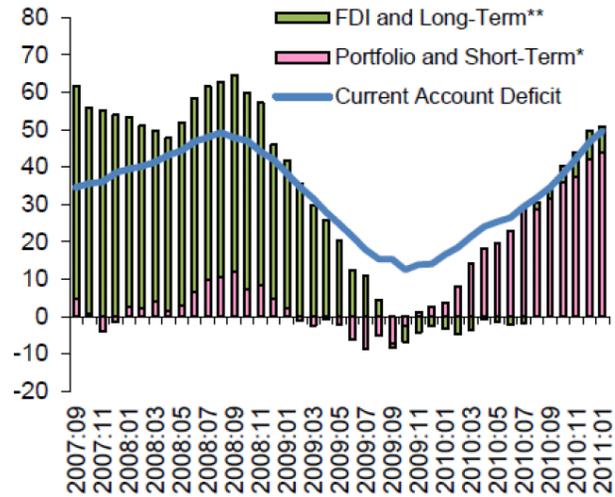
FIGURE 5. Main Sources of Current Account Deficit Finance*(12-months Cumulative, Billion USD). Source: CBRT.

credit boom. Given that the source was mainly short-term capital flows, these developments have generated a very important financial risk of a sudden stop. Therefore, policy actions were needed to induce a soft landing of the economy, ensuring corrections in the current account, the exchange rate and the credit growth.
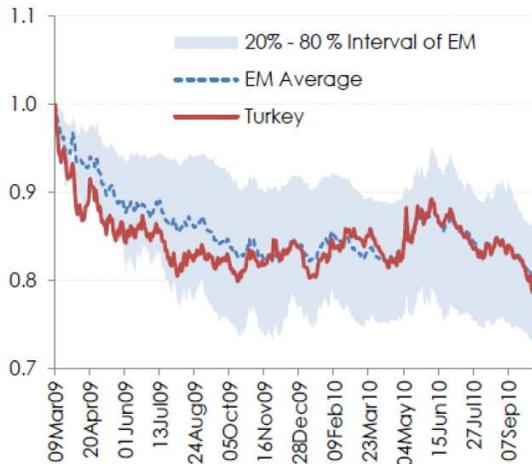

FIGURE 6. TL and Other EM Currencies Against USD (9 March 2009=1)
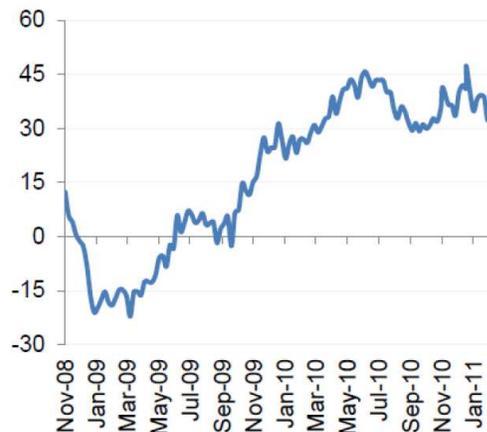
FIGURE 7. Total Loan Growth Rate (13 Weeks Moving Average, Annualized, FX Adjusted). Source: CBRT.

The CBRT, in these regards, has started to implement a new policy framework in late 2010 to contain the effect of volatile short term capital flows on the domestic economy. The new

framework have incorporated financial stability along with the price stability as an objective. In the process CBRT has introduced the interest rate corridor (as a cyclical tool) and the reserve option mechanism (as a structural tool) as additional policy tools.[3]

2.2.1. Interest Rate Corridor

Central banks offer two standing facilities to ensure that the overnight interest rate in money markets are close to the conventional (target) policy rate: a lending facility where the central bank is ready to supply funds overnight at a given lending rate against collateral and a deposit facility where banks deposit overnight to earn the deposit rate. Then the interest rate corridor is the wedge (or the corridor) between the lending rate (the ceiling) and the deposit rate (the floor). Central banks usually implement a symmetric and narrow corridor to effectively steer the overnight rate at the money markets. We here discuss the interest rate corridor as a potential policy tool and its particular relevance for capital flow management.

As additional policy tools, the width of the corridor as well as its upper and lower limits can be effectively used to help cushion the economy from excessive fluctuations in short-term capital flows. A wider corridor creates higher uncertainty about short-term yields and in principle discourages short-term portfolio inflows (consider, for example, a simple mean-variance optimization perspective of portfolio investors). Ceteris paribus, decreasing particularly the lower limit of the corridor induces a higher uncertainty about the short-term yield. Such a policy can be thought as a low-probability extreme-event risk for international portfolio investors (Figure 8). A likely lower yield coupled with the resulting exchange rate uncertainty might then discourage short-term portfolio investment (e.g. carry trade flows). In sum, reducing the lower limit during surges in capital flows and increasing the upper limit during capital outflow periods would counteract against the volatility in capital flows. In Figure 9, we can think that when there is a strong short-term capital inflow (outflow) which increases (decreases) the supply, reducing (increasing) the lower (upper) limit of the corridor smooth the movement of supply. In these regards, the corridor policy can be thought as a policy-induced uncertainty shock to smooth capital flows, ensure milder fluctuations in the exchange rate, and in turn support domestic financial stability. Moreover, as opposed to

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[3]For a general overview of the new policy framework of the CBRT, see Başçı and Kara (2011); Kılınç, Kılınç, Turhan (2012); Akçelik, Başçı, Ermişoğlu, Oduncu (2013); Akçelik, Aysan, Oduncu (2013); and Aysan, Fendoğlu, Kılınç (2013). For a detailed analysis of additional policy tools, see Alper, Kara, and Yörükoğlu (2012); Binici *et al.* (2013); Değerli and Fendoğlu (2013); Küçüksaraç and Özel (2012); and Oduncu, Akçelik, Ermişoğlu (2013).

setting the policy rate for a predetermined period as in the conventional framework, a central bank can steer the money market rate (within the corridor) on a daily basis via liquidity operations. In this regard, the corridor provides flexibility for the monetary policy to react to volatile capital flows in a timely manner.
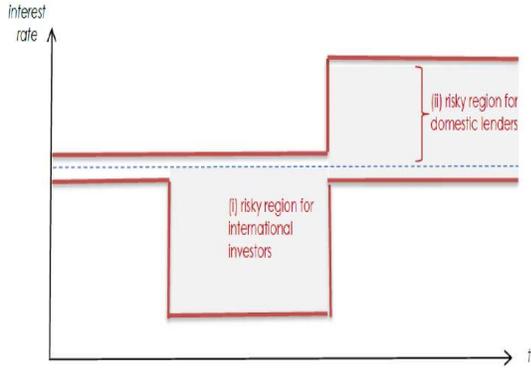

FIGURE 8. The Interest Rate Corridor and Its Asymmetric Effect on Domestic/Global Lenders
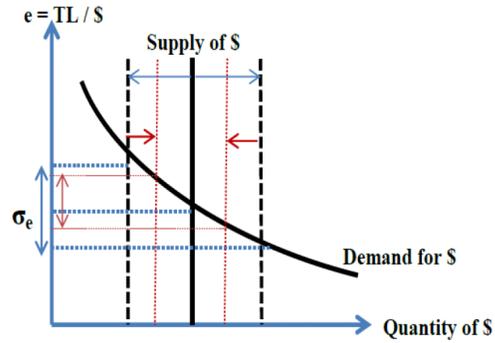
FIGURE 9. The Smoothing Role of Interest Rate Corridor

The CBRT has introduced the interest rate corridor as a policy tool in late 2010, and actively used both the upper and lower limits (Figure 10). Due to surge in capital inflows after the Fed's QE2, the CBRT has cut the lower bound aggressively and widened the corridor to discourage short-term capital flows. In late 2011 and 2012 during which the Euro debt crisis has been intensified, the upper bound has been increased to prevent reversal in capital flows. As concerns about the Euro-zone economies have been weakened gradually after mid-2012, the upper bound has been steadily decreased in response capital inflows.

2.2.2. Reserve Option Mechanism

The reserve option mechanism (ROM) is a market-friendly tool that acts as an automatic stabilizer which contains possibly distortionary effects of excessive volatility in capital flows on the domestic business cycles. The ROM allows banks to voluntarily hold a certain fraction of their domestic currency (TL) required reserves in foreign currency (FX) or gold. The amount of FX or gold that can be held per unit of TL required reserves is called the reserve option coefficient (ROC). For example, suppose ROM allows banks to hold up to 50% of their TL required reserves in FX, and the ROC is equal to 1. Then, a bank that is obliged to hold 100TL as required reserves can hold 50TL-worth of FX and 50 TL to fulfill her reserve requirements -if would like to fully utilize the ROM facility-. Similarly, if the ROC is equal to 2, the bank can hold 50TL*2-worth of FX and
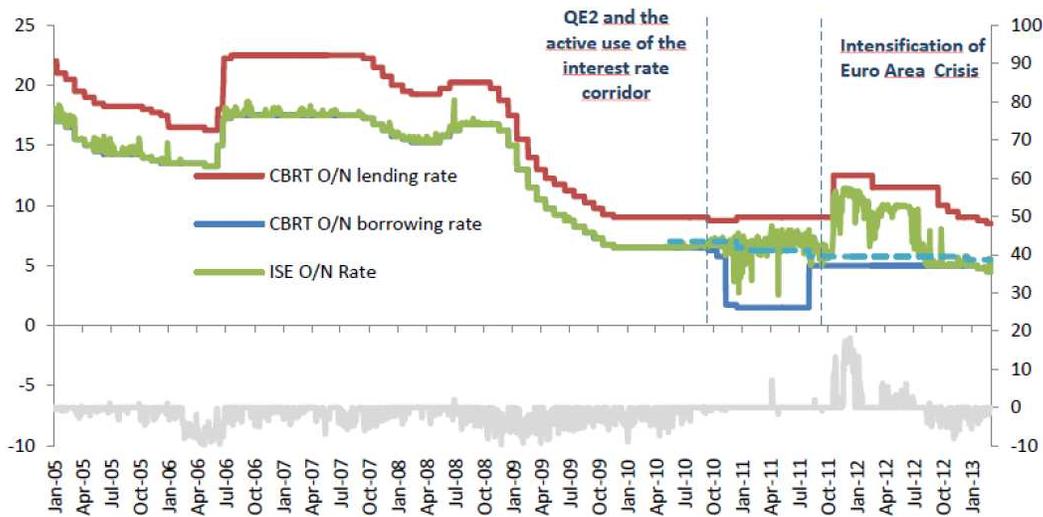
FIGURE 10. The Implementation of the Interest Rate Corridor

50 TL to meet the 100-TL reserve requirement. Since the domestic interest rates are larger than the foreign currency interest rates, it is still profitable for banks to hold foreign currency in place of TL required reserves even if the reserve option coefficients are larger than 1. The fraction of ROM facility that the bank would like to utilize is market-determined, and depends on the bank's relative cost of FX funding to the TL funding. In particular, banks utilize the facility up to a certain threshold at which the cost of FX is equalized with the TL funding.

ROM can be considered as a policy tool that decreases the slope of effective demand for foreign exchange (Figure 11). When supply increases, there would be lower cost and/or higher availability of FX funds for domestic banks. Then the attractiveness of using ROM increases and banks would put some of extra capital inflows at the central bank in place of TL required reserves. When there is an outflow, there would be higher cost and/or lower availability of FX funds for domestic banks. Then banks can use their reserves in ROM at the central bank in response to capital outflows. Hence a fraction of ROM-based FX reserves at the CBRT would be released through the economy, decreasing the depreciation pressure and possibility of a credit crunch. In these regards, the ROM facility acts as a market-friendly automatic stabilizer that potentially smooths the effect of volatile capital flows on the exchange rate and in turn on domestic business cycles and gives banks flexibility in liquidity management. Therefore, in effect the slope of demand curve decreases with ROM from D^1 to D^0 (Figure 11). The difference between the smoother demand curve D^1 with ROM and steeper demand curve D^0 without ROM would then be the reserve holdings of banks in ROM at

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the Central Bank (Figure 12).
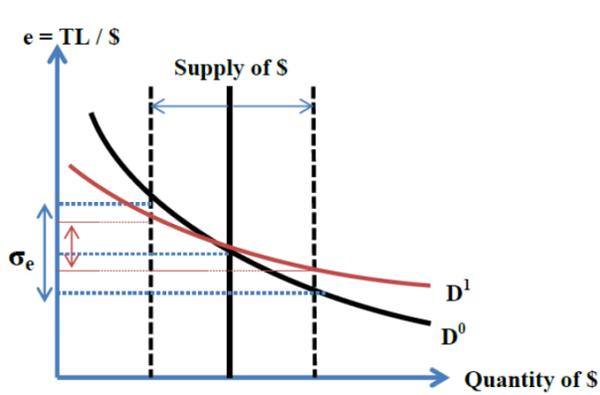
FIGURE 11. The Reserve Option Mechanism and
its smoothing effect on the exchange rate
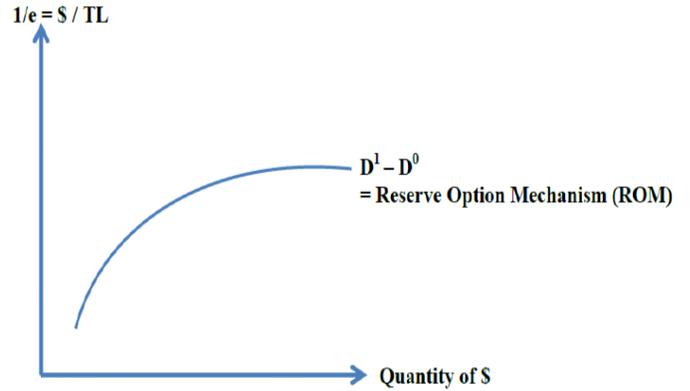
FIGURE 12. The Reserve Option Mechanism and
its effect on FX reserves

CBRT started with the introduction of ROM in late 2011. Reserve option coefficient was 1 at the time. In the second half of 2012 with the stenghtening of capital inflows, construction of ROM gained pace and higher ROC numbers were put in place (Figure 13).With the introduction of ROM, FX reserve holdings of private banks in the central bank through the reserve option mechanism has increased significantly (Figure 14). These reserve holding also fluctuated showing the automatic stabilizer charactertics of the facility.
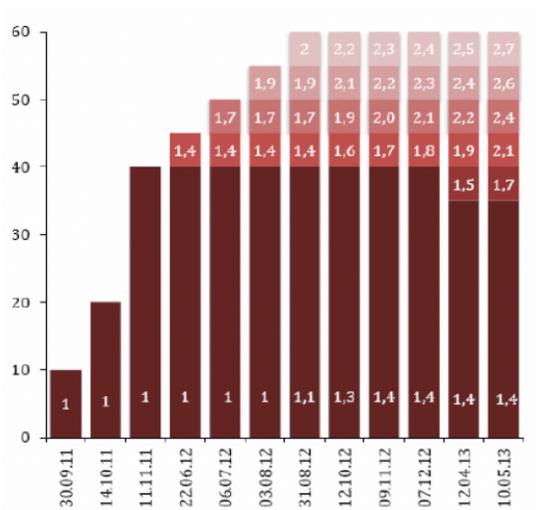
FIGURE 13. Reserve Option Coefficients for FX
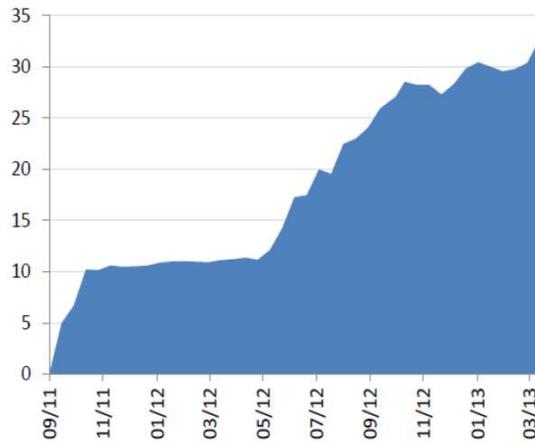
FIGURE 14. FX Reserves of Banks in ROM
(Billion USD).
Source: CBRT.

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2.3. Policy Results

The new policy framework of CBRT has been successful in achieving a soft landing in the economy and lessening the financial stability risks. One main concern was the size of the current account deficit and it's financing by short-term capital flows. After the implementation of the macroprudential policies starting in late 2010, both the current account deficit (Figure 15) and the maturity of financing (Figure 16) have improved significantly. From the peak of more than 10 % of GDP in 2011, current account deficit decreased to 6 % of GDP at the end of 2012. During the process, GDP continued to grow with the main contributor to the growth being the net exports. This was an unusual combination for Turkey in the sense that a large correction in current account balance and positive growth from net exports in consecutive quarters happened without a crisis for the first time in more than the last three decades.
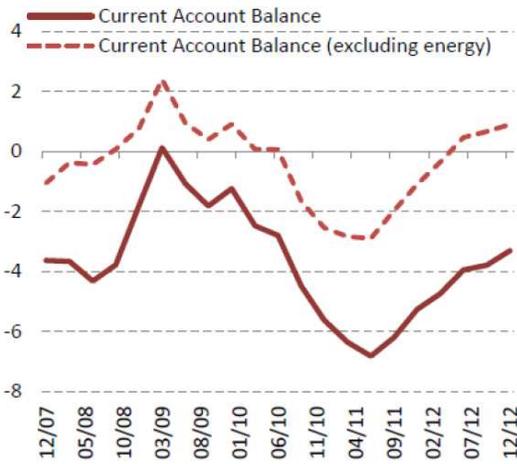
FIGURE 15. Current Account Balance (Seasonally Adjusted, Quarterly Average, Billion USD). Source: CBRT.
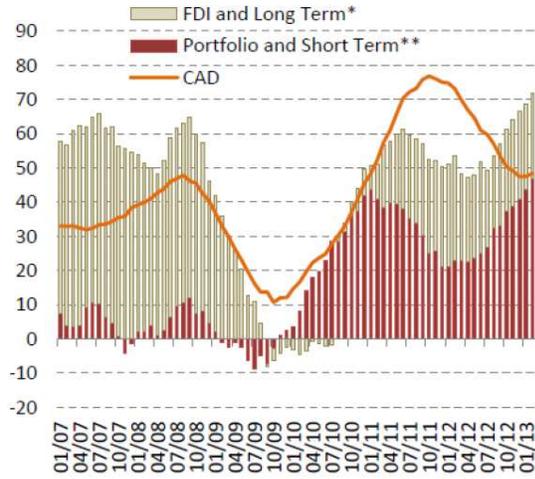
FIGURE 16. Main Sources of Current Account Deficit Finance (12-months Cumulative, Billion USD). Source: CBRT.

One of the main aims of the new policies was to avoid overvaluation and excess volatility in exchange rates. After the global crisis and before the new policy framework in Turkey, between March 2009 and October 2010, Turkish lira appreciated around 20 percent along with other emerging country currencies (Figure 6). This large appreciation in a short period was mostly caused by the short-term capital inflows and was not in line with the fundamentals. So in the initial phase of the new policies, increasing the reserve requirements and lowering the lower part of the interest rate corridor generated 15 percent depreciation in Turkish lira until August 2011, when the European debt problems started. In the same period, almost all other emerging country currencies

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appreciated another 5 percent against the US dollar (Figure 17). This period was like a controlled experiment period for the new policy tools in Turkey. There were not much global financial worries, common capital flows were appreciating the emerging market currencies but Turkish lira experienced a significant controlled depreciation. Later on with the European debt problems and other global policy uncertainties, emerging country currencies and Turkish lira moved in similar fashion. However, Turkish lira has kept its relative differential of around 15 % against other emerging country currencies.

Another aspect of the currency was that its volatility stayed very low compared to other emerging countries (Figure 18). Especially in 2012 with the active use of corridor and increasing size of the reserve option mechanism, implied FX volatility of Turkish lira decreased relative to the peer emerging countries with current account deficits. As interest rate corridor smoothed the supply shifts in foreign exchange and as reserve option mechanism decreased the sensitivity of demand to supply shifts, the volatility of Turkish lira decreased significantly (Figure 18).
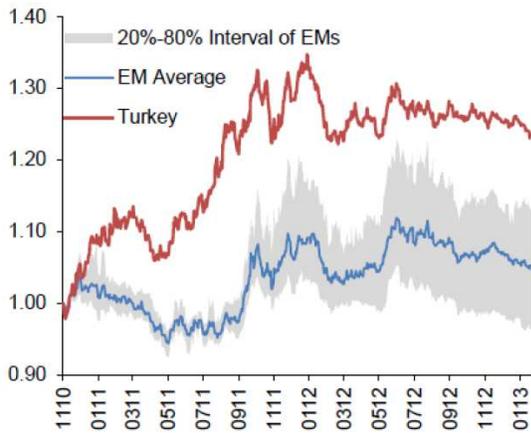
FIGURE 17. Exchange Rates in Emerging Economies (vis-a-vis USD, 01.11.2010=1)
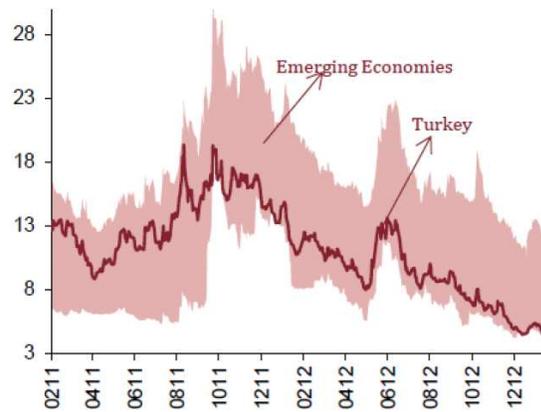
FIGURE 18. Implied FX Volatility in Emerging Economies (1-month maturity)

Another main aim of the new policy framework in Turkey was to contain the fast credit growth. In annual terms, credit growth was above 30 percent at the end of 2010. This credit growth slowed down to around 25 percent at the end of 2011 and around 18 percent at the end of 2012 (Figure 19). Improvement in the current account deficit was coupled with the slowdown in the credit growth. Therefore the new policy framework was also successful in controlling the credit growth.
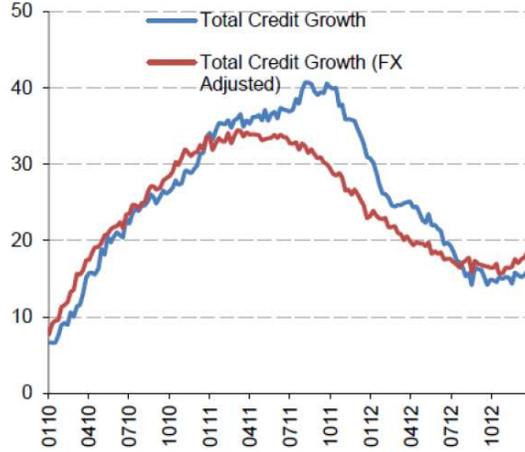
FIGURE 19. Total Credit Growth (Annual Percentage Change)

3. Data Set and the Methodology

For comparison purposes, we use the same set of countries with Bruno and Shin (2013b): Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Malaysia, Malta, Mexico, Netherlands, Philippines, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, and Uruguay (46 countries).

In Figure 20, we present external loans of BIS-reporting banks to a set of emerging market countries, growth in which can be regarded as a fair measure of change in gross bank-based capital flows. The figure mainly suggests a harmonized cross-border lending boom before the global financial crisis.[4]

We use the growth of interoffice assets of foreign banks in the U.S. as a proxy for the rate at which global banks are engaged in wholesale funding to the rest of the world. Net interoffice assets measure the net claim of the branch/subsidiary of a foreign bank on its headquarter. Normally, one would expect subsidiaries as lending outposts financed by funds from headquarters. However, as shown in Figure 21, the decade after 2001 exhibits the opposite: the subsidiaries in the US became the wholesale funding posts to their parent bodies, as reflected in positive, large and persistent

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[4]We choose a subset of countries for brevity in presenting the idea. Similar lessons can be drawn for a larger set as well.
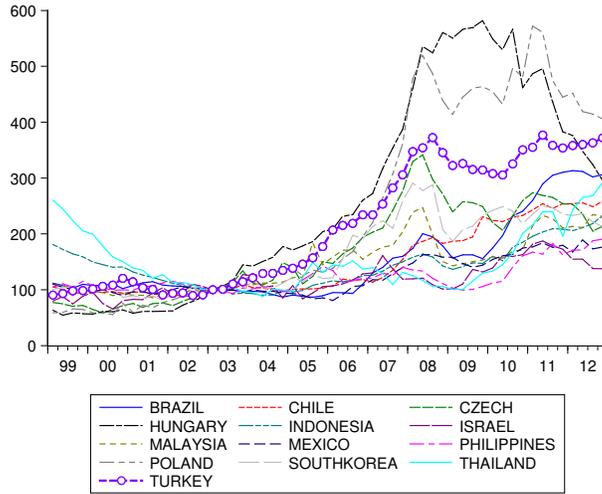
FIGURE 20. External loans of BIS-reporting banks to the countries listed. The series are normalized at 2003=100.
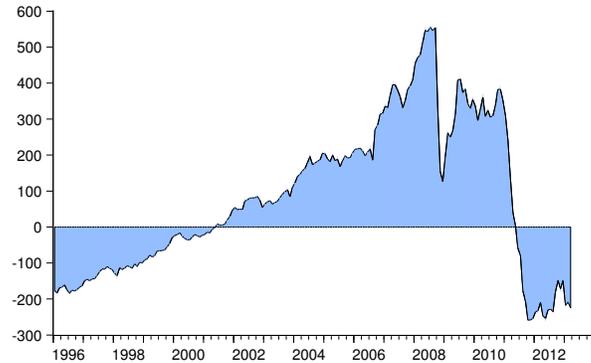
FIGURE 21. Net interoffice assets of foreign banks in the US.

net interoffice assets.[5] As the European crisis unfolded in late 2010, such wholesale funding has exhibited a sharp reversal, i.e. the subsidiaries drawing funds from their parent bodies.

The second variable we use to reflect activities of global banks are related to the level of or the change in leverage. The level of leverage captures the rate at which an additional dollar of bank capital is transformed into lending, whereas change in leverage captures the extent of which additional lending is supported by an increase in bank capital. As proxies for these two variables, and following Adrian and Shin (2010) and Bruno and Shin (2013b), we use the level of and the

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[5]Since the US dollar plays a dominant role in global banking system, focusing on USD-denominated funds is very likely to capture the essence of global cross-border flows sufficiently well. See Bruno and Shin (2013a).

change in the VIX (the CBOE's index of 1-month implied volatility of S&P500 index). We include the VIX in log-levels (VIX) as well as in quarterly log difference (ΔVIX).[6]

We control for a set of global and domestic variables that are potentially effective in cross-border capital flows as well. We use real exchange rate, real GDP growth, and change in gross government debt to GDP as domestic control variables, and growth in the world money supply (stock of M2 in the US, Eurozone and Japan, M4 in the UK) as the global control variable.[7] The sample period spans from 2004Q1 to 2012Q4, the last quarter for which data is available for all the series.[8] The data is collected from WEO, IMF's IFS, Fed Board, and the BIS. We start the sample from 2004 (although the data dates back to 1996), since Turkey had experienced significant structural changes in the few years following her 2001 economic crisis.[9]

Table 1 summarizes descriptive statistics of the variables used in our analysis:

Table 1: Descriptive Statistics

Variable	Mean	Std.Dev.	Min	Max
BIS Loans Growth	.0232	.1075	-.7781	.6996
Δ Interoffice	-.0087	.0522	-.3170	.0039
VIX	2.933	.3890	2.4327	3.7873
Δ VIX	-.0004	.2893	-.6075	.9556
Δ Money Stock	.0147	.0208	-.0271	.0497
Real GDP Growth	.0290	.0463	-.1959	.3908
Δ Debt to GDP	.0382	.0466	-.2508	.4468

Note: Sample period: 2004Q1-2012Q4.

To assess the effect of macroprudential policies, we estimate variants of the following benchmark panel regression specification:

$$\Delta L_{i,t} = \alpha + \beta_1 \Delta \text{interoffice}_{t-1} + \gamma_1 \text{VIX}_{t-1} + \delta_1 \Delta \text{VIX}_t + \text{controls}_{i,t|t-1} + e_{i,t} \tag{1}$$

where $L_{i,t}$ is banking sector capital inflow to country i at quarter t, interoffice is the interbank office assets of foreign banks in the US, VIX is the log of end-quarter VIX index. Control variables

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[6]We use the log of end-quarter VIX following Bruno and Shin (2013b). Results are by and large robust to using log of quarterly average of the VIX.

[7]We use quarterly log difference of real exchange rate, and real GDP growth as year-on-year percentage change. Since gross government debt is available only at yearly frequency, we use linear interpolation to convert change in debt to GDP into the quarterly frequency. World money supply, stock of M2 in the US, Eurozone and Japan, M4 in the UK, is converted into the US dollar using quarterly average of respective nominal exchange rates.

[8]The data is available upon request for the period 1996Q1-2012Q4.

[9]Results for the sample period 1996-2012 are available upon request. For comparison purposes with Bruno and Shin (2013b), we present the results for 1996-2012 in column [0] of Table 2, and in Table A1 in the Appendix.

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are the real exchange rate, world money supply, real GDP growth, change in government debt to GDP, as details of which presented above. All variables (including the control variables) except ΔVIX are lagged by one quarter to ease endogeneity problems.

4. Empirical Results: Could Macroprudential Policies in Turkey increase the resilience of Turkish economy to cross-border capital flows?

We present the estimation results of variants of the panel regression in Table 2. For convenience in reading the results, we would like to summarize the nature of interaction terms used in the regression for the case of ΔInteroffice (see Table 3 below).

[Tables 2 around here]

Table 3: The Nature of interaction terms in the regression (for ΔInteroffice)

Turkey	$\beta_1 + \beta_3$	$\beta_1 + \beta_2 + \beta_3 + \beta_4$
Others	β_1	$\beta_1 + \beta_2$
	Before 2010Q4	After 2010Q4

The coefficient β_1 reflects the estimated effect of change in wholesale funding on cross-border capital flows prior to 2010Q4, as an average measure for all countries (excluding Turkey). β_2 measures the incremental impact of wholesale funding on capital flows after 2010Q4. $\beta_1 + \beta_3$ reflects the effect of wholesale funding on capital flows to Turkey (in comparison to the average) prior to 2010Q4, and $\beta_1 + \beta_2 + \beta_3 + \beta_4$ the marginal effect after 2010Q4.

The results suggest that an increase in wholesale funding leads to a significant increase in cross-border capital flows, as shown in column [1], and even more strongly for Turkey (column [2]). After 2010Q4 during which Turkey has started implementing a battery of macroprudential policies, the effect of wholesale funding on capital flows has diminished significantly ($\beta_4 < 0$, column [3]).

Similar results can be drawn for the other global measure, the VIX, which reflects the leverage of global banks. An increase in the VIX leads to a reduction of cross-border capital flows, as expected (column [4]), and even more strongly after 2010Q4 (column [5]). For Turkey, on the other hand, the sensitivity of capital flows to the VIX decreases after 2010Q4 ($\gamma_4 > 0$, column [5]).[10]

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[10]The results for ΔVIX is inconclusive in that even though the coefficients are by and large inline with the theoretical predictions, the coefficients are statistically not different from zero. The only significant term (δ_2 in column [5]) suggest that an increase in the change in leverage of global banks leads to a significant reduction in cross-border flows after 2010Q4 (compared to 2010Q4).

To this end, we formally test whether there is a change in sensitivity of capital flows to Turkey to global measures (interoffice, VIX, and ΔVIX) after 2010Q4, and whether there is a difference between Turkey and the other countries after 2010Q4 regarding the sensitivities. The formal test results are summarized in Table 4 below:

Table 4: F-tests for sensitivity to capital flows (before and after 2010Q4 for Turkey, and Turkey versus the others after 2010Q4)

Null hypothesis	p-value
$\beta_2 + \beta_4$	0.0003
$\beta_3 + \beta_4$	0.0010
$\beta_1 + \beta_2 + \beta_3 + \beta_4$	0.0005
$\gamma_2 + \gamma_4$	0.2191
$\gamma_3 + \gamma_4$	0.0477
$\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$	0.1029
$\delta_2 + \delta_4$	0.0874
$\delta_3 + \delta_4$	0.3025
$\delta_1 + \delta_2 + \delta_3 + \delta_4$	0.0981

The results suggest that capital flows to Turkey become less sensitive to wholesale funding (interoffice assets) after 2010Q4 ($\beta_2 + \beta_4$ is negative and significant) while other countries has become more sensitive. Moreover, sensitivity to wholesale funding has been higher for Turkey before 2010Q4 compared to the other countries ($\beta_3 > 0$), and become only slightly higher than the average after 2010Q4 ($\beta_3 + \beta_4$ is only slightly positive and significant). Finally, the total effect of wholesale funding on capital flows to Turkey is positive and significant after 2010Q4 ($\beta_1 + \beta_2 + \beta_3 + \beta_4 > 0$).

Moreover, capital flows to Turkey have been less sensitive to the VIX before 2010Q4 ($\gamma_3 > 0$, though insignificantly), and become significantly less sensitive after 2010Q4 compared to the rest of the economies ($\gamma_3 + \gamma_4$ is negative and significant). Moreover, the total effect of VIX on capital flows to Turkey after 2010Q4 ($\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$) is slightly significant at 10%. The total effect of ΔVIX ($\delta_1 + \delta_2 + \delta_3 + \delta_4$) is insignificant at 10%.

Overall, majority of the evidence suggests that, controlling for other domestic factors, cross-border capital flows to Turkey has become less sensitive to global banking activities after the implementation of prudential policies.

Regarding the control variables, we find that (i) currency appreciation (an increase in RER) leads to an estimated increase in capital flows. This might be due to a potential improvement in borrowers' balance sheet after the currency appreciation, leading to local banks becoming more

willing to lend. Nonetheless, we find this effect insignificant for our sample. (ii) global money stock has a significant and positive effect on capital flows, indicating banks' greater demand for funding. (iii) GDP growth has a positive and significant impact on cross-border flows, possibly due to capital being more likely to flow into growing and less-risky economies. (iv) Change in debt to GDP has a negative and significant effect on the flows, highlighting the importance of fiscal soundness for the perceived riskiness of an average economy.

It is also worth discussing whether cross-border capital flows to Turkey are less sensitive to domestic fundamentals or other common external factors after the implementation of macroprudential policies. In Table 5, we present the sensitivity of capital flows to the real exchange rate, real GDP growth, change in debt to GDP, and world money stock (our control variables in the previous analysis). We follow a similar strategy, using three interaction terms as in Table 2.

[Tables 5 around here]

Testing for whether $\eta_3 + \eta_4 = 0$, for instance, reflects testing whether Turkey behaves differently than the rest of the economies after 2010 for the variable in question (Table 6). Capital flows to Turkey appears to be less sensitive to GDP growth after 2010 compared to the rest of the economies. We observe no difference, though, regarding the sensitivity of capital flows to real exchange rate, world money stock or government debt.

Table 6: F-tests for sensitivity to capital flows to the additional variables

Null hypothesis	Δ RER	Δ Money Stock	Δ GDP	Δ Debt to GDP
$\eta_3 + \eta_4$	0.001	0.000	0.198	0.000
$\eta_2 + \eta_4$	0.000	0.000	0.000	0.000
$\eta_1 + \eta_2$	0.245	0.413	0.923	0.000
$\eta_1 + \eta_3$	0.003	0.000	0.000	0.000
$\eta_1 + \eta_2 + \eta_3 + \eta_4$	0.000	0.000	0.003	0.000

Similarly, testing for whether $\eta_2 + \eta_4 = 0$ is a test of whether sensitivity of capital flows to Turkey to the variable has been changed after 2010. For all the variables, we observe a statistically significant change in the sensitivity. A real depreciation rather than an appreciation is estimated to encourage capital inflows, which might reflect the rather smooth Turkish real exchange rate after 2010 ($\eta_2 + \eta_4 = 0$ is rejected at .05 and $\eta_2 + \eta_4 < 0$). Turkey have been more sensitive to global money supply before the prudential policies ($\eta_3 > 0$), and becomes less sensitive after

the prudential policies ($\eta_4 < 0$), and even less compared to the rest of the economies ($\eta_4 < \eta_2$). Moreover, capital flows to Turkey have been less sensitive to GDP growth after 2010 ($\eta_2 + \eta_4 = 0$ is rejected at .05 and $\eta_2 + \eta_4 < 0$).

5. Conclusion

Due to unprecedented quantitative easing policies in advanced economies, many emerging market economies, especially the ones with favorable pull factors like stronger growth, have experienced large volume of short-term capital flows. Yet, prevailing fiscal and monetary policy uncertainties and the fragility in the recovery in advanced economies have created a volatile global financial environment, leading to excessively volatile global capital flows. Accordingly, these emerging market economies including Turkey have faced important financial stability concerns, thereby have implemented various macroprudential policies, e.g. reserve requirements, caps on foreign exchange operations, other capital controls, etc., in order to mitigate potential effect of such waves in capital flows on the domestic business cycles.

To cushion the economy from excessively volatile short-term capital flows, Turkey has devised new policy tools starting in late 2010, mainly the interest rate corridor and the reserve option mechanism. After providing a thorough analysis of this new policy framework and presenting supportive anecdotal evidence, we empirically test whether cross-border capital flows to Turkey become less sensitive to global variables compared to rest of the economies after the implementation of macroprudential policies. Controlling for a set of domestic and global variables, our results suggest that the macroprudential policies appear successful: gross capital flows to Turkey have become less sensitive to global banking activities. Moreover, gross capital flows to Turkey have become less sensitive to changes in world money supply or domestic GDP growth compared to the rest of the economies.

In future research, we would like to extend the analysis to assess effectiveness of macroprudential policies from a broader perspective: whether the policies have been successful at containing sensitivity of not only bank-based cross-border flows but of portfolio inflows or domestic credit growth to global financial conditions, and not only for Turkey but for a larger set of countries. We also would like to pinpoint the structural break date (for which we take the *de-jure* date for Turkey, 2010Q4, in this paper) for each country and assess the effectiveness of policies accordingly to sharpen the analysis.

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Tables used in the main text (next page)

Table 2: Determinants on cross-border banking capital flows and the effectiveness of macroprudential policies in Turkey

Coef.	Variables	[0]	[1]	[2]	[3]	[4]	[5]
β_1	Δ Interoffice	0.052**	0.301***	0.301***	0.297***	0.301***	-0.020
		(0.023)	(0.053)	(0.053)	(0.052)	(0.053)	(0.085)
β_2	Δ Interoffice*Post2010				0.134**		
					(0.054)		
β_3	Δ Interoffice*Turkey			0.350***	10.224***		
				(0.017)	(0.993)		
β_4	Δ Interoffice*Post2010*Turkey				-10.002***		
					(1.000)		
γ_1	VIX	-0.054***	-0.050***	-0.050***	-0.051***	-0.051***	-0.055***
		(0.006)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
γ_2	VIX*Post2010						-0.011***
							(0.003)
γ_3	VIX*Turkey					0.026**	0.016
						(0.011)	(0.012)
γ_4	VIX*Turkey*Post2010						0.079***
							(0.016)
δ_1	ΔVIX	-0.032***	0.001	0.001	0.000	0.001	-0.002
		(0.006)	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)
δ_2	ΔVIX*Post2010						-0.064**
							(0.029)
δ_3	ΔVIX*Turkey					-0.012	-0.013
						(0.011)	(0.012)
δ_4	ΔVIX*Turkey*Post2010						-0.020
							(0.017)
	Turkey*Post2010				0.012**		-0.232***
					(0.005)		(0.047)
	ΔRER	0.067	0.048	0.048	0.057	0.051	0.057
		(0.049)	(0.073)	(0.073)	(0.073)	(0.073)	(0.075)
	ΔMoney Stock	0.109	0.292**	0.294**	0.333***	0.290**	0.307**
		(0.073)	(0.111)	(0.112)	(0.112)	(0.112)	(0.121)
	GDP Growth	0.283***	0.297**	0.298**	0.302**	0.299**	0.291**
		(0.104)	(0.120)	(0.121)	(0.115)	(0.121)	(0.125)
	ΔDebt to GDP	-0.148*	-0.297***	-0.296***	-0.275***	-0.295***	-0.250***
		(0.085)	(0.086)	(0.086)	(0.087)	(0.086)	(0.089)
	Constant	0.186***	0.172***	0.172***	0.175***	0.172***	0.187***
		(0.021)	(0.029)	(0.029)	(0.029)	(0.029)	(0.030)
	Observations	2,443	1,595	1,595	1,595	1,595	1,595
	R-squared	0.080	0.135	0.135	0.140	0.135	0.143
	Number of id	46	46	46	46	46	46
	Fixed effects	Y	Y	Y	Y	Y	Y

Notes. Cluster-robust standard errors in parantheses. ***,**,* denote significance level at .01, .05 and .1, respectively. Δ is defined as percentage growth given by $\Delta x_t = ln(x_t/x_{t-1})$, except ΔInteroffice. Since interoffice assets takes negative values as well, ΔInteroffice is calculated as $\Delta\text{Interoffice}_t = (\text{Interoffice}_t - \text{Interoffice}_{t-1})/abs(\text{Interoffice}_{t-1})$. Column [0] is based on the sample period 1996Q1-2012Q1 (same as Bruno and Shin, 2013b). Column [1] onwards use the period 2004Q1-2012Q4 (for reasons explained in the text). ΔDebt to GDP series (which is annual) is converted to quarterly frequency using linear interpolation. Post2010 takes a value 1 for 2010Q4 onwards, and 0 else.

Table 5: Cross-border banking capital flows and the local variables: further assessing the effectiveness of macroprudential policies in Turkey

Coef.	Variables	[1]	[2]	[3]	[4]
	Δ Interoffice	0.296***	0.268***	0.237***	0.271***
		(0.057)	(0.053)	(0.048)	(0.056)
	VIX	-0.050***	-0.051***	-0.043***	-0.051***
		(0.009)	(0.009)	(0.007)	(0.009)
	ΔVIX	0.000	-0.000	-0.005	-0.003
		(0.009)	(0.009)	(0.009)	(0.009)
η_1	ΔRER	0.031	0.053	0.038	0.048
		(0.088)	(0.073)	(0.075)	(0.074)
η_2	ΔRER * Post2010	0.182			
		(0.204)			
η_3	ΔRER * Turkey	0.054			
		(0.082)			
η_4	ΔRER * Post2010 * Turkey	-0.616***			
		(0.174)			
η_1	ΔMoney Stock	0.285**	0.348***	0.270**	0.285**
		(0.111)	(0.121)	(0.113)	(0.112)
η_2	ΔMoney Stock * Post2010		-0.546**		
			(0.257)		
η_3	ΔMoney Stock * Turkey		0.067		
			(0.107)		
η_4	ΔMoney Stock * Turkey * Post2010		-1.064***		
			(0.316)		
η_1	GDP Growth	0.299**	0.302**	0.453***	0.303**
		(0.120)	(0.118)	(0.070)	(0.120)
η_2	GDP Growth * Post2010			-0.466***	
				(0.148)	
η_3	GDP Growth * Turkey			-0.289***	
				(0.070)	
η_4	GDP Growth * Turkey * Post2010			0.116	
				(0.157)	
η_1	ΔDebt to GDP	-0.300***	-0.274***	-0.268***	-0.260***
		(0.086)	(0.087)	(0.086)	(0.095)
η_2	ΔDebt to GDP * Post2010				-0.133*
					(0.079)
η_3	ΔDebt to GDP * Turkey				-0.093
					(0.114)
η_4	ΔDebt to GDP * Turkey * Post2010				-1.634***
					(0.236)
	Turkey*Post2010	-0.012**	0.012***	0.010***	0.030***
		(0.005)	(0.004)	(0.003)	(0.003)
	Constant	0.172***	0.174***	0.149***	0.175***
		(0.029)	(0.029)	(0.022)	(0.029)
	Observations	1,595	1,595	1,595	1,595
	R-squared	0.135	0.137	0.143	0.136
	Number of id	46	46	46	46
	Fixed effects	Y	Y	Y	Y

Notes. Cluster-robust standard errors in parentheses. ***,**,* denote significance level at .01, .05 and .1, respectively.

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