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Working Paper

Response of Turkish financial markets to negative interest rate announcements of the ECB

Working Paper, No. 1614

Provided in Cooperation with:

Koç University - TÜSİAD Economic Research Forum, Istanbul

Suggested Citation: Güneş, Gökhan Ş.; Öz, Sumru (2016) : Response of Turkish financial markets to negative interest rate announcements of the ECB, Working Paper, No. 1614, Koç University-TÜSİAD Economic Research Forum (ERF), Istanbul

This Version is available at:

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**RESPONSE OF TURKISH FINANCIAL MARKETS TO
NEGATIVE INTEREST RATE ANNOUNCEMENTS
OF THE ECB**

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Working Paper 1614
December 2016

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RESPONSE OF TURKISH FINANCIAL MARKETS TO NEGATIVE INTEREST RATE ANNOUNCEMENTS OF THE ECB*

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December 7, 2016

Abstract

This paper examines the impact of negative interest rate announcements of the ECB on Turkish financial markets. Negative Interest Rate Policies (NIRP) are expected to affect emerging market and developing economies (EMDEs) through an increase in the inflow of capital searching for higher yields. The expectation for an increase in short-term capital inflows to an EMDE might have transmission channels to the whole economy similar to those of expansionary monetary policies, except for a sign change in case of the exchange rate channel. The rest of the transmission channels are portfolio, interest rate, and credit channels. The latter is excluded from the analysis since it takes time to realize. Accordingly, we analyze the impact of negative interest rate announcements of the ECB on EUR/TRY and USD/TRY exchange rates; 1-month and 3-month TRLibor rates; BIST 100 Index, as well as 2-year and 10-year bond returns using GARCH (1,1) model. The results show that the announcements significantly affect both the volatility of Turkey's financial indicators and their returns especially through interest rate and portfolio channels. The robustness of the results on volatility is tested by using an event study.

Key words: NIRP, transmission channels, financial indicators, Turkey

JEL classification: E58, F30, G10

*Presented at the Koç University-TÜSİAD ERF Conference titled "An Evaluation of Negative Interest Rate Policies" in November 4, 2016. We thank to Selva Demiralp and Hamza Demircan for their support throughout the study. We also thank to İnsan Tunalı, Mehmet Yörükoğlu, and Cem Çakmaklı for their valuable comments on an earlier draft presented at the Koç University Economics Department Seminar. All remaining errors are ours.

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1 Introduction

In the aftermath of 2008-9 financial crisis, major central banks not only cut the policy rates to almost zero, they also used unconventional monetary policy tools, such as asset purchase programs, forward guidance, and credit easing to revive their economy. Although Fed announced that it would start to taper off quantitative easing (QE) policies in May 2013 in line with the strengthening of economic prospects in the US, European Central Bank (ECB) continued to use asset purchase programs. Later, facing with the decline in the net supply of eligible assets for purchase programs and downside risks to growth and inflation in the Euro area, ECB cut the policy rate to negative territory (-0.10 per cent) for the first time in June 2014. This is followed by further cuts of the same amount in September 2014, December 2015, and March 2016, reaching -0.40 per cent in total. Central banks of Sweden, Japan, and Hungary have also cut policy rates to below zero with the same motivation since the beginning of 2015. In fact, the central bank of Denmark removed the perceived lower bound of zero policy rate earlier, in July 2012, but with different motivation. As it is the case for Swiss National Bank, which cut its policy rate to negative territory in December 2014, the main reason for implementing negative interest rate policies (NIRP) in Denmark is to make investment in their currencies less attractive, so avoid currency overvaluation. It's in fact a response to deteriorating economic prospects in the Euro area, which triggered massive capital inflows to both countries.

NIRP conducted by major central banks is expected to have an impact on emerging market and developing economies (EMDEs) as well. To our knowledge, the first study on the effects of NIRP on EMDEs is a section in World Bank study by Arteta et al. (2016), which analyzes how NIRP could have an impact on financing conditions for EMDEs. It then conducts an event study to assess the average immediate impact of NIRP announcements on EMDEs financial markets. We take Arteta et al. (2016) as a starting point and focus on the movements of financial indicators of Turkey during ECB's negative interest rate announcements. First, we use GARCH (1,1) model proposed in Bollerslev (1986) to assess the immediate return and volatility effects of ECB's negative interest rate announcements on Turkish financial markets. Then, we make an event study analysis to check the robustness of volatility results obtained using the GARCH (1,1) model.

The rest of the paper is organized as follows: Section 2 analyzes the transmission channels of capital inflows towards EMDEs expected after NIRP announcements of major central banks, while Section 3 presents data and the methodology. The empirical results are given in Section 4 and Section 5 concludes.

2 The possible impacts of NIRP on EMDEs

The transmission channels of the implementation of NIRP to activity and inflation in the domestic economy are conceptually analogous to those of conventional (expansionary) monetary policies (Arteta et al. 2016). Similarly, unconventional monetary policies, including NIRP implemented by some major central banks of the world, might have impacts on EMDEs similar to those of accommodative monetary policies, such as quantitative eas-

ing (QE). International investors are encouraged to search for higher yields, which induce capital flows to EMDEs. The expectation for an increase in short-term capital inflows to an EMDE might have transmission channels to the whole economy similar to those of expansionary monetary policies, e.g. a domestic rate cut, with some minor differences:

Exchange rate channel: It is apparent that capital inflows to an EMDE result in the appreciation of its exchange rate. This channel works in reverse direction compared to a domestic rate cut where exchange rate is expected to depreciate.

Portfolio channel: There is evidence that accommodative monetary policies abroad give rise to an increase in EMDE equity prices. For example, Chen et al. (2011) find that QE policies supported EMDE equity prices. Ehrmann and Fratzscher (2006) also show that US monetary policy has been an important determinant of global equity markets, though they test it in the reverse direction. Analyzing 50 equity markets worldwide, they find that returns fall on average around 3.8 per cent in response to a 100 basis point tightening of US monetary policy, ranging from a zero response in some to a reaction of 10 per cent or more in other countries. The degree of global integration of countries and not a country's bilateral integration with the United States is a key determinant for the transmission process.

Interest rate channel: Chen et al. (2011) find that QE policies not only support EMDE equity prices, but they also compress government and corporate bond, and CDS spreads. This channel seems to be related to a decrease in risk perception. Indeed, Chen et al. (2011) find evidence that QE programs in advanced economies influenced market expectations about the strength of cross-border financial flows to emerging market economies. In other words, the announcement of QE measures in one economy contributed to easier global liquidity conditions through the immediate re-pricing of assets in global financial markets. In case of NIRP, the expectation that negative rates encourage global investors to shift cross-border financial flows from NIRP countries to others, including EMDEs may result in the immediate re-pricing of assets in EMDEs.

Credit channel: Large capital inflows could be associated with rapid credit growth and rising private sector leverage in some EMDEs. Arslan and Taskin (2014) provide empirical evidence on the relationship between capital flows and domestic credit growth using a large cross-country panel dataset which includes both developed and developing economies. Using cross-country panel data, Lane and McQuade (2013) investigate the inter-relations between domestic credit growth and international capital flows over 1993-2008, with a special focus on the 2003-2008 boom period. They establish that domestic credit growth in European countries is strongly related to net debt inflows and this pattern also holds for an extended sample of 54 advanced and emerging economies.

3 Data and the Methodology

This study analyzes the immediate response of financial indicators of Turkey to NIRP announcements of the ECB. Although the transmission channels detailed in the previous section are all triggered by actual capital inflows, we can expect immediate adjustments

in some financial indicators of Turkey due to the expectation of capital inflows in the near future.

The financial market indicators we use in this paper are nominal effective exchange rates (both Euro/Turkish Lira and US Dollar/Turkish Lira); 1- and 3-month interbank market rates; 2- and 10-year bond yields, as well as equity prices (BIST Index) for exchange rate, interest rate, and portfolio channels, respectively. We do not include any indicator for the credit channel to the analysis since the realization of this channel takes time while we test only immediate impacts. First, we employ GARCH (1,1) model proposed in Bollerslev (1986) to estimate the change in returns and variance of these financial indicators for Turkey during ECB's negative interest rate announcements.

GARCH model:

GARCH models are used in the analysis of time series data, especially financial indicators, where high-frequency data is available. These models are especially useful when the goal of the study is to analyze and forecast volatility, but it is also possible to estimate the expected value of the mean. We employ the following GARCH(1,1) specification to empirically test the impacts of ECB's NIRP announcements on Turkish financial markets:

Mean Equation

$$X_t = \alpha + \rho X_{t-1} + \beta \Phi_t + \gamma \text{Announcement}_t + \epsilon_t, \quad \epsilon_t \sim N(0, \sigma^2) \quad (1)$$

Variance Equation

$$\sigma_t^2 = \Delta + \zeta \sigma_{t-1}^2 + \eta \epsilon_{t-1}^2 + \pi X_{t-1} + \theta \Phi_t + \xi \text{Announcement}_t, \quad (2)$$

where X_t is the return of the financial indicator¹, Φ_t s are other news release shocks, and Announcement_t is the dummy for ECB negative interest rate announcements, such that

$$\text{Announcement}_t = \begin{cases} 1, & \text{on the day of the announcement } (t), \text{ at } (t-1), \text{ and at } (t+1); \\ 0, & \text{otherwise.} \end{cases}$$

X_t s are chosen in accordance with the transmission channels of capital inflows:

- For exchange rate channel EUR/TRY and USD/TRY exchange rates are used.
- Interest rate channel is accounted for by 1-month and 3-month TRLibor rates
- The indicators used for portfolio channel are:
 - BIST 100 Index
 - 2-year and 10-year bond returns
- No indicator is used for credit channel since it takes time for the realization of this channel while we test daily impacts.

¹We use daily closing price differences as the daily return of the corresponding financial variable, except for the BIST 100. For the BIST 100, we use log BIST 100. The return series are stationary.

We control for the other news release shocks, Φ_t , related to

- Current Account (CA) Balance
- Consumer Price Index (CPI): 12 month
- Gross Domestic Product (GDP) Growth: QoQ
- Industrial Production (IP): Working day adjusted YoY
- Unemployment Rate (UR): Monthly
- Policy Rate set by The Central Bank of the Republic of Turkey (CBRT),

such that $\Phi_t = \Phi_{actual} - \Phi_{expectation}$. $\Phi_{expectation}$'s are taken from the expectations surveys of Bloomberg, where all but the CA Balance are in terms of per cent and the CA Balance is measured in billions of USD. The return of the financial indicators are also taken from Bloomberg for the period between 1/1/2014 and 9/8/2016.

4 Empirical Results

GARCH model:

The results of the mean equation (1) using GARCH (1,1) given in Table 1 show that the ECB announcements have a significant impact on Turkish financial indicators through interest rate and portfolio channels. Regarding the former, 1-month TRLibor rate falls 11 basis points. The indicators used for portfolio channel imply that BIST 100 index increases by 1.7 per cent and 2-year and 10-year bond returns decrease by 7.9 and 6.5 basis points, respectively.

Table 1: Results of the mean equation 1 using GARCH (1,1)

| Dependent Variable | TRLib_1M | TRLib_3M | EUR/TRY | USD/TRY | BIST_100 | Bond_2Y | Bond_10Y |
|------------------------------------|----------|----------|-----------|-----------|-----------|-----------|----------|
| Constant | -0.002 | 0.002 | 0.011 | 0.012 | 11.268*** | -0.002 | -0.001 |
| CA_Balance_Shock | 0.003 | 0.044** | 0.001 | -0.004 | -0.008 | -0.041 | -0.056* |
| CPI_Shock | -0.033 | 0.015 | 0.016* | 0.008 | -0.034* | 0.203*** | 0.157*** |
| GDP_Shock | -0.006 | -0.103 | -0.001 | 0.002 | 0.025*** | 0.024*** | 0.052*** |
| IP_Shock | -0.016** | -0.015* | 0.000 | 0.002** | -0.002 | 0.001 | 0.008 |
| UR_Shock | 0.017 | 0.029*** | -0.021 | -0.030 | -0.000 | 0.000 | -0.122** |
| CBRT_Shock | -0.048 | 0.045 | -0.004*** | -0.003*** | -0.009 | 0.010*** | 0.011*** |
| ECB Announcement | -0.111** | -0.070 | -0.003 | -0.010 | 0.017* | -0.079*** | -0.065** |
| TRLibor Differentials ^a | | | -0.001 | -0.001 | | | |
| AR(1) ^b | 0.226*** | 0.240*** | 0.002 | 0.004 | 0.364*** | 0.069 | 0.053 |

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Results of the variance equation 2 using GARCH (1,1)

| Dependent Variable | TRLib_1M | TRLib_3M | EUR/TRY | USD/TRY | BIST_100 | Bond_2Y | Bond_10Y |
|------------------------------------|-----------|----------|-----------|-----------|-----------|-----------|-----------|
| Constant | 0.009** | 0.011*** | 0.000** | 0.000* | 0.004 | 0.013*** | 0.010** |
| CA_Balance_Shock | 0.000 | 0.008 | 0.000** | 0.000 | -0.005*** | -0.003 | -0.008 |
| CPI_Shock | 0.022*** | 0.001 | -0.001*** | 0.000 | -0.003** | 0.016** | -0.004 |
| GDP_Shock | -0.018*** | -0.027** | 0.000 | 0.000 | -0.004*** | -0.016*** | -0.014*** |
| IP_Shock | -0.001 | 0.001 | 0.000 | 0.000*** | 0.000 | 0.002 | 0.001** |
| UR_Shock | 0.032*** | 0.044*** | 0.000*** | 0.000 | 0.004** | 0.038*** | -0.006 |
| CBRT_Shock | 0.011 | 0.036*** | 0.000 | 0.000*** | 0.004** | -0.003*** | -0.001 |
| ECB Announcement | -0.008 | 0.001 | 0.000 | -0.000*** | -0.002*** | -0.011*** | -0.008*** |
| TRLibor Differentials ^a | | | 0.000 | 0.000 | | | |
| Return (-1) ^b | 0.001 | 0.002 | 0.003 | -0.001 | 0.000 | 0.020** | 0.010 |
| RESID ² (-1) | 0.098* | 0.033 | 0.125** | 0.129** | 0.134** | -0.004 | -0.016 |
| GARCH(-1) | 0.488** | 0.557*** | 0.535*** | 0.554*** | 0.439*** | 0.468*** | 0.440 |

*** p<0.01, ** p<0.05, * p<0.1

(a) In USD/TRY and EUR/TRY exchange rate specifications, we also include the interest rate differentials between Turkey vis-a-vis United States and Euro area, respectively, to account for monetary policy differences and risk perceptions related to these countries.

(b) We employ autoregressive component, which is order of 1 lag in all specifications to control for whether financial variables keep the direction of their last move.

The results of the variance equation 2 using GARCH (1,1) given in Table 2, show that the volatility falls significantly in Turkish financial indicators of USD/TRY exchange rate, BIST 100 index as well as 2-year and 10-year bond returns around ECB negative interest rate announcement dates.

In order to see whether each of four ECB announcements on NIRP has different impact on Turkish financial markets, we rerun the same specification by setting the *Announcement* dummy 1 for each ECB negative interest rate announcement date, such that

$$Announcement_{i,t} = \begin{cases} 1, & \text{on the day of each announcement } (i,t), \text{ at } (i,t-1), \text{ and at } (i,t+1); \\ 0, & \text{otherwise} \end{cases}$$

for $i=1$ to 4.

Table 3 gives the results of the impact of each ECB negative interest rate announcement on Turkish financial indicators. Although the domestic news release shocks are controlled for as it is the case for the first specification where we analyze the total effect of ECB negative rate announcements, they are not reported.

Table 3: Results of mean and variance equation for each ECB announcement

| Return | | | | | Variance | | | |
|----------|-----------|-----------|----------|-----------|------------|------------|------------|------------|
| Variable | ECB A.1 | ECB A.2 | ECB A.3 | ECB A.4 | ECB A.1 | ECB A.2 | ECB A.3 | ECB A.4 |
| TRLib_1M | -0,141 | -0,033** | -0,274 | -0,039*** | 0.0003 | -0.0124*** | 0.0017 | -0.0119*** |
| TRLib_3M | -0,186 | -0,036 | 0,016*** | -0,262* | 0.0091 | -0.0120*** | -0.0124*** | -0.0012 |
| EUR/TRY | -0,023*** | -0,020** | 0,024 | -0,002 | -0.0004*** | -0.0004*** | 0.0009 | 0.0003 |
| USD/TRY | -0,016*** | -0,008*** | 0,000 | -0,016** | -0.0003*** | -0.0003*** | -0.0002*** | -0.0003*** |
| BIST_100 | 0,023** | 0,044*** | -0,030 | 0,015*** | -0.0025*** | -0.0028*** | -0.0026*** | -0.0027*** |
| Bond_2Y | -0,123*** | -0,115** | -0,006 | -0,032 | -0.0107*** | -0.0117*** | -0.0129*** | -0.0123*** |
| Bond_10Y | -0,133*** | -0,091*** | 0,056*** | -0,055** | -0.0087*** | -0.0107*** | -0.0114*** | -0.0101*** |

*** p<0.01, ** p<0.05, * p<0.1

According to Table 3, the third ECB negative interest rate announcement has less impact on Turkish financial indicators compared to other three announcements. Leaving this announcement aside, all other announcements have expected impact on Turkish financial markets: Interest rates proxied by TRLibor rates decrease, Turkish Lira appreciates, BIST 100 Index increases, and bond returns fall. Table 3 also gives the results of the variance equation 2 for each ECB negative interest rate announcement. All of the significant results are negative implying that the volatility in Turkish financial indicators fall during each ECB announcement on negative interest rates.

Finally, we test when the ECB negative interest rate announcements affect the financial indicators of Turkey, specifically on the day before the announcement due to anticipation of it, on the day of the announcement or the day after the announcement due to delayed effects of financial markets closed at the time of the announcement.

Table 4: Results of mean and variance equation the day before, on the day, and the day after the ECB announcements

| Return | | | | Variance | | |
|----------|------------|------------------|-----------|------------|------------------|------------|
| Variable | Day before | Announcement day | Day after | Day before | Announcement Day | Day after |
| TRLib_1M | 0.002 | -0.034* | -0.131 | -0.0178*** | -0.0088** | -0.0022 |
| TRLib_3M | 0.004 | -0.007 | -0.150 | -0.0209*** | -0.0016 | 0.0056 |
| EUR/TRY | -0.019 | 0.024* | -0.024*** | -0.0001 | 0.0004 | -0.0010 |
| USD/TRY | -0.014 | -0.007 | -0.010 | -0.0004*** | -0.0003* | -0.0003 |
| BIST_100 | 0.028*** | 0.021** | 0.022** | -0.0033*** | -0.0032*** | -0.0035*** |
| Bond_2Y | -0.105*** | -0.065 | -0.064* | -0.0153*** | -0.0141* | -0.0139** |
| Bond_10Y | -0.030 | -0.091** | -0.058 | -0.0118*** | -0.0091* | -0.0106* |

*** p<0.01, ** p<0.05, * p<0.1

The analysis for the exact date of impact of ECB announcement on Turkish financial indicators reveal one puzzling result of the total impact of ECB negative rate announcements summarized in Table 1, that there is no significant impact through exchange rate channel. In line with the previous results, the USD/TRY exchange rate is still unaffected. However, Table 4 indicates that Turkish Lira appreciates against Euro on the day before (probably because financial markets expect the ECB announcement), depreciates on the announcement date, and appreciates again on the day after.

Table 4 also depicts that 1-month TRLibor rate is affected only on the day of the ECB announcement, while the effect on BIST Index is distributed among the three days, i.e. before, after and on the day of the announcement almost of the same size, between 2-3 per cent. Therefore, the effect on portfolio channel is as expected, i.e. BIST 100 Index increases and bond returns fall during these three days. Regarding the volatility analysis on the day before, on the day, and on the day after the announcement, we see that all significant results are again negative implying that the volatility in Turkish financial indicators fall around the day of ECB announcements on negative interest rates.

Event study:

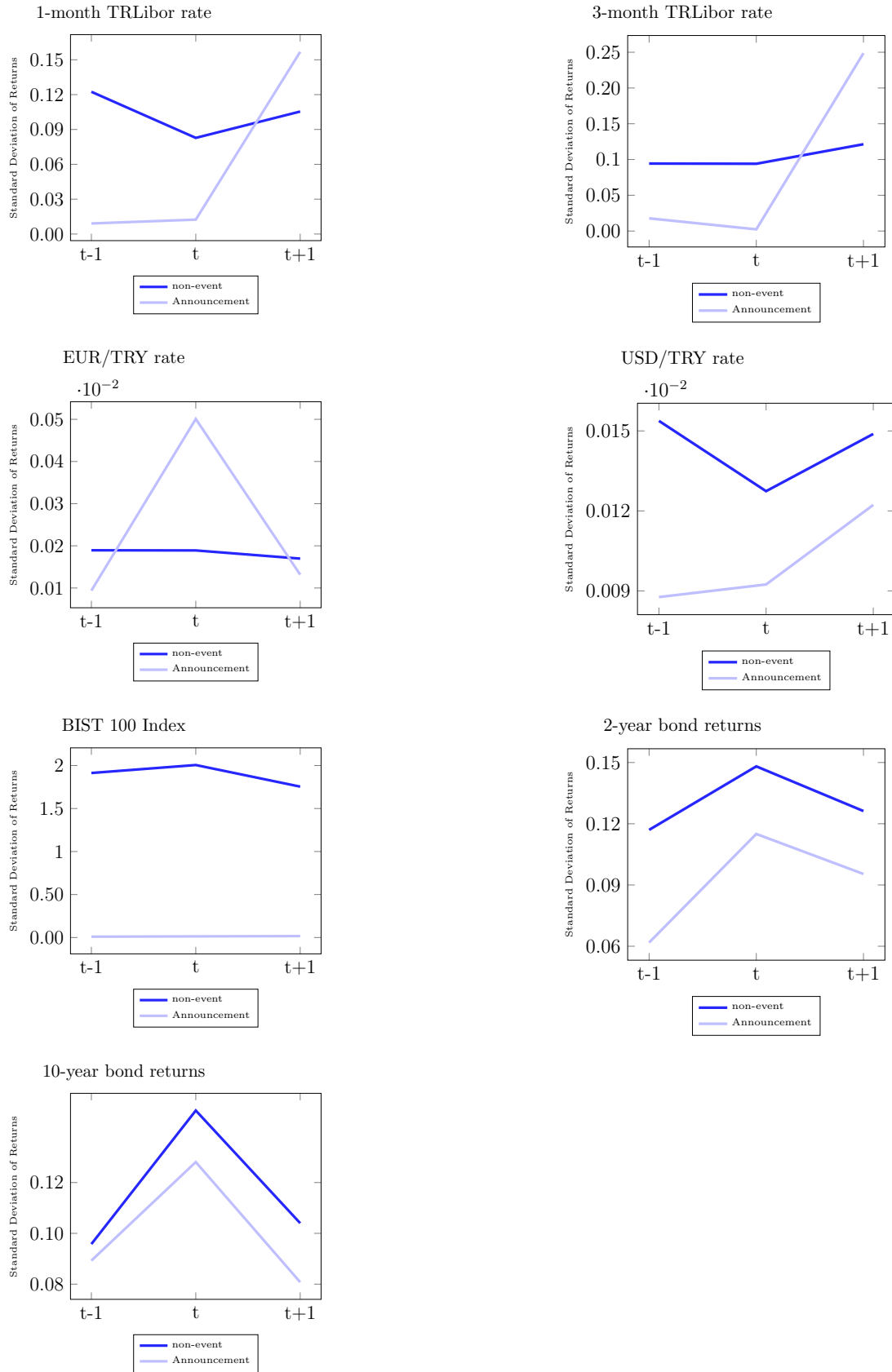
The robustness of the above results on volatility, i.e. the impact of ECB's negative interest rate announcements on the volatility of financial indicators of Turkey, is examined using an event study method employed in Rosa (2013). Rosa (2013) analyzes the effects of Federal Open Market Committee (FOMC) minutes release on the volatility of US asset prices and checks whether, and to what extent, the volatility of asset prices is higher on release days compared to nonevent days. The idea is that as long as the content of the minutes is not completely anticipated, the release of the minutes causes market participants to revise their expectations, and this should be reflected in higher volatility of asset prices compared to a period free of such an event. Since asset price volatility may be time-varying, it is important to properly control for both intraday and day-of-the-week effects when gauging whether the release of the minutes induces elevated price fluctuations (Rosa, 2013). To that end, 1) the standard deviation of the five-minute returns on release days, and 2) the standard deviation of the five-minute returns on same weekdays and hours, but on non-announcement days are compared.

Following a similar method, but using daily instead of intra-day data, we compare standard deviations of daily returns of the same financial indicators used in GARCH (1,1) analysis on negative interest rate announcement days of the ECB and that of the same weekday of non-announcement weeks. We compare the standard deviations not only on the day, but also on the day before and after the ECB announcements on NIRP with the same days of non-announcement weeks.

The ECB announcements take place on Thursdays, therefore we compare 1) the standard deviation of each financial indicator on Wednesdays, Thursdays, and Fridays for the announcement weeks with 2) the standard deviation of them on the same weekday for non-announcement weeks. We also exclude weeks of the news release shocks ² when calculating the standard deviation in non-announcement weeks to control for these shocks as we did in the GARCH (1,1) model.

²If they take place on Wednesdays, Thursdays, and Fridays.

Figure 1: Results of the event study before, after and on the day of the ECB announcements



The results given in Figure 1, show that the volatility is higher in ECB announcement weeks than that of non-announcement weeks only on the day after the ECB announcements for both indicators of the interest rate channel and for EUR/TRY exchange rate on the day of the ECB announcements. The volatility of the other financial indicators on the ECB announcement weeks is lower than the non-announcement weeks in line with the results of the GARCH (1,1) model given in Table 4.

The results of the event study related to the indicators of the interest rate and exchange rate channels, where the volatility is higher on the day after and on the day of announcement, respectively, compared to those of non-announcement weeks are also in parallel with the results of the GARCH (1,1) model given in Table 4. Although the variance of 3-month TRLibor rate and EUR/TRY exchange rate are statistically insignificant, they have positive values indicating an increase in volatility.

5 Conclusions

Negative Interest Rate Policies (NIRP) are expected to affect emerging market and developing economies (EMDEs) through an increase in the inflow of capital searching for higher yields. The increase in short-term capital inflows to an EMDE might have transmission channels to the whole economy similar to those of expansionary monetary policies at home, except for a sign change in case of the exchange rate channel, i.e. the exchange rate is expected to appreciate instead of depreciate as it is the case for expansionary monetary policies, e.g. an interest rate cut. The rest of the transmission channels are portfolio, interest rate, and credit channels. The latter is excluded from the analysis since it takes time to realize while we investigate only immediate impact.

We show that the negative interest rate announcements of the ECB affect the volatility of Turkey's financial indicators and the change in their returns using a GARCH (1,1) model, with the magnitude of the change in returns are statistically significant in case of interest rate and portfolio channel variables. Regarding the interest rate channel, 1-month TRLibor rate falls 11 basis points. The results for indicators related to the portfolio channel imply that BIST 100 index increases by 1.7 per cent and 2-year and 10-year bond returns decrease by 7.9 and 6.5 basis points, respectively. Although the total impact of all NIRP announcements of the ECB through the exchange rate channel is insignificant, announcement based analysis show that Turkish Lira appreciates against both Euro and USD during the first two announcements.

The volatility falls significantly in Turkish financial indicators related to exchange rate and portfolio channels: USD/TRY exchange rate, BIST 100 index as well as 2-year and 10-year bond returns. A detailed analysis on the exact date of the impact reveals that the volatility in these four indicators fall the day before, on the day, and the day after the announcement. The robustness of this finding is confirmed by the event study results, where we compare standard deviations of daily returns of the same financial indicators used in GARCH (1,1) analysis on negative interest rate announcement days of the ECB to that of the same weekday of all other weeks, where there is no ECB announcement and no other news release shocks. Indeed, the volatility of the four financial indicators

(USD/TRY exchange rate, BIST 100 index, 2-year, and 10-year bond returns) on the ECB announcement weeks is lower than that of the non-announcement weeks. This result implies that the ECB announcements on negative interest rates encourage global investors to shift cross-border financial flows from NIRP countries to others, including Turkey, thus help calm the Turkish financial markets.

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