ESSAYS IN MACRO-FINANCE

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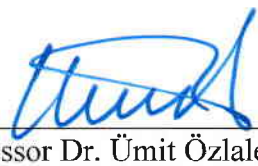

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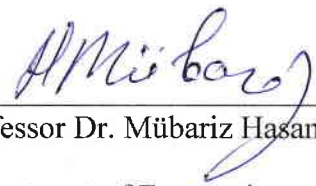

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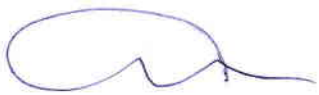

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To my beloved family

ABSTRACT

This dissertation includes three essays within macro-finance literature ranging from international macroeconomics, to labor and housing market dynamics. While the focus of first essay is more on international, particular focus of last two essays is on the Turkish economy.

In the first essay, we examine the impacts of unconventional monetary policies, stock market volatilities, and banking conditions in center economies including the US, UK, and Europe on macroeconomic and financial performance of a sample of emerging economies, which consists of Brazil, Russia, India, China, South Africa, Turkey, and Indonesia over the period between 2009:M1 and 2017:M12. Using dynamic factor modelling approach, we find significant roles of asset purchase program by the Fed, volatility conditions in the UK, and European banking conditions in shaping the global financial and economic conditions.

Second essay investigates the role of sentiment, which is aggregate investor attitude, in explaining asset prices within housing market framework. We uncover the long run relationship among sentiment, housing credit and prices, and supply in Turkish housing market over the period between 2010:M1 and 2018:M6. We find that the sentiment is significant in forecasting housing credit and supply in the short run. The sentiment is also a significant factor at work in explaining the housing prices and supply of dwellings in the long run.

The third essay is at the intersection of corporate finance and labor market. We examine the effect of going public on employment level in firms. Moreover, we investigate the main motivation behind issuing equity by considering the use of capital

raised at initial public offerings (IPO) date. To do so, we consider IPO listed firms in Borsa Istanbul (BIST) and use annual data from financial reports between 2000 and 2016. We find that accessing public equity market has positive impact on employment growth through accessing debt market. As their borrowing abilities improve, firms tend to increase their expenditures on physical capital. In turn, firms need to hire more employees to run their operations. When compared to mature firms, young firms have higher employment growth. Moreover, we find that the labor productivity is higher for large firms.

ÖZET

Bu tez, makro finans literatürü dahilinde uluslararası makroekonomiden istihdam ve konut piyasası dinamiklerini içeren üç makaleden oluşmaktadır. Birinci makalenin odak konusu daha çok uluslararası ekonomi iken son iki makalenin odak konusu Türkiye ekonomisidir.

Birinci makalede; Amerika, İngiltere ve Avrupa'yı içeren merkez ekonomilerdeki geleneksel olmayan para politikalarının, borsa oynaklıklarının ve bankacılık koşullarının Brezilya, Rusya, Hindistan, Çin, Güney Afrika, Türkiye ve Endonezya'dan oluşan gelişmekte olan ülkelerin makroekonomik ve finansal performanslarına 2009:Ocak ve 2017:Aralık dönemleri arasındaki etkileri incelenmektedir. Buradan hareketle, dinamik faktör modellemesi yaklaşımının kullanılarak, Amerika Merkez bankasının uyguladığı varlık alım politikasının, İngiltere'deki oynaklık koşullarının ve Avrupa'daki bankacılık koşullarının küresel finansal ve ekonomik şartları üzerindeki etkin rolleri olduğuna ulaşılmaktadır.

İkinci makalede; konut piyasası çerçevesinde yatırımcı davranışlarının varlık fiyatlarının açıklanmasındaki rolü incelenmektedir. Türkiye konut piyasasında, 2010:Ocak ve 2018:Haziran döneminde algı, konut kredisi, konut fiyatları ve konut arz miktarı arasında uzun dönemli bir ilişki olduğu ortaya çıkmaktadır. Algı, kısa dönemde konut kredisi ve konut arz miktarının tahmin edilmesinde etkiliyken, uzun dönemde konut fiyatlarının ve konut arz hareketlerinin açıklanmasında önemli bir faktör olarak dikkat çekmektedir.

Üçüncü makalede ise kurum finansı ve istihdam piyasası alanlarının kesişimi yer almaktadır. Bu kapsamda, 2000 ve 2016 yılları arasında Borsa İstanbul'da bulunan

firmaların halka arz edildiklerinde elde ettikleri sermayenin kullanımı ve firma istihdam düzeyi üzerindeki etkileri incelenmektedir. Bunun sonucunda, hisse senedi piyasasına erişimin, borç piyasasına erişim yoluyla, istihdam büyümesi üzerindeki olumlu etkisi olduğuna ulaşılmaktadır. Borçlanma yetenekleri geliştikçe firmalar, fiziksel sermaye harcamalarını arttırma eğilimindedirler. Bunun dönüşü ise operasyonlarını devam ettirebilme adına daha fazla işçi istihdam etmeleri olarak karşımıza çıkmaktadır. Olgun firmalara kıyasla, genç firmalar daha fazla istihdam artışı tecrübe etmektedirler. İlaveten, işgücü verimliliğinin büyük firmalar için daha fazla olduğu sonucuna ulaşılmaktadır.

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I felt myself extremely lucky in pursuing my PhD studies at Özyeğin University thanks to its academic environment and library opportunities. I am also grateful to administrative staff of Graduate School of Business at Özyeğin University for their assistance and administrative matters.

Inspirational courses that I took at Özyeğin University, University of Vienna, and Bilkent University constitute the contents of chapters presented in this thesis. Therefore, I am also grateful to the faculty members, whom I took courses during my graduate studies. I have learned a lot from them, and they improve my knowledge of finance, economics, and research. I am also very indebted to Hüseyin Çağrı Sağlam, Emin Karagözoğlu, and Hakan Berument for their invaluable support at the beginning of this journey.

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CHAPTER I

INTRODUCTION

> Industrial countries are most concerned that domestic aggregate demand be set at the level that best fosters price stability and a return to full employment at home. In contrast, many emerging market economies may be concerned not only with the level of domestic demand (as needed to achieve objectives for employment and inflation) but with other considerations as well. First, expansionary policies in the advanced economies that, all else being equal, tend to cause the currencies of emerging market economies to appreciate, restraining their exports. Second, because many emerging market economies have financial sectors that are small or less developed by global standards but open to foreign investors, they may perceive themselves to be vulnerable to asset bubbles and financial imbalances caused by heavy and volatile capital inflows, including those arising from low interest rates in the advanced economies. (Bernanke, 2013)

The real economies and financial markets have been rapidly becoming interconnected due to financial openness. Therefore, following and understanding the global economic and financial conditions is important for a world, in which economies have deep economic and financial integration.

According to what Bernanke (2013) stated, not only expansionary policies but also contractionary conditions in advanced economies have spillover effects on financial markets and real macroeconomic conditions in the rest of global economies.

The global financial crisis in 2008 affects the returns of asset prices, the directions and volume of capital flows, the credit conditions, the performance stock markets, the dynamics of labor and housing markets in both advanced and emerging economies. Advanced economies follow expansionary policies, which may also have impacts on emerging economies, to recover and stimulate their own economies.

Heterogeneous characteristics across countries lead each of them to react differently to expansionary and contractionary conditions in terms of timing and intensity.

This thesis contributes to empirical literature on the spillover effects of conditions and policies conducted in major advanced economies on the emerging economies. Moreover, we observe heterogeneity across the responses of emerging economies. Our particular horizon covers the period after the global financial crisis. This period is unique because it covers a large volume of capital flows into emerging economies. In the second chapter, our work relies on international dimension. In the third and fourth chapters, we consider Turkey as our particular focus economy.

The second chapter studies the dynamic interactions among advanced economies and developing economies. The traditional literature considers the US as the main driver of global financial and economic conditions. However, we have little known about the global impacts of conditions in the UK and Europe. Therefore, asking whether the UK and Europe play a significant role in shaping the global financial and economic conditions becomes important. To serve our aim, we consider Brazil, Russia, India, China, South Africa, Turkey, and Indonesia as emerging economies, which have deep connection in financial and economic system.

To observe the role of each candidate advanced economies, we consider both expansionary and contractionary conditions. As expansionary policies, we consider asset purchase programs conducted by each of the central banks in the US, UK, and Europe. To identify the contractionary conditions, we consider stock market volatilities and a measure of liquidity conditions in the advanced economies. Our variables of interest to us for emerging economies are as follows: country risk premium, equity returns, real effective exchange rates and foreign exchange reserves.

Using dynamic factor modelling (DFM) approach enables us to capture dynamic interactions via impulse response functions and to compare responses of each variables across countries via asymmetry tests.

Our analyses in this chapter rise important results. First, the monetary conditions by the Fed, stock market volatility conditions in the UK, and European banking system play significant role in shaping the global financial and economic conditions. This result calls academicians and policy makers in emerging economies to follow conditions in different major regions to shape their own future policies. Second, we observe heterogeneity across emerging economies to same external shocks. This finding highlights the fact that individual characteristics of each emerging economies should matter. Third, our asymmetry test results suggest us to consider volatility conditions as the global indicator because we do not observe heterogeneity across emerging variable when they are hit by the volatility conditions.

In the third chapter, we study the housing market dynamics in Turkey. Historical housing prices in the US and Europe had reached their peak points right before the crisis erupted in both regions. This brings an important question into discussion: is an upward trajectory in housing prices a signal for financial instability?

To recover the devastating consequences of financial crisis in 2008, major central banks decrease interest rates to zero lower bound (ZLB) and conduct asset purchase programs. These expansionary monetary policies relax credit conditions in emerging economies, as well. However, such credit conditions in the housing market lead to housing price appreciations.

It is worth to understand the behavior and determinants of housing prices in emerging economies. The literature on the determinants of housing prices considers credit as the main driver of housing price appreciations. There is also an increasing number of

studies that consider psychological factors in explaining the appreciation in housing prices. These recent attempts highlight the importance of studying non-fundamentals within housing market framework.

This study, to best of our knowledge, is the first to investigate the role of sentiment within housing market framework in Turkey. We examine the long run level relationship among sentiment (aggregate investor attitude), housing credit, housing prices, and supply in the housing market within bounds testing approach over the period 2010:M1 and 2018:M6. Moreover, we investigate the causal relations among these variables. We also set up counterfactual scenarios to investigate how the path of housing prices behave in response to change in credit volume and sentiment.

We have important findings. First, bounds testing approach suggests that there is a long run relation among stated variables. Second, causalities running from sentiment to supply and to housing credit indicate the short run predictive power of sentiment. Third, we have one-way causation running from housing credit to housing prices. Fourth, estimation results suggest that sentiment is also a long run factor at explaining the housing prices. As a fifth result, housing prices are sensitive to change in sentiment as in credit volume, but with a lesser magnitude. Overall results highlight the role of sentiment in housing market framework.

In the fourth chapter, we investigate whether going public has impact on employment decision in a firm. Issuing initial public offerings (IPOs) is one of the most important events in a firm's life. At the same time, labor is the main input for operations of a firm. Firms in an economy hit by the financial crisis should consider different funding schemes to make corporate decisions and sustain their operations. Accessing external equity market is one way to feed the operations in a firm because going public relaxes financial constraints of a firm.

The literature on IPOs is very rich. However, there is little known about the impacts of going public on employment level in a firm. To investigate the effects of capital raised at IPO on employment growth in a firm, we consider IPO listed firms in BIST over the period between 2000 and 2016.

To observe the employment growth performance in a firm, we consider the time horizon starting from the pre-IPO period and to subsequent three periods ahead of the IPO event date. We conduct several regressions and find that there is an association between going public and employment growth in firm.

We have a number of results regarding the IPO effect on corporate decisions. First, we estimate whether IPO listed firms experience employment growth around their IPO event year and find that the firms increase their employment levels. Second, we conduct test to investigate the role of capital raised at IPO date on employment growth and find that primary proceeds do not have direct impact on employment growth. Then, we estimate the role of internally generated funds on employment growth. We use pre-IPO asset growth as the proxy for internal funds. Our findings suggest that internal funds have effect on the employment growth. Fourth, we find that going public leads firm to access debt market, which improves its borrowing ability. This result is consistent with the literature on IPO motivations of a firm. Fifth, firms invest in physical capital have higher employment growth. This result suggests that the firms require more workers to hire to run its operations. As a sixth result, young firms experience higher employment growth. Lastly, we move to investigate the relation between firm size and labor productivity and find that large firms have higher labor productivity.

CHAPTER II

HETEROGENEOUS EFFECTS IN TRANSMISSION OF COMMON SHOCKS: A DYNAMIC FACTOR MODEL ON EMERGING ECONOMIES[1]

2.1 Introduction

Focusing on the monetary policies implemented by the central banks in advanced economies, recent studies show that there is an increasing correlation between cross border financial flows and total credit growth, which confirms the financial connectedness (Cerutti, Claessens, & Ratnovski, 2017; Lane & Milesi-Ferretti, 2007; Passari & Rey, 2015). Deepened economic and financial integration across economies induce researchers to seek factors, which identify the nature of global economic and financial conditions at best to shape their own national future policies.

From the standpoint of an economy, the behavior of capital flows, global integration, and external assets and liabilities are important to ease risk sharing. Therefore, tracking the external balance sheet of countries is important to understand the global financial conditions. With this regard, the composition of the US external balance sheet is notable as it has a special role of being center of global monetary system and the US monetary policy is the driver of global financial cycle, i.e., co-movement in capital flows, asset prices, and credit growth (Rey, 2018). There is a dense literature, which

[1] This is a coauthored work with Burak Alparslan Eroğlu.

identify the US as the driver of the global financial conditions because monetary, credit and liquidity conditions in the US play prominent role in shaping the global financial conditions (Bekaert, Hoerova, & Lo Duca, 2013; Bhattari, Chatterjee, & Park, 2018; Bruno & Shin, 2015; Forbes & Warnock, 2012; Rey, 2018; Weale & Wieladek, 2016).

However, testing the importance of other major centers is scarce in the literature. A recent study explores whether financial conditions in Europe (Euro area and UK) play significant role on global liquidity conditions (Cerutti et al., 2017). In their panel estimation, they consider both US and European macroeconomic and financial factors and find that the global conditions are best described by US monetary policy implementations and exchange rates and European banking conditions.

Understanding the role of different centers, the US, UK, and Euro Area, in shaping the global financial environment would be important especially for the emerging economies[2] that are sensitive to these major economies. In this context, we consider Brazil, Russia, India, China, South Africa (hereafter, BRICS), Turkey, and Indonesia in our sample of emerging economies, which take a significant part in global trading, economic and financial interactions[3]. As suggested by the recent literature, in terms of magnitudes, emerging economies display more sensitive reactions to external economic and financial shocks relative to advanced economies (Bhattari et al., 2018; Chen, Filardo, He, & Zhu, 2015; Korniyenko & Loukoianova, 2015)

Trade linkages, geographical locations, financial openness, macroeconomic characteristics, financial market structures, and risk premiums of emerging countries would be items that absorb shocks triggered from different sources at different

[2] An emerging economy integrated with the global markets with respect to economic and financial linkages have important spillovers from the rest of the world.
[3] BRICS, Turkey, and Indonesia account for 25% of World GDP in 2018 (FRED Economic data).

magnitudes. This raises interesting questions; in what extent do the major economies create heterogeneity regarding the response of emerging economies? How asymmetric, if any, do the emerging economies behave in response to shocks triggered from the advanced economies? This paper seeks answers to these questions by examining the interactions between advanced and emerging economies by using a dynamic factor modelling approach.

To study dynamic interactions, we consider macroeconomic and financial factors that may have impact globally. The literature introduces various indicators that capture the global financial conditions after the recent financial crisis in 2008. Specifically, the recent literature view unconventional monetary policies[4] proxied by the asset purchase programs (Bauer & Neely, 2014; Glick & Leduc, 2012; Kapetanios, Mumtaz, Stevens, & Theodoridis, 2012; Lenza, Pill, Reichlin, & Ravn, 2012; Baumeister & Benati, 2013; Gagnon, Raski, Remache, & Sack, 2011; Korniyenko & Loukoianova 2015; Bhattarai et al., 2018); stock market volatilities as a measure of investors' uncertainty and risk appetite (Bekaert et al., 2013; Bruno & Shin, 2015; Chen et al., 2015; Forbes & Warnock, 2012; Garcia-Escribano & Han, 2015; Josifidis, Allegret, Gimet, & Pucar, 2014; Rey, 2018); risk attitudes and lending abilities of banks (Bruno & Shin, 2015; Cerutti et al., 2017; Coimbra & Rey, 2019; Garcia-Escribano & Han, 2015) as the main factors shape the global conditions.

[4] Design and implementation of monetary policies in advanced countries have both domestic and international spillover effects. The liquidity injection via asset purchase programs increases output and asset prices; however, on the other hand, contributes to economic overheating and asset market excess in some regions due to the large currency appreciation and capital inflow pressures.

Bekaert et al. (2013) characterize the interaction between components of VIX, i.e., risk aversion and uncertainty, and monetary policy stance in a Structural VAR[5]. Their results indicate that lax monetary policy lowers risk aversion on stock market over the period of 1990:M1 and 2007:M7. Furthermore, their test explores that the uncertainty component of the VIX plays more prominent role on business cycle. Josifidis et al. (2014) investigate monetary policy responses to financial shocks over two periods, 1995:Q1-2001:Q4 and 2002:Q1-2010:Q4, of ten EMEs with Structural Bayesian VAR. In the first crisis period, their results indicate that the GDP decreases in response to a positive shock on EMBI and VIX. An increase in EMBI and VIX lead to capital outflows from EMEs. However, two volatility shocks have short lived impacts on EMEs. The second crisis period, in which the financial openness relaxes, reveal that GDP of each EMEs' decreases and these economies experience net capital outflow with a higher amplitude, when compared to first period, in response to external shocks. Interest rates increase in the aftermath of a shock on EMBI and VIX. The change in reserves displays the growing impact of VIX in the second sub period, in which financial integration strengths. An interesting result emerges, the exchange rate in Turkey appreciates in the first sub-period, however, depreciates in the second crisis period. An empirical investigation by Dahlhaus, Hess, and Reza (2014) provides an evidence of spillover effects and transmission mechanism of US QE on Canada via Factor Augmented VAR (FAVAR), which employs 122 US and 149 Canadian variables ranging from 1983:Q1 through 2013:Q3. Key results

[5] Due to seminal contribution of Sims (1980), a collection of VAR models seem to be general to conduct analyses in recent literature of applied macroeconomics and finance to capture dynamic interdependencies. Different versions of VAR methodology have been used in the literature; VAR (Balatti, Brooks, Clements, & Kappou, 2018; Bhattari et al., 2018; Bruno & Shin, 2015; Garcia-Escribano & Han, 2015); Bayesian VAR (Weale & Wieladek, 2016); Factor VAR (Choi, Kang, Kim, & Lee, 2017; Dahlhaus, Hess, & Reza, 2014); Structural VAR (Bekaert et al., 2013).

are as follows: expansion in US balance sheet reduces the 10-YR TRSRY spread and increases GDP by 0.023. Domestically, asset prices increase, and lending conditions relax. On the other hand, corporate spread declines, in turn, investment and consumption increases. From the viewpoint of Canada, long-term asset holdings in the US reduce 10-YR Canadian government bond spread. As what the US experience, GDP, consumption and investment in Canada increases. Results also show that the transmission into Canadian economy occurs via financial channel. Chen et al. (2015) examine cross border effects of QE on real activity of 17 countries by conducting a global vector error correction model (GVECM) employs monthly data over 2007 and 2013. Two GVECMs for the US monetary policy shock are constructed in terms of the term spread, 10YR TRSRY – 3M TRSRY, (corporate spread, AAA- EFFR). In response to a term spread shock, real GDP and credit growth, and VIX display a positive reaction. However, CPI and equity prices decline. Corporate bond spread model delivers different results in terms of equity prices and CPI. Developing countries are more sensitive to corporate spread shocks rather than term spread shocks. Korniyenko and Loukoianova (2015) conduct regressions to test whether and in what extents unconventional monetary policy measures implemented in the US, UK, Japan, and Euro area have impact on global monetary and liquidity conditions. Their sample consists of 103 EMEs and 28 advanced countries. Quarterly tests employ VIX, real GDP growth, inflation, real exchange rate, export growth, and total assets of banks for the period of 2002:Q1 through 2014:Q2. The findings show that impacts of monetary policies differ depending on the characteristics of each program and economic conditions in each country. However, in general, policies have significant impact on liquidity conditions in EMEs. Bruno and Shin (2015) analyze impacts of monetary policy transmission of US on domestic and international dimension by conducting VAR. They consider VIX, real federal funds target rate, leverage, and real

effective exchange rate in their sample between 1995:Q4 and 2007:Q4. For the domestic dimension, they find that the monetary policy has significant impact through risk taking channel. Test for international dimension requires them to set a new VAR including federal funds rate, leverage, BIS banking flows, VIX, and real effective exchange rate. Their distinct finding through this analysis is that the US dollar plays a prominent role in global banking system. Garcia-Escribano and Han (2015) investigate the impact of credit expansion on GDP growth of EMEs by using quarterly data span over 2002:Q1 and 2012:Q4 period in VAR set up. To capture the global funding cost and risk aversion, they employ LIBOR rate and VIX, respectively. Their panel study considers corporate, consumer, and housing credits and reveals that corporate credit shocks have positive impact on GDP growth via investment channel, while consumer credit shocks influence GDP growth through consumption channel. Weale and Wieladek (2016) examine the announcement effects of large-scale asset purchases of government bonds on real GDP and CPI in BVAR by using monthly data from 2009:M3 to 2014:M5 for the US and UK. An announcement shock worth 1% of nominal GDP leads to an increase about 0.58% (0.25%) of real GDP and 0.62% (0.32%) in CPI in the US (UK). They also find that portfolio rebalancing (signaling) channel operates in the US (UK). Moreover, asset purchases reduce uncertainty in both countries. With respect to transmission channels, they find that portfolio balance (risk-taking) channel playing a role in the US (UK). Choi, Kang, Kim, and Lee (2017) employ FAVAR to observe how global liquidity stem from advanced economies affects EMEs. To do so, the authors take G5 countries, namely, US, UK, France, Germany, and Japan as advanced economies and the Czech Republic, Hungary, Israel, Korea, Mexico, the Philippines, Poland, Romania, Thailand, and Turkey as EMEs. The authors consider three momenta for global liquidity: policy-driven, market-driven, and risk averseness. VAR including quarterly macro financial data for 1990:Q1-

2014:Q3 delivers that policy-driven global liquidity increases stock prices and output as well as capital flows into EMEs, while risk averseness weakens EMEs' output, CPI, stock prices, and local currencies. Moreover, market-driven liquidity boosts stock markets and lowers borrowing costs. Bhattari et al. (2018) examine the spillover effects of US QE on thirteen emerging markets classified by the IMF including so-called fragile five. Their VAR approach employs securities held outright by the Fed as the proxy for unconventional monetary policy conditions in the US. Moreover, they consider monthly macro and financial variables from 2008:M1 to 2014:M12 for the US and EMEs. Internally, expansionary monetary QE shock decreases long term Treasury yields and increases asset prices in the US. Spillover effects are also significant as US QE shock appreciates domestic currencies of EMEs. Moreover, a positive shock on US QE peaks credit flows into EMEs. Among the EMEs, the results show that fragile five economies, i.e., Brazil, India, Indonesia, Turkey, and South Africa, respond more strongly to impulse triggered from QE shock. The most distinctive outcome is that the response of exchange rates and long-term bond yields is almost four times larger for these economies than to that of rest of EMEs.

To sum up, those who studied spillover effects of large scale asset purchase programs find appreciation of currencies and asset prices, reduction of interest rates in emerging markets, increase in capital flows to emerging economies. Common findings of studies made on the effects of stock market volatilities and banking distress conditions in major economies on emerging economies are as follows: a reduction in equity returns and capital flows, weak performance of national currencies, a contraction in credit conditions.

To uncover the dynamic heterogeneities and their sources in globalized environment, working with high dimension data becomes more realistic as there is a

strong co-movement among macroeconomic and financial time series. Due to its methodological advantage, factor modelling approach becomes preferable because it can deal with the curse of high dimensionality. Recent studies confirm that modelling performance of DFM is stronger than to that of VAR models. Hence, the use of DFM has been expanding in the literature (Alessi & Kerssenfischer, 2019; Barigozzi, Conti, & Luciani, 2014; Corsetti, Duarte, & Mann, 2018; Kerssenfischer, 2019; Stock H. & Watson, 2005).

Our paper is similar to Cerutti et al. (2017) but differs in two dimensions. First, while their measure of monetary policy is federal funds rate, we are interested in the effects of large scale asset purchase programmes as unconventional monetary policy. We believe that federal funds rate may not capture actual impact of monetary policy decisions in post-crisis period. Therefore, we consider amount of actual amount of securities held outright in balance sheet of central bank of each center economies. Second, their estimation results rely on panel regresion but ours are on impulse reponses obtained through dynamic factor modelling (DFM) as in Barigozzi et al. (2014) and Corsetti et al. (2018). We exploit the advantages of DFM in the following dimensions. First, DFM is advantageous over VAR in terms of parameterization such that the DFM is a less parameterized approach. However, setting up country-by-country VAR models is costly in terms of time and parameterization. Second, DFM approach allows us to take all possible interactions among variables across countries. On the other hand, country specific models may lack of possible expected interactions with other economies. Overall, DFM provides us the heterogeneous dynamic effects across economies together with less parameterization. Moreover, DFM allows us to obtain consistent pairwise differences across impulse responses.

Regarding the discussion and questions raised, this chapter tests the following general hypothesis: Emerging economies exhibit asymmetric responses to the expansionary and contractionary economic and financial events in major economies. We argue that the roots of these effects should not be restricted to the US only. Contrary to general traditional idea, we consider economic and financial factors of the UK and Euro Area that they have significant impacts globally, as well. We find that monetary policy decisions by the Fed, stock market volatilities in the UK, and banking conditions in Europe capture global financial and economic conditions. Moreover, our results suggest that the responses of variables in emerging economies display heterogeneity to similar external shocks.

The paper proceeds as follows: Section 2 provides recent developments in the global economy after 2009 and the related literature. Section 3 introduces data and econometric methodology with specification. The empirical evidence is presented in Section 4. Finally, Section 5 concludes the paper.

2.2 Global Conditions After 2009 and Related Literature

The impacts of the financial crisis in the US economy spread globally and had spillover effects on real economies and financial markets. To restore the markets, central banks hit their main policy rates very close to zero lower bound (ZLB). Panel A of Figure 2.1 displays the sharp decrease in short interest rates in advanced economies starting in early 2009. However, ZLB approach failed to overcome the devastating impacts of crisis, which led central banks to conduct unconventional monetary policies[6] to recover and stimulate their economies and financial markets. To do so, they conduct open market operations, i.e., large scale asset purchases[7] (LSAP), to bring down the long-term interest rates. With the help of such policies, they aim to affect asset prices and the level of output. Programs expand monetary base and improve credit conditions. The structures of programs, which expand balance sheets[8], differ across central banks[9]. Panel B displays the time series behavior of inflation in major economies. Although Euro area experienced deflation in 2009:Q3 and zero inflation between 2015:Q2 and 2016:Q3, overall inflation in each region is around 2%. Stock market volatility indices shown

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[6] Conventional wisdom of central banks requires them to buy and sell debt securities. These transactions in the bond market shape the short-term interest rates and affects the monetary base. The changes in interest rates and monetary base have impact on liquidity and credit conditions, and asset prices. However, such purchases may not be applicable and effective on interest rates when they are very close to zero because of the substitution effect. Once the interest rates are at their rock bottom points unconventional monetary policies involve asset purchases and direct lending to banks are addressed to ensure good financial conditions and stimulate the economy.

[7] From theoretical perspective, changes in asset prices are not necessarily the result of bond purchases. If the balance sheet of government changes through asset purchases while holding the government expenditures and income distribution fixed, namely, an unchanged fiscal policy, the equilibrium price and consumption stream do not change. With this respect, this implementation has no impact and becomes irrelevant, *Wallace Neutrality.* (Wallace, 1981)

[8] During the programs, the Fed, BoE, an ECB expand their balance sheets up to around 4,5 trillions of dollars, 450 billions of sterling, and 2,5 trillions of euros, respectively. See Table A2.7-9.

[9] More detailed information on LSAP of each central banks -Federal Reserve (Fed), Bank of England (BoE), and European central bank (ECB) -can be found on the following websites;
https://www.federalreserve.gov/monetarypolicy/bst_openmarketops.htm
https://www.bankofengland.co.uk/markets/quantitative-easing-and-the-asset-purchase-facility
https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html#cspp

in panel C exhibit a joint movement over the whole period. The peak points in the beginning of 2009 and in the end of 2011 are due to financial crisis in the US and sovereign debt crisis in the Euro area, respectively. The time series of TED spread is displayed in panel D. In the last quarter of 2011, liquidity conditions in the Euro area distinguishably worsened once the crisis has erupted.

Due to financial crisis in 2008, credit default swaps of emerging economies reach highest points relative to their own averages in the beginning of 2009. Over the horizon, there is a high correlation across CDS values as shown in panel A of Figure 2.2. There are two striking points we observe in the time series of CDS values. Russian CDS value increase dramatically in the end of 2014 because of the sanctions imposed by the U.S. upon their invasion in Ukraine. Due to corruption scandals, political instability increased the riskiness of Brazil in the international area around the beginning of 2016. Panel B in Figure 2.2 displays the performance of national currencies of emerging economies in our sample. While there was a joint movement among all currencies up to 2011, the currencies started to move in separate directions afterwards. Yuan is the currency that performs better than the rest of national currencies. The sharp decline in Russian ruble coincides with the political sanctions imposed by the US. As the Fed announced to end its quantitative easing program, almost all of the national currencies started to depreciate. By the end of our sample period, Turkish lira was the worst performed currency in the sample.

The combination of political uncertainties, high current account deficit and external debt stocks cause the Turkish lira being the weakest currency among other currencies. Panel C exhibits the time series of current account deficit as a percentage of GDP for emerging economies in our sample.

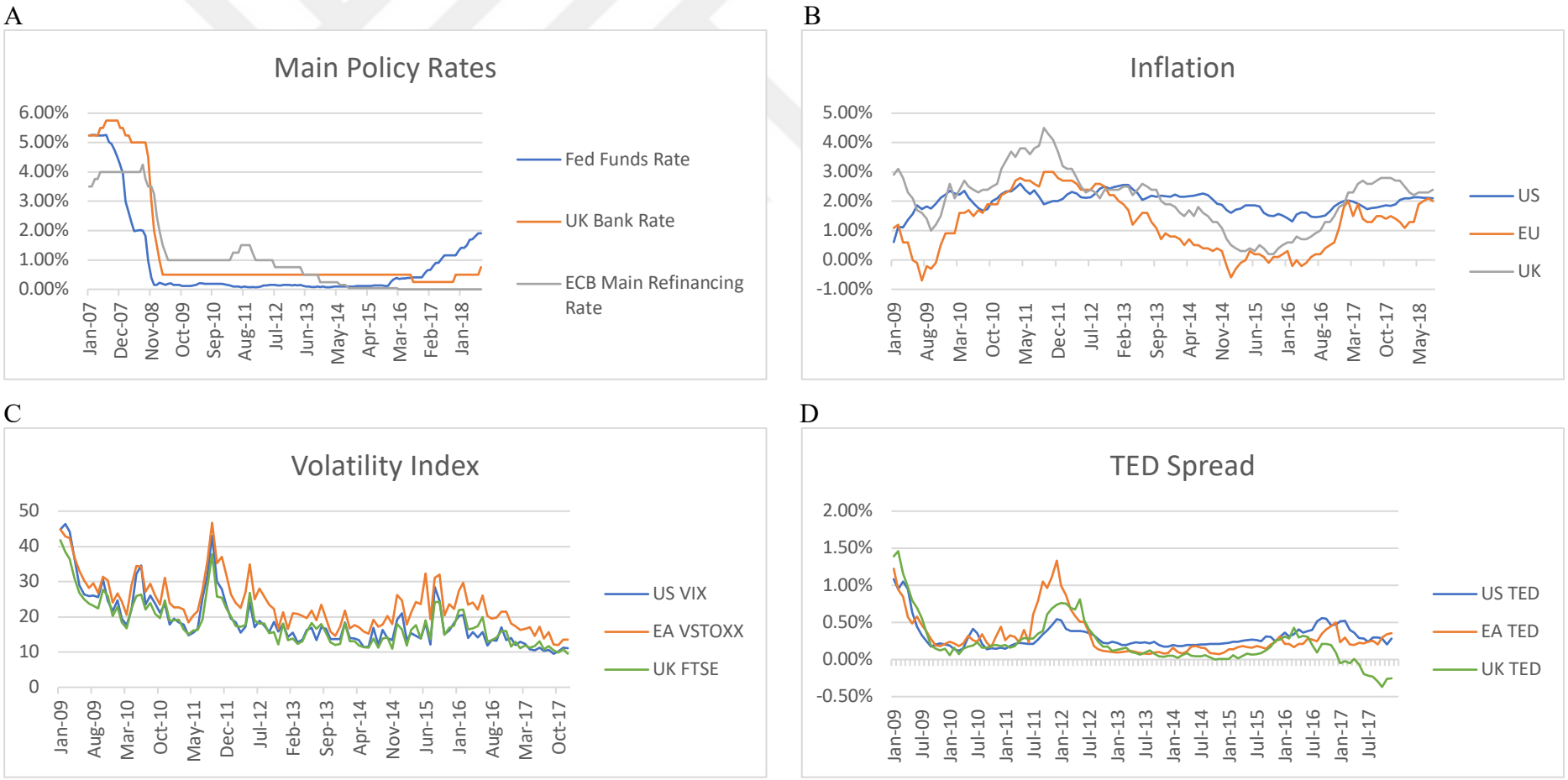

Figure 2.1: Time series of main variables in major economies
(Source: IMF IFS and Fred St. Louis)

Except for the Russia and China, all emerging economies in our sample run current account deficit. Particularly, Turkey has the highest deficit over the horizon. Panel D displays the external debt stocks of economies. As shown by the time series of external debt as a percentage of gross national income in each emerging economies, the situation is much more severe for Turkish economy.

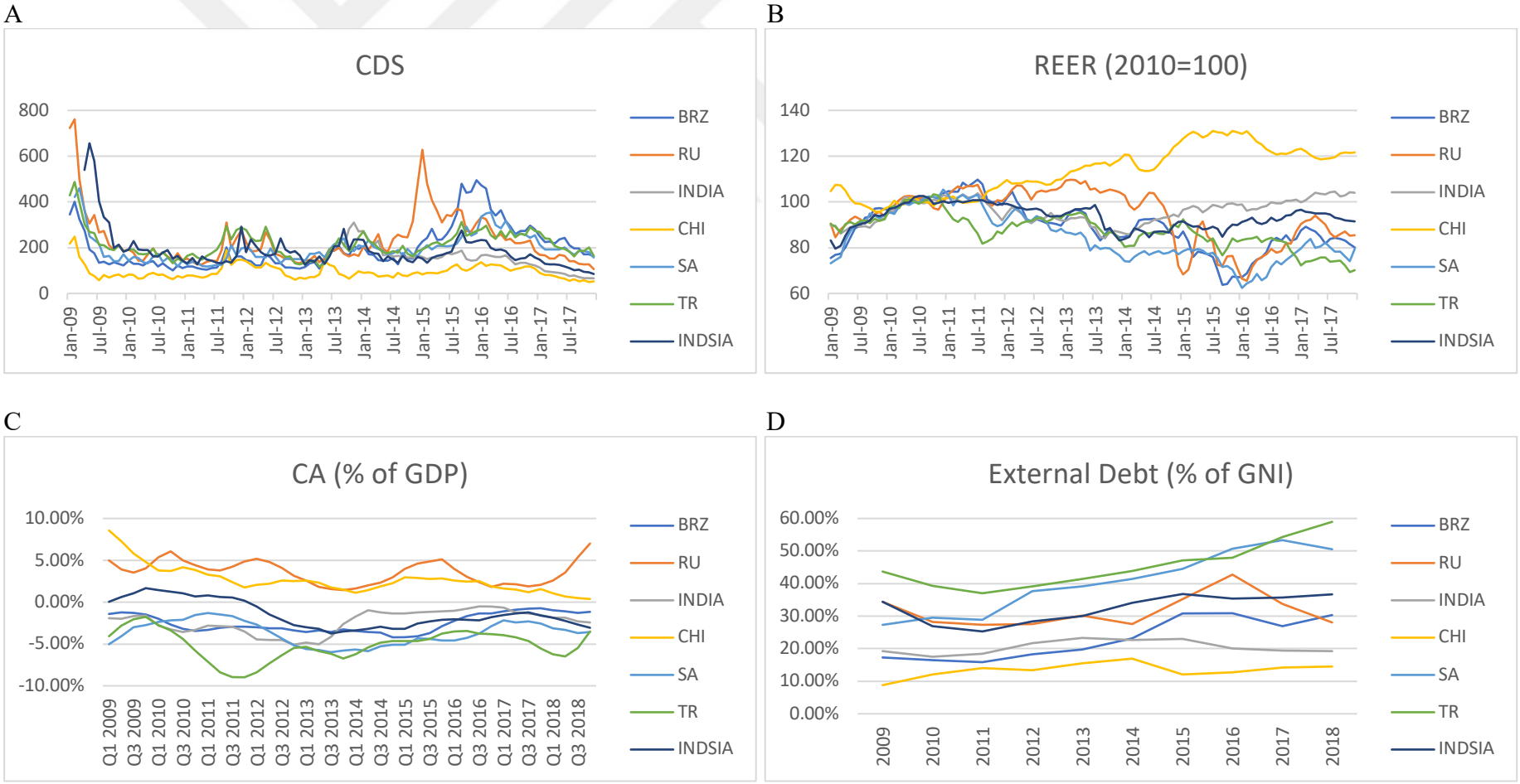

Figure 2.2: Time series of main variables in EMEs
(Source: Bloomberg and IMF IFS)

2.3 Data and Methodology

2.3.1 Data

In this paper, we use monthly data on macroeconomic and financial conditions in economies under consideration in this study from 2009:M1 to 2017:M12. This span captures the spillover effects of capital flows and unconventional monetary policy decisions by the Fed, BoE, and the ECB.

Once the conventional monetary tools fail to overcome the resulting effects of the financial crisis, central banks in major advanced economies follow unconventional tools. The Fed, BoE, and ECB purchased large scales assets to drive down long-term interest rates to stimulate their economies. These market operations, which have global effects, expand their balance sheets. Therefore, it is important to evaluate the impacts of balance sheet expansions of these central banks on our sample of emerging economies. Statements and reports released by the central banks are useful in obtaining the information on the balance sheet. We use sum of total asset purchases in each program as a proxy for monetary policy decisions by each of the central banks in the US, UK, and Europe.

To capture risk aversion and uncertainty, we use stock market implied volatility indices in advanced economies. The stock markets we consider in this study are CBOE S&P 500, FTSE 100, and VSTOXX for the US, UK, and Europe, respectively.

In the global banking system, market observers consider the TED spread, the difference between London Interbank Offered Rate (LIBOR) interbank market interest rate and the risk-free rate, as a proxy for funding liquidity. The LIBOR rate reflects uncollateralized lending in the interbank market, which is subject to default risk, and the

risk-free rate guaranteed by the government. This spread indicates the yield between unsecured top-rated interbank and risk-free government loans. When the uncertainty increases in the economy, the rates banks charge for the unsecured loans increase, which drives up the LIBOR rate. Moreover, holding government bonds would be attractive for banks. With these effects together, the TED spread, indicator of credit risk, increases in times of uncertainty. When the banks face liquidity problems, then the TED spread widens and flight to quality (liquidity) manifests itself (Boudt, Paulus, & Rosenthal, 2017; Brunnermeier, 2009; Brunnermeier, Nagel, & Pedersen, 2008). We use TED spread to measure banking conditions in each of three advanced economies.

An increase in the TED spread has affects similar to an increase in the VIX although with less statistical power. VIX index is a useful proxy of the "global risk appetite" not only in equity, and equity-options markets, but also in corporate credit markets (Collin-Dufresne, Goldstein, & Martin, 2001).

Since the nature of sovereign credit risk is important in determining the cost of capital flows to emerging economies, we use an insurance contract called credit default swap (CDS) of emerging economies in our sample. A measure of a sovereign credit risk allows market participants to diversify risk while they are forming their portfolios. CDS, which reflect the state of domestic asset markets, are driven more by external factors (Longstaff, Pan, Pedersen, & Sinleton, 2011). We use CDS as a proxy for country risk premium for sample of emerging economies.

To measure the stock market performance in emerging economies, we employ MSCI index. Based on the market capitalization, this index selects the most liquid stocks that can be easily traded.

To capture the performance of domestic currencies, we employ real effective exchange rate (REER), which is the weighted average of domestic currency with respect to other major currencies. This variable is indicative in terms of evaluating how well the domestic currency performs in response to external shocks.

The volume of reserves is an indicator of how resistant a country is when a shock hits the economy. In situations where the domestic currency depreciates, the use of reserves can be a cure to value the home currency. So, considering the behavior of reserves would serve us to understand the resilience of emerging economy to capital outflows and currency shocks.

More detailed information on data with their units and sources, and variables with their construction, summary statistics and correlation matrices can be found in Appendix.

2.3.2 Methodology and Specification

In this study, we observe the heterogeneous impacts of external shocks triggered from advanced economies on internal macroeconomic and financial variables of emerging economies including BRICS, Turkey, and Indonesia by following dynamic factor modelling (DFM) approach over the period between 2009 and 2017[10]. We test the heterogeneity in the transmission of monetary policies, stock market volatilities, and banking distress from the US, UK, and Euro Area across our sample of emerging economies. Since our data set consists of three variables for each of the advanced

[10] Advanced economies: US; UK; Euro Area
External variables: Monetary Policy (Asset Purchase Programs), Stock Market Volatility, TED spread
Emerging economies: Brazil, Russia, India, China, South Africa, Turkey and Indonesia
Internal variables: CDS, MSCI, REER, FX reserves.

economies and four variables reflect the macroeconomic and financial conditions in each of the seven emerging economies, in total, we expect to have 37 macroeconomic and financial time series. Using DFM methodology allows us to make formal comparisons among the impacts of designated shocks on selected macroeconomic and financial dimensions of emerging economies. Observing the degree of heterogeneity among the responses of internal variables to external shocks would be beneficial for policy makers because they could shape their future policies and conduct reforms accordingly.

From the viewpoint of methodological approach, we follow factor modelling as in Barigozzi et al. (2014) and Corsetti et al. (2018). To observe heterogeneity and, hence, make comparison across variables, we compute relative standard deviation of impulse response functions obtained through DFM. As we are interested in computing the differences between impulse responses, we conduct asymmetry tests. Our null hypothesis is that there are no differences across impulse responses obtained through DFM. Error bands for relative standard deviation and pairwise differences across variables are achieved via bootstrapping.

To induce the stationarity, we transform[11] the data in hand. Since our one of the external series starts from 2009:M7, asset purchase program by the ECB, we shortened the horizon to adjust span of the series. By doing so, all of the time series start from the same date. To extract the common factors, we rely on the criterion by Bai and Ng (2002), which suggests 4 factors. After determining the number of factors, we set up VAR model with one lag suggested by Schwarz criterion (SIC). Our interpretations on dynamic interactions rely on impulse response functions and related confidence intervals, which are computed with 199 bootstrap draws.

[11] See Table A2.2 in Appendix.

To achieve interaction results, we employ DFM, in which we have $n = 36$ macroeconomic and financial time series[12] as shown in vector form:

$$Y_t = (y_{1t}, y_{2t}, \dots, y_{36t})',$$

which is a $36x1$ vector of observables from advanced and emerging economies.

First, we extract common factors F_t,

$$Y_t = \Lambda F_t + \varepsilon_t, \quad (1)$$

where F_t is $rx1$ vector of unobserved factors ($r = 4$ is number of factors we select), Λ is nxr $(36x4)$ matrix of factor loadings, and $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \dots, \varepsilon_{36t})'$ is an $nx1$ vector of $n = 36$ approximation errors. The right-hand side consists of common and idiosyncratic components, ΛF_t and ε_t, respectively.

Second, we run a VAR on F_t, which can be written in lag-operator form as follows;

$$A(L)F_t = e_t,$$

where $A(L)$ is an rxr matrix of lagged polynomials of order s, which is selected by SIC, and e_t is an $rx1$ vector of innovations, which are orthogonal to idiosyncratic components, ε_t.

The relationship between the innovations, e_t, and structural shocks, η_t, is as follows:

$$e_t = H\eta_t,$$

where H is rxr unknown parameter matrix that governs variance covariance of e_t.

[12] Due to data limitation, we exclude Indian CDS values.

Shocks can be written as a linear combination of innovations as long as the VAR system is invertible.

$$\eta_t = H^{-1} e_t.$$

Third, we obtain $IRFs$.

In this paper, our main interest is the impulse response functions ($IRFs$) to external structural shocks triggered from advanced economies.

To find the IRF we use innovations in lag-operator form, $A(L)F_t = e_t$, and structural shocks, $\eta_t = H^{-1} e_t$ and reach

$$F_t = A(L)^{-1} H \eta_t.$$

Substituting last equation into (1) yields us following equation

$$Y_t = \Lambda A(L)^{-1} H \eta_t + \varepsilon_t,$$

where the IRF is

$$\Lambda A(L)^{-1} H.$$

In this study, IRF^h is rxr $(r = 4)$ matrix at horizon h is composed of $IRF^h_{i,j}$, $i = 1,2,3,4$ and $j = 1,2,3,4$ which is j^{th} factor's response of i^{th} factor's structural shock.

To recover IRF^{*h}, $\frac{\partial Y_{i,t}}{\partial \eta_{j,t}}$, for original variables from IRF^h of factors, we multiply IRF^h by factor loadings from both sides and get

$$IRF^{*h} = \Lambda \, IRF^h \, \Lambda'$$

where IRF^{*h} is $36x36$ matrix of the responses of original variables. Finally, we introduce uncertainty with bootstrapped confidence intervals.

2.4 Results

2.4.1 Dynamic Interactions: Impulse Response Functions (IRFs)

This section presents the dynamic interactions between the emerging and advanced economies. Each of monetary policy shocks, volatility shocks, and banking distress shocks is identified with one standard deviation shock. The impulse response functions[13] from our DFM are with 95% confidence bands.

Figure A2.1 displays the impulse responses of CDS values of each emerging economies to each of the shocks with their origin. We observe that, in general, both expansionary and contractionary shocks have expected impacts on risk premiums of countries. For example, as an expansionary condition, asset purchase program conducted by the Fed decreases CDS values of Brazil and Russia at most with a response of -0.23 and -0.44, respectively. However, the response of risk premiums of China and Turkey do not exhibit a decrease. For the China case, one explanation on why CDS value has positive reaction to asset purchase program by the Fed would be its trading role with the US. Ongoing high current account deficit and external debt in Turkey eliminate the possible risk mitigating spillover effects of expansionary monetary policy decision by the Fed. Estimation results confirm the negative relation between the CDS of these countries and unconventional monetary policy implementation by the ECB and BoE with a lesser impact. On the contrary, we have evidence on positive volatility shocks leading to an increase in the risk premiums of countries, which confirms the findings of Josifidis et al. (2014). A shock stemming from the US stock market volatility has the

[13] See Table A2.10 and A2.11 for significant impulse response functions with their magnitudes.

highest impact on Russian and Chinese CDS, whereas the UK volatility affects the CDS values of Brazil and Turkey at most. In particular, why the US stock market volatility has highest impacts on risk premiums of China and Russia can be explained as follows: trade competition between the US and China make these two economies more sensitive two each other. The US sanctions have had devastating effects on Russian economy. The Russian CDS value hit its historical record once the sanctions were imposed in 2014. Therefore, it is plausible that Russia is more vulnerable to contractionary actions stemming from the US. Another explanation would be the increasing ties between Russia and China. In addition to geographic conditions, due to their economic and political collaborations, these two eastern countries display similar reactions to US shocks. For the risk premiums of Brazil and Turkey, an explanation would be the dense volume of exchange trading in terms of currencies of these economies in the UK[14]. High shares of exchange trading confirm the strong impact of UK volatility on Brazilian and Turkish economy. Since there is a strong tie between performance of currency and sovereign risk, it is expected that volatility increase in the UK would have highest impact on risk premiums of these countries through the currency channel. The consequences of stock market volatility shock in Euro area is similar to that of UK. These results suggest that the risk premiums and uncertainty move in the same direction. While considering the sources of volatility shocks, policy makers should also consider uncertainty comes from the UK and Euro area for further policy actions. The responses of CDS to banking conditions verify that the TED spread has similar impacts to that of volatility proxies in terms of direction of the interaction.

[14] According to the most recent report on global foreign exchange market turnover in 2019 by Bank for International Settlements (BIS), the percentage shares of daily averages of exchange trading volume of Brazilian Real (BRL) and Turkish Lira (TRY) is around 42% (27%) and 54 % (13%) in the UK (US).

Figure A2.2 presents the interaction results between MSCI values of emerging economies and designated external shocks. In response to monetary policy conditions, stock market performance of Brazil, Russia, and China display positive reactions. As suggested by Anaya, Hachula, and Offermanns (2017), this result highlights the importance of financial market as a transmission channel through which monetary policy can transmit to the economy. Compared to monetary policies operated by the ECB and BoE, Fed's program has the highest impact on MSCI of above-mentioned economies. This result highlights the importance of monetary policy action by the Fed in terms of its size, which result in high volume of capital flows to emerging economies. Our estimation results suggest that the asset purchase program initiated by the BoE has no significant impact on MSCI. An increase in volatility shocks in all of the external regions lead to a decrease in equity returns in all emerging economies. Regarding the magnitudes, our key finding is that the volatility conditions in the UK has the strongest negative impacts on financial markets in all emerging economies except only for the China, which is affected mostly by a shock in the US, which is measured by VIX.

Figure A2.3 displays the responses of real effective exchange rates to expansionary monetary policy shocks and contractionary volatility shocks including stock market and banking distress indices. Estimated responses of currencies in emerging economies to unconventional monetary policy shock by the Fed suggest appreciation of domestic currencies. However, they are statistically insignificant except for the Russian ruble, which is the only currency has significant response to monetary policy actions in all major centers. As a major oil exporter, Russia records a current account surplus, which has an increasing impact on its currency. The other two expansionary monetary policies have increasing effect on national currencies. Compared

to asset purchase programs, APP conducted by the ECB has the highest impact on TRY and CNY. Being an important trading partner with European Union, both Chinese and Turkish economy are affected by the ECB's monetary policies through trade and exchange rate channel. Turkey's trade linkage with EU is deeper than to that of with UK[15]. Comparing magnitudes of peak responses may confirm China has more dense trading behavior with European union rather than the UK[16]. Since China plays a major role in both direct and indirect global trade, it is plausible that yuan responds significantly to APF program by the BoE, as well. Overall, as shown by the impulse response functions, we have enough evidence on appreciation of domestic currencies in response to asset purchase programs implemented by the major central banks (Kolasa & Wesołowski, 2018). As expected, volatility conditions cause national currencies to depreciate. US stock market volatility has its highest impact on Russian ruble. Since its economy is highly dependent on oil-exports, Russian petrocurrency is significantly exposed to fluctuations in oil price, which is quoted in USD. Therefore, a contractionary policy by the US has significant and negative impact on ruble. Distinguishably, stock market volatility in the UK has the highest impact on currencies except for the Brazilian real and Chinese yuan, which are affected at most by the VIX. This result supports that the foreign exchange trading in the UK is heavier than the other major centers[17]. The

[15] In 2017, while imports from (exports to) Europe in Turkey is about 85 billions of USD (75 billions of USD), imports from (exports to) UK in Turkey is around 6,5 billions of USD (9,6 billions of USD).
[16] The data reported by UNCTAD show that China has a surplus of around 130 billions of USD (35 billions of USD) with its trade with European Union (UK) in 2017. Imports from (exports to) Europe in China is about 244 billions of USD (370 billions of USD) in 2017. In the same year, imports from (exports to) UK in China is around 22 billions of USD (56 billions of USD).
[17] According to the most recent report on global foreign exchange market turnover in 2019 by Bank for International Settlements (BIS), as of April, 43% of global foreign exchange trading took place in the UK. The volume of daily turnover in the UK and US was around 3.5 trillions of USD and 1.3 trillions of USD, respectively. Regarding the currencies, 3.2 trillions of USD / 1.3 trillions of EUR and 1.2 trillions of USD / 500 millions of EUR were traded in the UK and US, respectively (BIS, 2019).

effects of liquidity shocks on currencies are not different than to that of volatility shocks except for the TRY and CNY. Candidate explanation for the appreciation of these two currencies may rely on currency carry trade[18]. TRY can be identified as an investment currency with its high interest paid nature to attract capital flows. Once the liquidity constraints hit the economy, capital inflows slowly and the exchange rates appreciate gradually (Brunnermeier et al., 2008). The appreciation of CNY can be explained through balance of payments channel. Since China runs current account surplus, exports exceed imports, there is an increase in the demand of CNY, which results in an appreciation. Our results also suggest that credit tightening in Europe has the highest impact on depreciation of Russian ruble.

Figure A2.4 presents the estimated impulse responses of FX reserves in each emerging economies to external shocks. Among the expansionary monetary policy shocks, in general, the unconventional policy by the Fed has the highest positive impacts on reserves[19]. Capital flows into emerging economies increase foreign exchange holdings. Surprisingly, we observe insignificant responses to volatility shocks. Tightened liquidity conditions reduce FX reserves, which confirms the traditional role of reserves to act as a cushion once the illiquidity arises (BIS, 2011). In terms of magnitudes, contraction in credit opportunities stemming from the Euro area has the strongest impacts on reserves in all emerging economies in our sample. This result

[18] An investment strategy consists of selling low interest rate currencies and investing in high interest rate currencies. As opposed to what uncovered interest rate parity (UIP) states, currencies with high interest rate appreciates against currencies with low interest rate.

[19] The share of US dollar (Euro) in total FX reserves in the World, on average, is around 60% (20%) between 2009:Q1and 2018:Q4 (IMF COFER).

highlights the importance of bank lending channel from Euro area to emerging economies[20].

2.4.2 Asymmetry Tests

In this part, we present the results of tests on whether there exist significant differences across impulse responses of each of the variables we consider for the emerging economies to the same shocks. The difference is insignificant if the zero line is in between the confidence intervals (Barigozzi et al., 2014). Setting up VAR system on factors allows us to estimate and compare impulse responses from the same information set. Our aim is to observe whether same variables across emerging economies display heterogeneity in response to same external shock. We are not interested in the magnitudes but the signs of significant differences, if exist. To quantify the asymmetries, we pick Turkey as the reference economy.

CDS

In response to expansionary monetary policy by the Fed, Brazil and Russia show heterogeneity in CDS. The reaction of Turkey is greater than to that of Brazil and Russia as shown in Figure A2.5. The response of China, however, is not statistically different from Turkey[21]. In response to asset purchase programs by the ECB and BoE, the reaction only of Russia is significantly different than Turkey. Regarding the volatility shocks,

[20] For example, as of December 2017, the claims that the US, UK, Spain, and France have on Turkey is around 17, 18, 84, and 37 billions of USD, respectively. Total exposure of Spanish banks on Brazil was around 161 billions of USD, whereas the banks in the US had 68 billions of USD of exposure in the same period. Further details can be found on country tables (B4 Residence of counterparty by nationality of reporting bank) under Consolidated banking statistics (CBS) released by the BIS.

[21] As suggested by the impulse response functions, the peak responses of CDS values in China and Turkey is around 0.23 and 0.22, respectively.

there are no significant differences across responses. The differences between impulse responses to liquidity shocks indicate that there is also heterogeneity among Turkey, Brazil, and Russia. Directions of pairwise differences indicate both Brazil and Russia react more than Turkey.

MSCI

Reaction of Russia to all unconventional monetary policies is significantly different than Turkey. The pairwise differences of impulse responses between Turkey and Brazil indicate strong heterogeneity for policies by the Fed and BoE but weak heterogeneity for policy by the ECB. We do not observe significant differences among impulse responses to volatility shocks. Credit constraints create heterogeneity for Brazil and Russia, both reacting less than Turkey as displayed in Figure A2.6.

REER

Figure A2.7 exhibits results. Except for the Russia, none of the economies reacts significantly when we test for the asymmetries in exchange rates. We have evidence on Russia reacts more when there is a monetary policy shock hit by the Fed. In response to banking distress shocks triggered from the US and UK, the reaction of Russia is less than Turkey.

FX Reserves

When we consider the pairwise differences across impulse responses to monetary policy shocks, we observe significantly different reactions from Brazil, India, China, and Indonesia. As shown by Figure A2.8, while Brazil and China react more, India and

Indonesia react less than Turkey. As in testing for heterogeneity in REER, we do not have asymmetry in response to volatility shocks. We find Brazil and Indonesia react significantly more whereas the China reacts less than Turkey, which suggest heterogeneity in FX reserves exist when there is liquidity constraint in the global economy.

Overall, testing for asymmetry provide us with evidence on negative differentiation of Turkish economy from other emerging economies in our sample. Situations where the reaction of Turkey create heterogeneity in CDS in the opposite direction compared to Brazil and Russia can be explained through its high level of external debt stocks as a percentage of gross national income[22]. The strong response of Brazilian and Russian risk premiums to credit constraint shock relative to Turkey may be due to their use of higher volume of bank credit[23]. Regarding the heterogeneity in the MSCI, equity market in Turkey can be assumed as not appealing for the foreign investors due to weak performance of TRY. Therefore, expansionary monetary policies did not affect stock market performance on Turkey in the expected direction. Relatively more reaction of Turkey to liquidity constraints seem likely to be its higher reliance on portfolio flows when compared to Brazil and Russia. Heterogeneity in foreign exchange reserves can be attributed to the roles of China ad Brazil, as being the largest two FDI recipient economies[24] in our sample. Not detecting heterogeneity across none of the

[22] Between 2010 and 2018, the average external debt as a percentage of gross national income in Brazil, Russia, and Turkey is 23%, 31%, and 45%, respectively (World Bank, International Debt Statistics).
[23]According to data released by BIS, on average, bank credit to private non-financial sector in Brazil/Russia/Turkey was around 984/724/470 billions of USD in between 2014 and 2018 (BIS, Table F2.5)
[24] See https://unctad.org/en/PublicationsLibrary/diaeiainf2019d1_en.pdf .

variables in response to volatility shocks yield us to consider volatility measures as global economic and financial indicator.

2.5 Conclusion

In this paper, we contribute to the existing literature in spillover effects of monetary policies adopted by major central banks and financial conditions in developed economies on developing ones. We examine and compare the cross-border effects of unconventional monetary policy decisions conducted by the major central banks (Fed, ECB, and BoE), stock market volatilities and banking distress conditions in developed economies (US, UK, and Euro Area) on developing economies (BRICS, Turkey, and Indonesia). We investigate how major economies create heterogeneity across developing economies, if any. Using DFM enables us to reach dynamic interactions between developed and developing economies on the reliance of same information set. To extend traditional literature, which consider the US as being the driver of global economic and financial conditions, our data set includes time series of Euro area and the UK. Our analysis over the period between 2009 and 2017 generates important results. First, our findings present that unconventional monetary policies by the Fed have significant spillover effects across emerging economies in our sample. These findings are consistent with Tillmann (2016) and Anaya et al. (2017). Asset purchase program by ECB has spillover effects but with a smaller magnitude. Second, due to its bank-centric economy, we document that the banking conditions in Europe play prominent role in capturing the liquidity constraints, which is a similar finding in Cerutti et al. (2017), as well. Third, we disclose the major role of exchange trading market in the UK. This result highlights

the importance of financial market volatility shocks stemming from the UK. Fourth, asymmetry tests suggest that there are heterogeneities across emerging economies.

We also have evidence on negative differentiation of Turkish economy from the emerging economies, which are listed in the same group with respect to their characteristics. Running the highest current account deficit as a percentage of GDP and having the highest volume of external debt stocks can be counted as the main characteristics that make Turkey differs from other emerging economies.

Since we do not observe heterogeneity across emerging economies when they are hit by the volatility shocks triggered from either of developed economies , we could identify volatility index as the global economic and financial indicator (Bruno & Shin, 2015).

We conclude that different degrees of financial connectedness and country specific characteristics play major role behind all possible asymmetries across emerging economies. Global conditions evolved after the financial crisis in 2008 and policies conducted in developed economies have impacts on emerging economies. Policy makers in each of the emerging economies should shape their own future policies by considering the effects of each specific external shocks on their own economy. Not all economies should behave in the same direction because there are heterogeneities across these economies even some display negative differentiation.

2.6 Appendix

Table A2.1: Data

Data	Countries	Frequency	Unit	Span	Source
VIX	US	M	Index	2009:1-2017:12	FRED
FTSE, VSTOXX	UK, EA		Index		Bloomberg
LSAP	US	M	Millions of $	2009:1-2017:12	FRED
	UK		Millions of £	2009:3-2017:12	BoE
	EA		Millions of €	2009:7-2017:12	ECB
LIBOR	US, UK, EA	M	%	2009:1-2017:12	Bloomberg
3M-Treasury Rate	US, UK, EA	M	%	2009:1-2017:12	Bloomberg
TED Spread (LIBOR-3M-Treasury Rate)	US, EA, UK	M	%	2009:1-2017:12	Bloomberg
MSCI	BRICS TI	M	Millions of $	2009:1-2017:12	Bloomberg
CDS	BRCS TI	M	Index	2009:1-2017:12	Bloomberg
REER	BRICS TI	M	Index	2009:1-2017:12	FRED
FX Reserves	BRICS TI	M	Millions of $	2009:1-2017:12	IMF IFS

This table reports the data with their frequency, unit, span, and source. VIX, FTSE, and VSTOXX are the volatility measures. Large scale asset purchase (LSAP) programs are unconventional monetary policies conducted by the Fed, BoE, and ECB. The London Interbank Offered Rate (LIBOR) is the benchmark interest rates at which banks charge another in the international banking market. TED Spread is the difference between the LIBOR and risk-free rate. MSCI is an index to measure equity market performance. CDS is a proxy for country risk premium. Real Effective Exchange Rate (REER) is a measure of a domestic currency against a weighted average of foreign currencies. Foreign Exchange Reserves (FX Reserves) are foreign assets hold by the central bank. Due to data restriction, we do not include CDS value of India.

Table A2.2: Variables with Their Construction

Variables	Construction
US Volatility	First difference of log CBOE S&P Volatility Index
UK Volatility	First difference of log FTSE 100 Volatility Index
EA Volatility	First difference of log VSTOXX Volatility Index
US LSAP	First difference of log assets held by the Fed
UK LSAP	First difference of log assets held by the BoE
EA LSAP	First difference of log assets held by the ECB
US TED Spread	3M LIBOR – 3M T-Bill
UK TED Spread	3M LIBOR – 3M Gov. Bond Yield
EA TED Spread	3M LIBOR – 3M Gov. AAA
Equity Return	First difference of log MSCI
Risk Premium	First difference of log CDS
Real Effective Exchange Rate	First difference of log REER
Foreign Exchange Reserves	First difference of log foreign exchange reserves

This table reports the construction and transformation of variables used in this study. By taking log of a difference, we satisfy stationarity of time series.

Table A2.3: Summary Statistics of Stock Market Volatilities and TED Spread in Center Economies

Country	Variables	Mean	Std. Dev	Min	Max
US	VIX	18.9	7.71	9.51	46.35
	TED Spread	0.31	0.17	0.11	1.08
UK	FTSE	18.11	6.36	9.54	41.75
	TED Spread	0.22	0.31	-0.37	1.46
Euro Area	VSTOXX	23.77	7.14	11.98	46.67
	TED Spread	0.31	0.26	0.07	1.33

This table reports the summary statistics of volatility measures and TED Spread in the US, UK, and Euro Area.

Table A2.4: Correlations of Stock Market Volatilities and TED Spread Across Center Economies

	Variables		US	UK	Euro Area
Panel A		US	1	0.96	0.92
	Volatility	UK		1	0.96
		Euro Area			1
Panel B		US	1	0.72	0.64
	TED Spread	UK		1	0.74
		Euro Area			1

This table reports correlations. Panel A (B) displays the correlations of volatility measures (TED Spread) across center economies.

Table A2.5: Correlations Between Stock Market Volatilities and TED Spread in Center Economies

		TED Spread
US		0.51
UK	Volatility	0.74
Euro Area		0.63

This table reports correlations between volatility and TED Spread in the US, UK, and Euro Area.

Table A2.6: Summary Statistics of Variables of Emerging Economies

Country	Variables	Mean	Std. Dev	Min	Max
Brazil	MSCI	2,415.67	776.44	958.97	3,835.1
	CDS	199.52	95.1	100.6	494.93
	REER	89.14	10.53	63.78	109.77
	FX Reserves	327,414	56,036.16	185,851	373,107
Russia	MSCI	672.5	172.41	347.8	1,086.36
	CDS	230.96	114.3	106.5	761.109
	REER	93.99	11.73	65.51	109.71
	FX Reserves	394,441.32	61,584.54	297,086	483,884.8
India	MSCI	14.72	2.36	6.64	19.81
	CDS	-	-	-	-
	REER	95.92	5.4	84.11	104.54
	FX Reserves	290,391.92	39,494.96	238,715	385,103.9
China	MSCI	8.02	1.13	4.67	11.43
	CDS	95.27	32.2	50.08	248.33
	REER	113.39	10.64	95.61	131.05
	FX Reserves	3,166,720	527,339.98	1,912,066	3,993,212.7
South Africa	MSCI	102.47	14.5	50.81	128.05
	CDS	197.87	62.85	117.63	459.934
	REER	84.58	10.76	62.42	105.41
	FX Reserves	38,578.26	3,337.8	29,602.38	42,735
Turkey	MSCI	467,067.42	101,743.68	217,633.51	704.819,43
	CDS	216.25	59.81	117.8	487.393
	REER	87.38	7.58	69.34	103.35
	FX Reserves	90,191.54	14,127.9	64,222.57	112,609.6
Indonesia	MSCI	0.46	0.089	0.14	0.61
	CDS	188.02	86.11	85.24	656.451
	REER	93.36	5.29	79.58	102.59
	FX Reserves	95,610.98	18,962.7	48,120.32	124,143.4

This table reports the summary statistics of MSCI, CDS, REER, FX Reserves in Brazil, Russia, India, China, South Africa, Turkey, and Indonesia. MSCI and FX Reserves are in millions of US dollars.

Table A2.7: Timeline of Asset Purchase Program by the Fed

Date	Event / Program	Information
November 25, 2008	FOMC Statement	FED announces it will launch large scale asset purchase program (LSAP) including housing-related government-sponsored enterprises (GSEs) and mortgage-backed securities (MBSs) backed by Fannie Mae, Freddie Mac, and Ginnie Mae. Purchase of up to 100 billion dollars in GSE and 500 billion dollars in MBS will be conducted.
March 18, 2009	FOMC Statement	To promote economic recovery and to preserve price stability, the committee decided to expand FED's balance sheet further by purchasing up to an additional 750 billion dollars of MBS and 100 billion dollars of agency debt. In addition to this, purchase up to 300 billion dollars of long-term treasury securities will be conducted.
September 23, 2009	FOMC Statement	The committee has decided to complete the purchases of MBSs and agency debt by the end of the first quarter of 2010. On the other hand, purchases of treasury securities will be completed by the end of October 2009.
November 4, 2009	FOMC Statement	The committee has decided to complete the purchases of agency debt securities at 175 billions of dollars.
November 3, 2010	FOMC Statement	While maintaining its existing policy of reinvesting principal payments from its securities holdings, the committee intends to purchase a further 600 billions of longer-term treasury securities by the end of the second quarter of 2011, a pace of about 75 billion dollars per month.
June 22, 2011	FOMC Statement	While maintaining its existing policy of reinvesting principal payments from its securities holdings, the committee will complete purchase of 600 billions of longer-term treasury securities by the end of June 2011, as planned.
September 21, 2011	FOMC Statement on Maturity Extension Program (MEP)	The committee has decided to extend the maturity of its security holdings. The FED will purchase 400 billions of dollars of treasury securities with maturities of 6 years to 30 years and sell an equal amount treasury security with maturities of 3 years or less with the aim of putting downward pressure on long term interest rates.
June 20, 2012	MEP operating policy	The continuation of the MEP will proceed at current pace and result in purchase, as well as the sale and redemption, of about 267 billions of dollars in treasury securities by the end of the 2012.
September 13, 2012	FOMC Statement	The committee will increase MBSs at a pace of 40 billions of dollars per month. With this action, holdings of longer-term securities will be increased up to 85 billions of dollars in each month till the end of 2012.
December 12, 2012	FOMC Statement	The committee will continue purchasing additional MBSs at a pace of 40 billions of dollars. The committee also will purchase longer-term treasury securities after its program to extend the average maturity of its holdings of treasury securities is completed at the end of 2012, initially at a pace of 45 billions of dollars per month.
December 18, 2013	FOMC Statement on Taper Tantrum	The committee has decided to modestly reduce the pace of its asset purchases. Beginning in January, purchase of MBSs will be decreased to 35 billions of dollars, instead of 40 billions of dollars; and purchase of treasury securities will be decreased to 40 billions of dollars, instead of 45 billions of dollars. Further reductions on purchases of both types of securities will be implemented till 2014:10.
October 29, 2014	FOMC Statement Completion of Asset Purchase Program	The committee decided to end large scale asset purchase program this month.
June 14, 2017	FOMC Statement on Balance Sheet Normalization	The committee expects to begin implementing a balance sheet normalization program, which would gradually reduce the Federal Reserve's securities holdings by decreasing reinvestment of principal payments from those securities.
November 1, 2017	FOMC Statement on Balance Sheet Normalization	The balance sheet normalization program initiated.

Table A2.8: Timeline of Asset Purchase Program by the ECB

Date	Event / Program	Information
March 28, 2008	Press Release on Long Term Refinancing Operations (LTRO)	
June 4, 2009	Press Release on Covered Bond Purchase Program (CBPP)	
July 2, 2009	CBPP	The program ends on June 30, 2010 once it reaches the targeted amount of 60 billion euros.
May 10, 2010	Securities Market Program (SMP)	The program, whose objective is to address the malfunctioning of securities markets and restore monetary policy transmission mechanism, ends following a Governing Council decision on September 6, 2012. The amount of SMP holdings at amortized cost is 74 billion euros at date October 12, 2018.
October 6, 2011	Press Release on CBPP2	
November 3, 2011	Covered Bond Purchase Program (CBPP2)	The program ends on October 31, 2012 once it reaches the amount of 16.4 billion euros, whereas the intended amount is 40 billion euros.
October 2, 2014	Press Release on CBPP3 and Asset-Backed Securities Purchase Program (ABSPP)	
October 15, 2014	Decision of the ECB on the implementation of CBPP3	
October 20, 2014	Covered Bond Purchase Program (CBPP3)	Alongside with other programs, CBPP3 enhance the transmission mechanism, facilitate credit conditions in the euro area, generates spill-over effects, and contribute a return of inflation rates closer to 2% over the medium term. As of October 12, 2018, end of week, the amount of CBPP3 holdings at amortized cost is 260 billion euros.
November 19, 2014	Decision of the ECB on the implementation ABSPP	
November 21, 2015	ABSPP	The program helps banks to diversify funding sources and stimulates the issuance of new securities. This type of securities is helpful for banks to ease credit conditions, which then be forwarded to real economy. As of October 12, 2018, end of week, the amount of ABSPP holdings at amortized cost is 27 billion euros.
March 4, 2015	Press Release on Public Sector Purchase Program (PSPP)	
March 9, 2015	PSPP	The design and implementation of the program leads Euro system to conduct purchases in a gradual and broad-based manner, aiming to achieve market neutrality to avoid interfering with the market price formation. Substitute purchases are allowed to be conducted. Under this program, the ECB and NCBs may purchase outright eligible marketable debt instruments from eligible counterparties on the secondary market. As of October 12, 2018, end of week, the amount of PSPP holdings at amortized cost is 2,083 billion euros.
April 21, 2016	Press Release on Corporate Sector Purchase Program (CSPP)	
June 8, 2016	Corporate Sector Purchase Program (CSPP)	The CSSP aims to strengthen the financing conditions of the real economy in Euro system. As of October 12, 2018, end of week, the amount of PSPP holdings at amortized cost is 172 billion euros.

Table A2.9: Timeline of Asset Purchase Program by the BoE

Date	Event / Program	Information
January 19, 2009	HM Treasury Statement	Announcement of the APF, which includes facilities to purchase high-quality commercial paper and corporate bonds.
March 5, 2009	News Release on Asset Purchase Facility (Launch of the program)	Bank of England announces 75 billion sterling asset purchase program. To meet the Committee's objective of total purchase, the Bank would also buy medium- and long-maturity conventional gilts in the secondary market.
April 9, 2009	News Release on Asset Purchase Facility (Continuation of the program)	The committee voted for the continuation of the program. Since the previous meeting, a total of 26 billion sterling of asset purchase had been made and two months are expected to be required to complete the program.
May 7, 2009	News release on Asset Purchase Facility (Expansion of the program	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 75 billions of sterling to 125 billions of sterling.
June 8, 2009	News Release on Asset Purchase Facility: Secured Commercial Paper	The bank intends to introduce a Secured Commercial Paper Facility to contribute to the APF's objectives of improving liquidity in credit markets that are not functioning normally.
August 6, 2009	News release on Asset Purchase Facility (Expansion of the program)	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 125 billions of sterling to 175 billions of sterling. Another three months are expected to be required to complete the program.
November 5, 2009	News release on Asset Purchase Facility (Expansion of the program)	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 175 billions of sterling to 200 billions of sterling. Another three months are expected to be required to complete the program.
February 4, 2010	News release on Asset Purchase Facility (Continuation of the program)	The committee voted to maintain the stock of asset purchases financed by the issuance of central bank reserves at 200 billions of sterling.
October 6, 2011	News release on Asset Purchase Facility (Expansion of the program)	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 200 billions of sterling to 275 billions of sterling. Four months are expected to be required to complete the announced program.
November 29, 2011	HM Treasury Statement	APF limit for purchases of eligible private sector assets is reduced to a ceiling of 10 billion sterling.
February 9, 2012	News release on Asset Purchase Facility (Expansion of the program)	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 275 billions of sterling to 325 billions of sterling. The committee expects the announced program of asset purchase to take three months to complete.
July 5, 2012	News release on Asset Purchase Facility (Expansion of the program)	The committee voted to continue with its program of asset purchases financed by the issuance of the Bank of England reserves and to expand its size from 325 billions of sterling to 375 billions of sterling. The committee expects the announced program of asset purchase to take four months to complete.
August 4, 2016	News release on Asset Purchase Facility (Expansion of the program)	The committee voted for a package that comprises the purchase of up to 10 billions of sterling UK corporate bonds and an expansion of the asset purchase scheme for UK government bonds of 60 billions of sterling, a total stock of these asset purchases to 435 billions of sterling. In total, APF reaches to 445 billion sterling.
August 4, 2016	News Release on Term Funding Scheme (Launch of the program)	The committee introduces Term Funding Scheme (TFS) to provide funding for banks at interest rates close to bank rate, which should help reinforce the transmission of the reduction in bank rate to the real economy with an amount of 100 billions of sterling, which increases the total size of APF up to 545 billion sterling.

Table A2.10: Significance of Impulse Response Functions

Response of ↓		*Shocks* → US			Euro Area			UK		
		LSAP	VOL	TED	LSAP	VOL	TED	LSAP	VOL	TED
Brazil	CDS	S-	S+	S+	S-	S+	S+	NS	S+	S+
	MSCI	S+	S-	S-	S+	S-	S-	NS	S-	S-
	REER	NS	S-	S-	NS	NS	S-	NS	S-	S-
	FX Reserves	S+	NS	S-	S+	NS	S-	NS	NS	S-
Russia	CDS	S-	S+	S+	S-	S+	S+	S-	S+	S+
	MSCI	S+	S-	S-	S+	S-	S-	S+	S-	S-
	REER	S+	S-	S-	S+	S-	S-	S+	S-	S-
	FX Reserves	S+	NS	S-	S-	NS	S-	NS	S+	S-
India	CDS	-	-	-	-	-	-	-	-	-
	MSCI	NS	S-	S-	S-	S-	S-	NS	S-	S-
	REER	NS	NS	NS	NS	NS	NS	NS	NS	S-
	FX Reserves	S-	NS	S-	S-	NS	S-	S-	NS	NS
China	CDS	S+	S+	S+	S+	S+	S+	NS	S+	NS
	MSCI	S+	S-	S-	S-	S-	S-	NS	S-	S-
	REER	NS	S-	S+	S+	S-	S+	S+	S-	S+
	FX Reserves	S+	NS	S-	S+	NS	S-	NS	NS	S-
South Africa	CDS	S-	S-	NS	S-	S-	NS	NS	S-	S+
	MSCI	NS	S-	S-	S-	S-	S-	NS	S-	S-
	REER	NS	S-	S-	S+	S-	S-	S+	S-	S-
	FX Reserves	S+	NS	S-	S-	NS	S-	NS	NS	S-
Turkey	CDS	S+	S+	S+	S+	S+	S+	NS	S+	S+
	MSCI	S-	S-	S-	S-	S-	S-	NS	S-	S-
	REER	NS	S-	S+	S+	S-	S+	NS	S-	NS
	FX Reserves	S+	NS	S-	NS	NS	S-	NS	NS	S-
Indonesia	CDS	NS	S+	S+	S-	S+	S+	S-	S+	S+
	MSCI	S-	S-	NS	S-	S-	S-	NS	S-	NS
	REER	NS	NS	S+	S+	S-	S+	S+	S-	NS
	FX Reserves	S-	S+	S-	S-	NS	S-	S-	NS	S-

This table reports the significance of impulse response functions. S+ refers to positively significant impact; S- refers to negatively significant impact; NS not significant impact.

Table A2.11: Maximum Impacts of Impulse Response Functions

Response of ↓		*Shocks* → US			Euro Area			UK		
		LSAP	VOL	TED	LSAP	VOL	TED	LSAP	VOL	TED
Brazil	CDS	-0.23	1.08	0.26	-0.2	1.09	0.5	NS	1.15	0.21
	MSCI	0.27	-0.91	-0.29	0.22	-0.92	-0.52	NS	-0.99	-0.23
	REER	NS	-0.34	-0.11	NS	NS	-0.17	NS	-0.2	-0.3
	FX Reserves	0.52	NS	-0.34	0.28	NS	-0.46	NS	NS	-0.47
Russia	CDS	-0.44	1.26	0.35	-0.33	1.22	0.64	-0.4	1.23	0.32
	MSCI	0.5	-1.11	-0.4	0.38	-1.08	-0.68	0.47	-1.08	-0.35
	REER	0.53	-0.78	-0.24	0.4	-0.76	-0.42	0.68	-0.78	-0.3
	FX Reserves	0.28	NS	-0.42	-0.35	NS	-0.6	NS	0.34	-0.32
India	CDS	-	-	-	-	-	-	-	-	-
	MSCI	NS	-1.02	-0.17	-0.4	-1.04	-0.36	NS	-1.13	-0.15
	REER	NS	NS	NS	NS	NS	NS	NS	NS	-0.16
	FX Reserves	-0.48	NS	-0.2	-0.94	NS	-0.33	-0.7	NS	NS
China	CDS	0.23	0.72	0.21	0.65	0.68	0.4	NS	0.67	NS
	MSCI	0.15	-0.93	-0.25	-0.51	-0.92	-0.47	NS	-0.96	-0.17
	REER	NS	-0.38	0.26	0.47	-0.34	0.34	0.37	-0.32	0.24
	FX Reserves	0.35	NS	-0.4	0.25	NS	-0.6	NS	NS	-0.37
South Africa	CDS	-0.3	-0.91	NS	-0.37	-0.83	NS	NS	-0.8	0.33
	MSCI	NS	-0.86	-0.22	-0.5	-0.88	-0.42	NS	-0.96	-0.16
	REER	NS	-0.58	-0.08	0.22	-0.64	-0.16	0.3	-0.75	-0.21
	FX Reserves	0.16	NS	-0.3	-0.4	NS	-0.47	NS	NS	-0.16
Turkey	CDS	0.22	0.96	0.15	0.36	1	0.31	NS	1.11	0.13
	MSCI	-0.27	-0.6	-0.09	-0.32	-0.66	-0.19	NS	-0.8	-0.1
	REER	NS	-0.46	0.15	0.36	-0.54	0.2	NS	-0.7	NS
	FX Reserves	0.14	NS	-0.22	NS	NS	-0.3	NS	NS	-0.25
Indonesia	CDS	NS	0.36	0.05	-0.23	0.42	0.1	-0.3	0.52	0.22
	MSCI	-0.27	-0.67	NS	-0.27	-0.74	-0.15	NS	-0.87	NS
	REER	NS	NS	0.2	0.14	-0.32	0.3	0.4	-0.48	NS
	FX Reserves	-0.24	0.36	-0.2	-0.56	NS	-0.25	-0.5	NS	-0.2

This table reports the peak points of significant impulse response functions. For example, when there is a shock on LSAP in US, the peak response of CDS in Brazil is -0.23.

Table A2.12: Results of Asymmetry Tests on Cross Country Differences of Impulse Response Functions

Pairwise Response differences of ↓ between ↓		*Shocks →*	US			Euro Area			UK		
			LSAP	VOL	TED	LSAP	VOL	TED	LSAP	VOL	TED
CDS	TR-BRZ		Y	N	Y		N	Y		N	Y
	TR-RU		Y	N	Y	Y	N	Y	Y	N	Y
	TR-IND		-	-	-	-	-	-	-	-	-
	TR-CHI		N	N	N	N	N	N	N	N	N
	TR-SA				N				N		
	TR-INDSIA										
MSCI	TR-BRZ		Y		Y			Y	Y		Y
	TR-RU		Y		Y	Y		Y	Y	N	Y
	TR-IND				Y	N			Y		
	TR-CHI					N			N	N	N
	TR-SA					N			N		
	TR-INDSIA		N								
REER	TR-BRZ		N	N			N		N	N	
	TR-RU		Y	N	Y	N	N	Y	Y	N	
	TR-IND		N								
	TR-CHI		N	N		N	N		N	N	
	TR-SA			N		N	N		N	N	
	TR-INDSIA								N		N
FX Reserves	TR-BRZ		Y	N	Y	Y	N	Y	Y	N	Y
	TR-RU		N	N		N	N		N	N	
	TR-IND		Y	N	N	Y	N	N	Y	N	Y
	TR-CHI		Y		Y			Y	Y		Y
	TR-SA		N						N		
	TR-INDSIA		Y		Y	Y		Y	Y	N	Y

This table reports the results of asymmetry tests. There is a significant difference between responses if the corresponding entry is Y; there is no significant difference between responses if the corresponding entry is N, there is a weak difference between responses if the corresponding entry is empty.

CDS

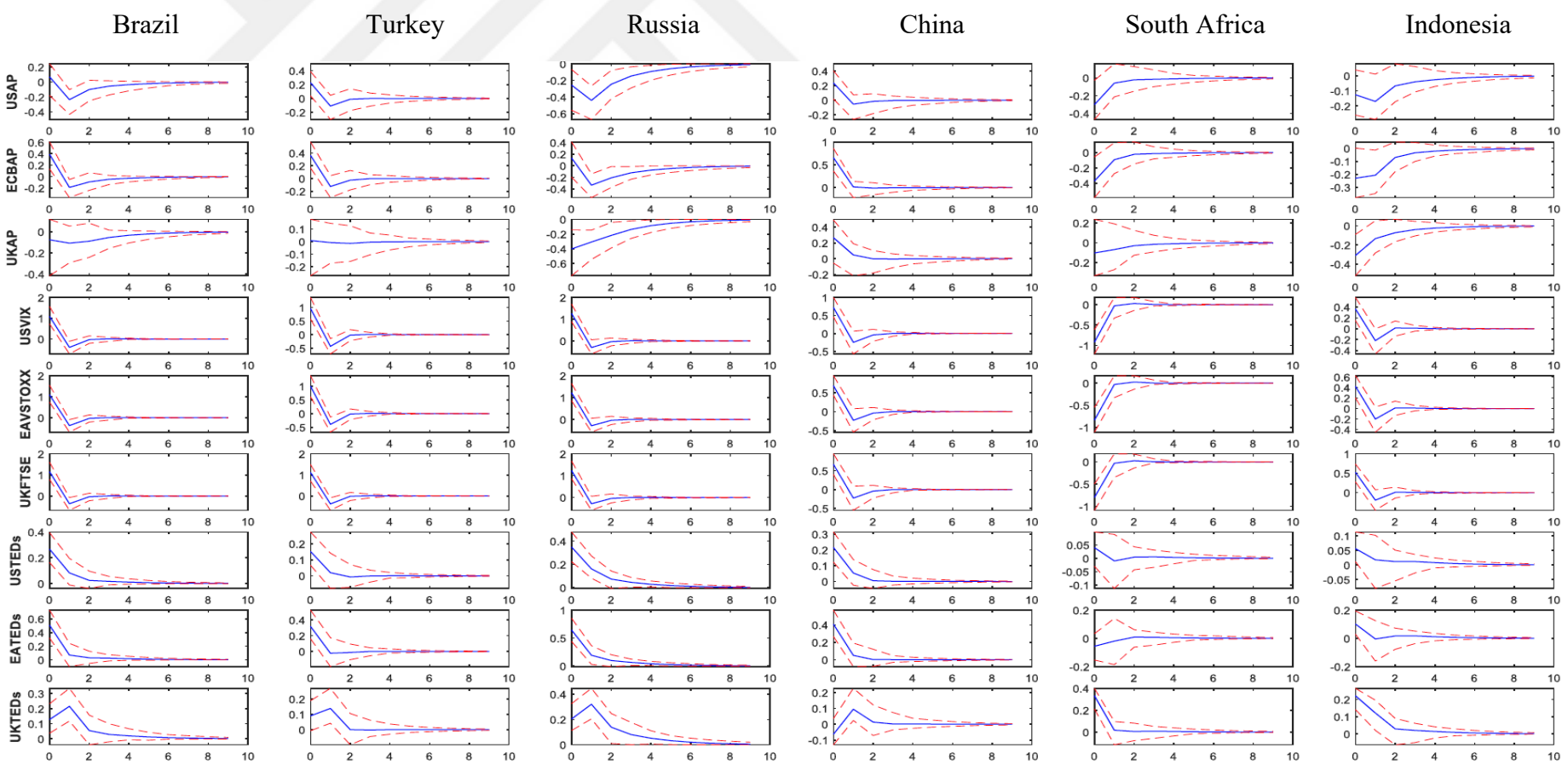

Figure A2.1: Impulse Responses of CDS to a one std. deviation external shock

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Solid lines are the estimated impulse response for the sample period with 95% bootstrap confidence intervals with dashed lines.

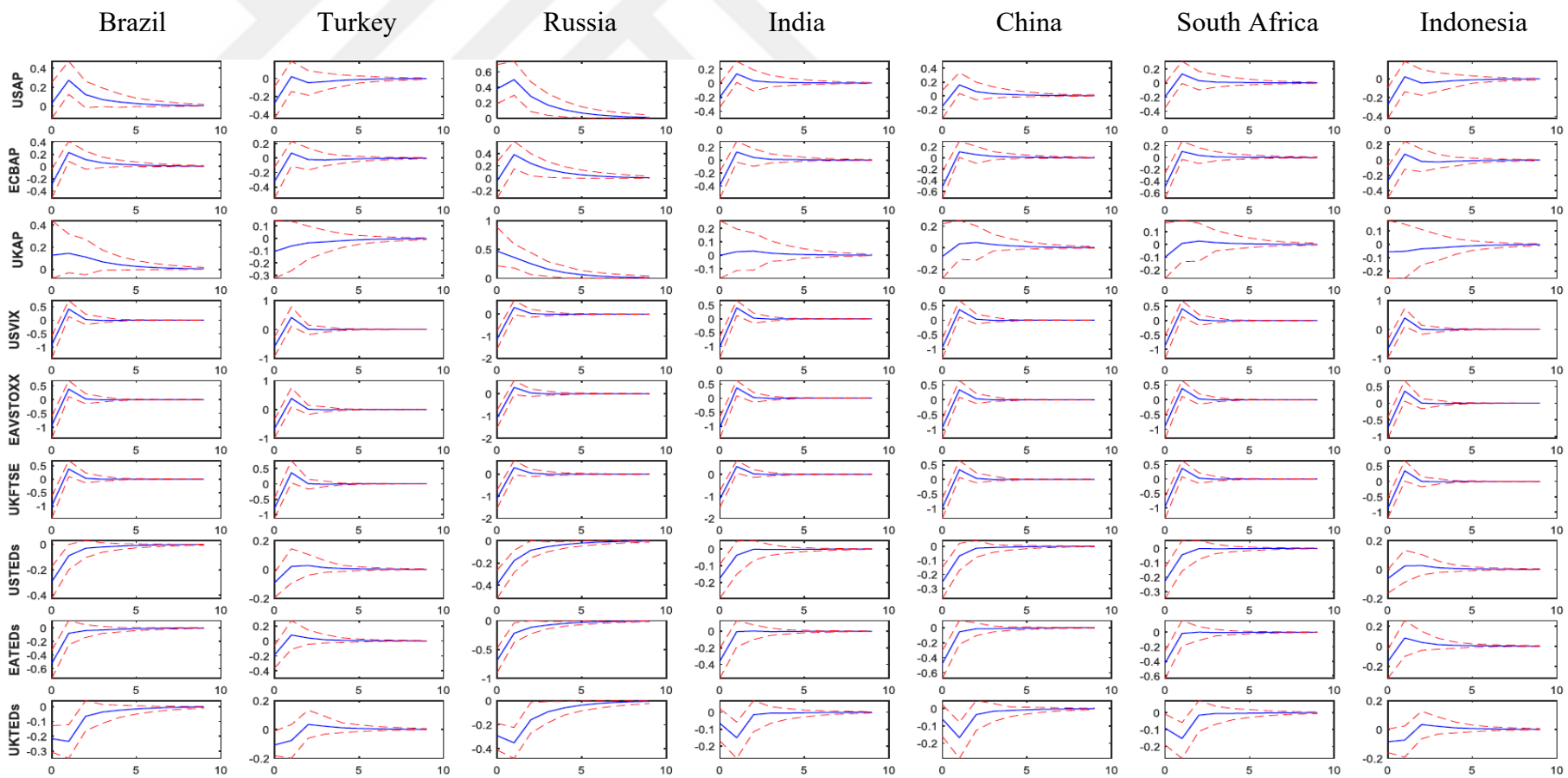

Figure A2.2: Impulse Responses of MSCI to a one std. deviation external shock

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Solid lines are the estimated impulse response for the sample period with 95% bootstrap confidence intervals with dashed lines.

REER

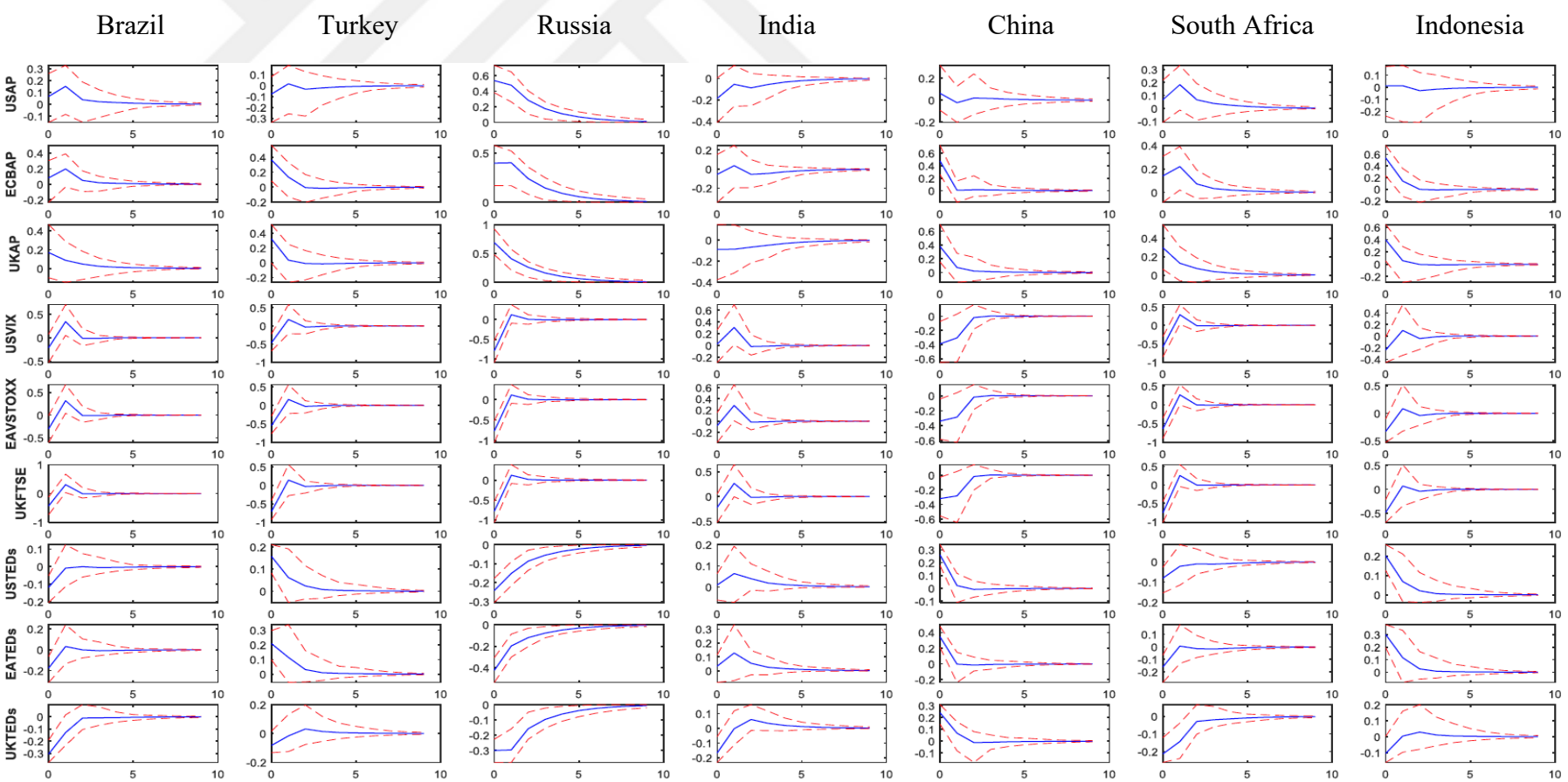

Figure A2.3: Impulse Responses of REER to a one std. deviation external shock

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Solid lines are the estimated impulse response for the sample period with 95% bootstrap confidence intervals with dashed lines.

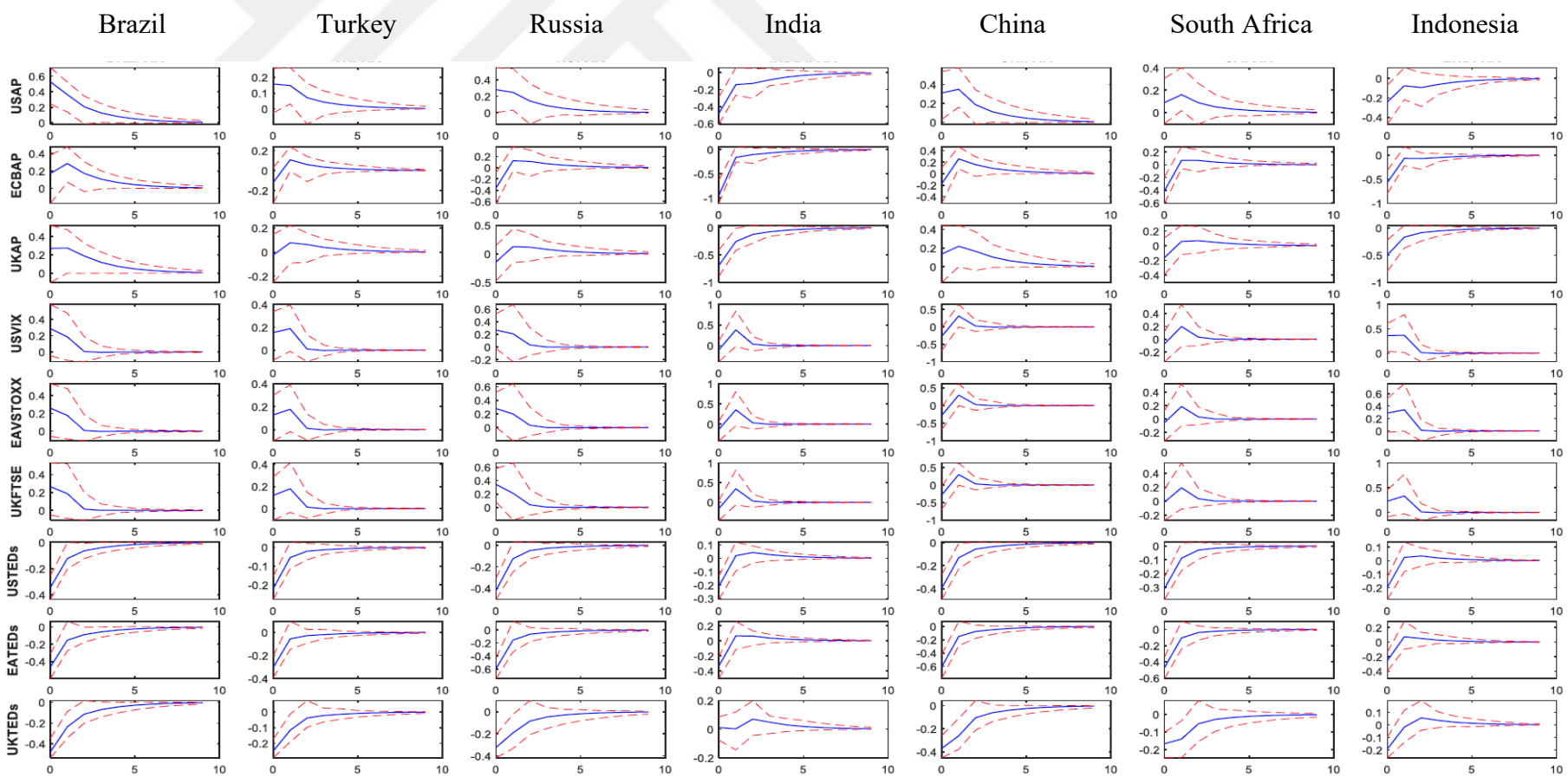

Figure A2.4: Impulse Responses of FX Reserves to a one std. deviation external shock

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Solid lines are the estimated impulse response for the sample period with 95% bootstrap confidence intervals with dashed lines.

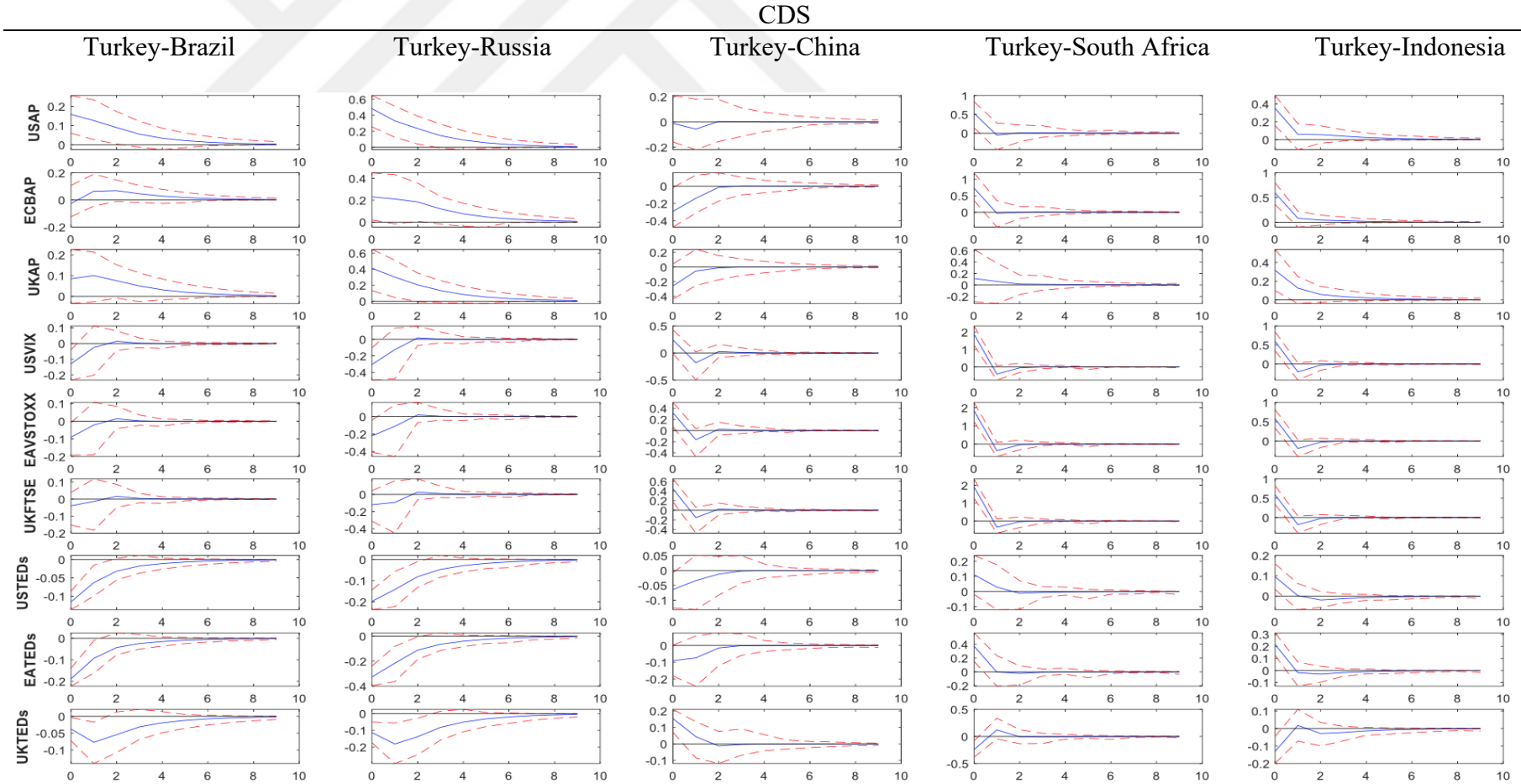

Figure A2.5: Impulse Response differences for CDS

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Benchmark country is Turkey.

MSCI

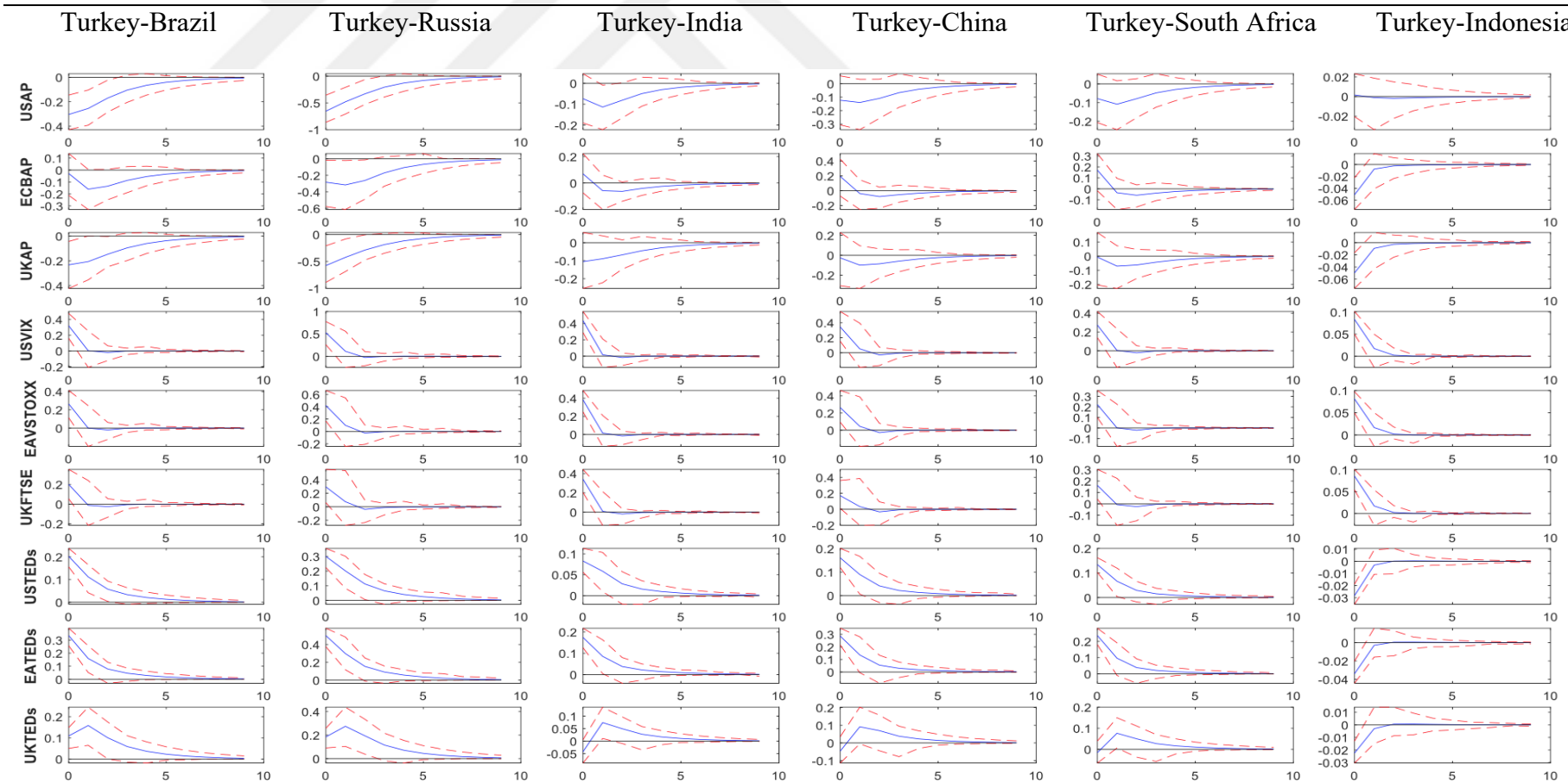

Figure A2.6: Impulse Response differences for MSCI

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Benchmark country is Turkey.

REER

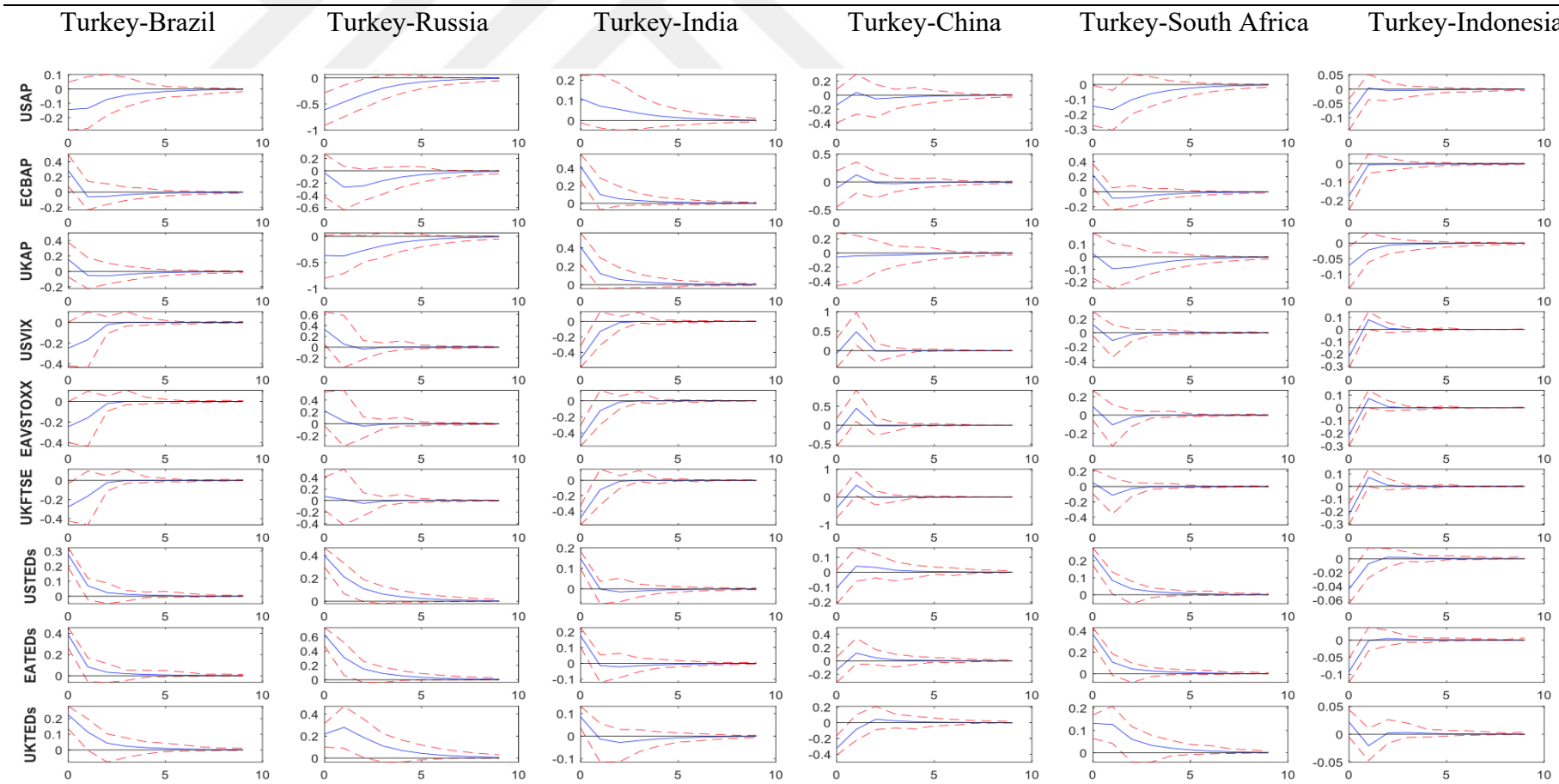

Figure A2.7: Impulse Response differences for REER

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Benchmark country is Turkey.

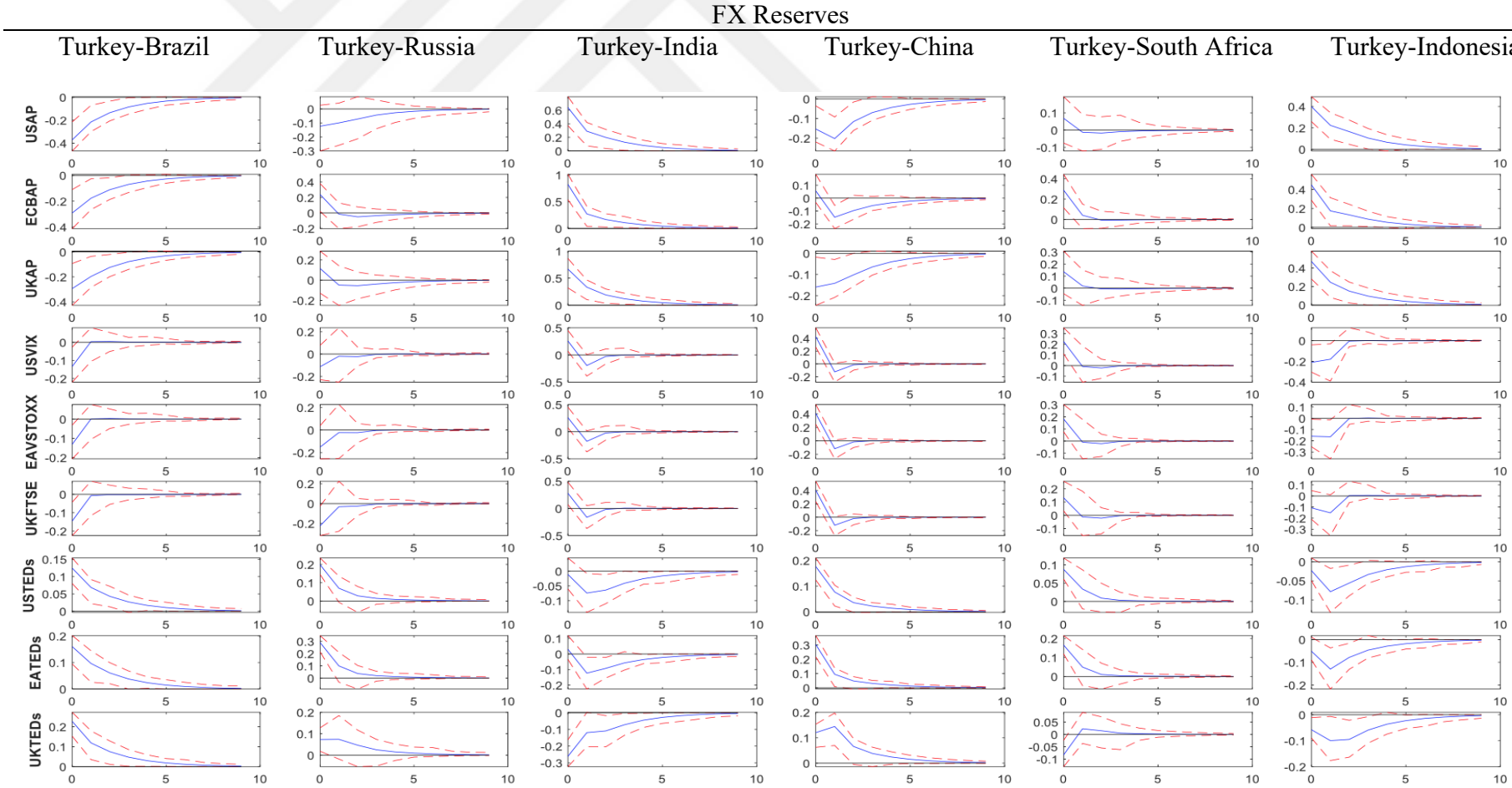

Figure A2.8: Impulse Response differences for FX Reserves

Each row displays the types and origin of shocks. Rows 1-3 indicate monetary policy shocks; 4-6 indicate volatility shocks; and rows 7-9 indicate banking distress shock. Each group of shocks is in the same order regarding the origin, i.e., the US, Euro area, and the UK. Benchmark country is Turkey.

CHAPTER III

THE ROLE OF SENTIMENT IN HOUSING MARKET WITH CREDIT-LED FUNDING: THE CASE OF TURKEY

3.1 Introduction

The determinants and effects of housing prices have always been important to follow for practitioners and policy makers. Historically, booms in housing market end up with economic contractions and financial instability. For example, peaks in housing prices in advanced economies were observed on the eve of recent episodes of crisis[25]. Particularly, the U.S. experienced a continuous increase in real property prices around 2006 and crisis erupted in 2007. Prices in Euro area had reached their peak points shortly before the economic contraction occurred. These experiences in advanced economies would imply that the housing price booms are likely to be indicators of possible downturn in an economy. Therefore, policymakers and authorities in developing economies should also consider peaks in housing prices[26] would be a signal of possible threat for economic performance. It is no surprise that any imbalance and contraction in housing market weaken financial stability (Koetter & Poghosyan, 2010).

[25] See Panel A and Panel B of Figure 3.1.

[26] See Panel C of Figure 3.1. Developing economies have appreciations in housing prices after the financial crisis in 2008.

In this study, we observe and provide empirical evidence by considering housing market dynamics in Turkey[27], where the housing prices exhibit continuous upward trajectory in recent years.

In Figure 3.1, panel D displays a co-movement of the housing prices and housing credit. While there is an upward trajectory in both series, we observe a joint decrease, starting from the last quarter of 2017, between time series of housing prices and credit. So, there is an association between housing prices and volume of credit on housing in Turkey.

We believe that the Turkish economy has experienced hard time to meet external funding between 2017:Q4 and 2018:Q4, in turn, credit market gets squeezed. Average selling time of houses[28] increased when the funding opportunities became restrictive. Meanwhile, the stocks of dwellings were increasing. Together with these effects, the number of unsold dwellings has increased in the housing market. While observing a decrease in dissolution rate of housing stocks, a continuous rise in housing prices led us to investigate the role of non-fundamentals[29] (attitude) in housing market in Turkey. As the growth objectives of Turkey highly rely on housing sector during easy credit conditions[30], we pose following questions to answer in this study: What are the relations and directions of causalities among sentiment[31], which is aggregate investor attitude, housing credit volume, house prices, and housing supply in Turkish housing market? How long does it take to correct the demand-supply disequilibrium in the market, if any? How

[27] Turkish economy has vulnerabilities include large external financing needs, limited foreign exchange reserves, increased reliance on short-term capital inflows, and high corporate exposure to foreign exchange risk. Signs of possible oversupply in the building and construction sector are also emerging (IMF, 2018).
[28] https://blog.reidin.com/en/ Monthly reports provide data on dissolution rate.
[29] Suggested by Case & Shiller (2003) housing price appreciation can be credited to over expectation, which affects housing demand and supply in the market.
[30] See Dalkılıç & Aşkın (2018).
[31] Aggregate investor attitude on asset prices in a market (Wang and Hui, 2017).

does the path of housing prices behave in response to a change in fundamentals and non-fundamentals?

Section 2 provides related literature on housing price dynamics in the context of credit and sentiment. In Section 3, we describe data and introduce methodology. Section 4 presents empirical results. Section 5 concludes the paper.

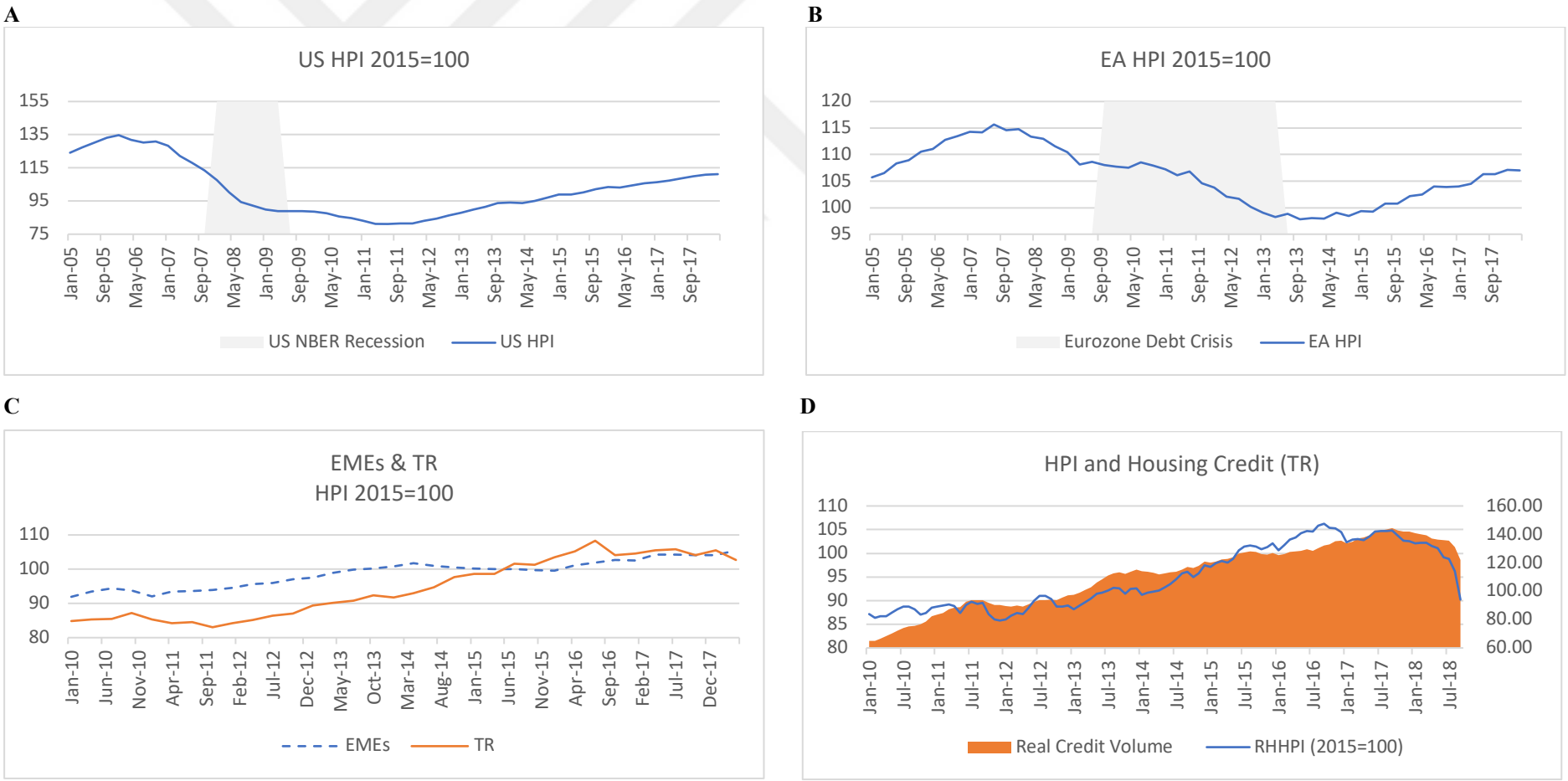

Figure 3.1: Housing Prices in the US, Euro Area, EMEs, and Turkey and Real Housing Credit (in billions of TL) in Turkey (Source: World Bank and CBRT)

3.2 Housing Price Dynamics and Related Literature

Households and especially real estate firms consider house as an investment and source of income for future. Increasing house prices have a wealth effect on household consumption as it has a positive impact on perceived wealth and relaxation of financial constraints, which make investors feel richer (Campbell & Cocco, 2007; Doling & Ronald, 2010). The determinants of housing prices are worth to understand. In theory, the price of a good is determined by demand supply interaction that occurs in the market. As the demand of an asset increases, its price would increase as well. This interaction would be appealing for suppliers so that they invest more to make profits. However, sometimes, due to speculative and psychological factors, agents in the economy do not consider the balance between demand and rigid supply in the short run. When the demand reaches its long run level, desire of making profit may result in an oversupply, which may cause prices to fall and put pressure on the economy (Conefrey & Whelan, 2012). Hence, understanding the interaction between short run demand and long run supply behavior is crucial.

There are many studies testing the relationship between house prices and its determinants. Fundamental and non-fundamentals are effective in determining the housing prices. Among the fundamental determinants of housing prices**;** construction costs, demographics such as population and disposable income as an affordability measure can be counted as significant ones (Case & Shiller, 1990; Gattini & Hiebert, 2010; Asal, 2018). On the contrary, there are also studies show such fundamentals are not effective in determining housing prices.

Recently, global housing prices exhibit dramatic appreciation and these increases in housing market during these periods withdraw attention because price rises cannot be credited to fundamental macroeconomic factors but to speculative and psychological factors (Gallin, 2006). The recent experience of boom and bust home price cycles in the US and European countries address human psychology to account for the dramatic price increases in housing market and therefore speculative thinking among investors plays important role in forming future expectations on housing prices (Shiller, 2015). For example, during booms period, exuberant expectations of investors drive already increased housing prices even further, which is likely to end up with bubbles (Adams & Füss, 2010).

3.2.1 Housing Prices and Credit Volume

The literature on the determinants of price movements attributes asset price appreciation highly to the existence and effects of large volume of capital flows[32]. High volume of capital inflows to emerging economies lower the costs of funding and provide opportunities in the form of credit for investors to undertake investment[33]. If an investor feels confident about finding financial sources and future value of housing, he confidentially borrows and spends money in buying house or undertaking new projects. Although inflows seem to be vital for emerging economies, they also have undesired outcomes such as currency appreciations, asset prices bubbles, default risk for the

[32] Weakening of credit standards, which, in turn, creates price appreciation, is the underlying reason behind the financial crisis in the US. Capital flows from China to the US is believed to be the common explanation of easy credit conditions in the US (Corden, 2009). Before the crisis erupted in the US, capital inflows and real property prices exhibit a jointly increasing pattern starting from the beginning of 2000. Price index and capital inflows, including direct investment, portfolio flows, and other investment, increased by one and a half times (FRED and IMF BOP statistics).

[33] Unconventional monetary policies conducted by the major central banks in advanced economies have spillover effects globally. Emerging economies benefit from capital flows originated from the asset purchase programs, particularly quantitative easing by the Fed.

borrowers, overheating, and inflationary pressures. So, having seen peaks in housing prices in emerging economies when capital flows are reversed makes this interaction important as it has economic and financial consequences. It is therefore important to study the relation between credit growth and housing prices.

This paper is related to literature on housing market dynamics, in which the credit-led housing funding causes price fluctuations. A house serves as a collateral for borrowing and house prices have an effect on growth via credit channel (Kiyotaki & Moore 1997; Bernanke, Gertler, & Gilchrist, 1999; Glaeser, Gottlieb, & Gyourko, 2010). Conditions of debt financing is crucially important to make investment decision in housing. Self-reinforcing mechanism between housing and credit market are considered by the monetary policy makers in assessing the performance of financial environment because majority of housing purchases are funded by credit (Anundsen & Jansen, 2013). Housing market, in which the booms in prices is fueled by the fast credit growth is likely to exacerbate the economy as a whole once the burst occurs (Cerutti, Dagher, & Dell' Ariccia, 2017). The recent global financial crisis exhibits the detrimental effects of less regulated credit growth in housing market. Households face over-indebtedness and financial intermediaries become highly leveraged as the risk in the economy with unmanaged credit market increases. Therefore, macroeconomic and financial stability in an economy is highly tied to funding schemes in the housing market.

There are many country specific studies, which test the interaction between credit volume and housing prices. Gimeno and Martínez-Carrascal (2010) find long run dependency between credit and housing prices in Spanish case between 1985 and 2009. Carrington and Madsen (2011) construct and test the implications of Tobin's q model to

analyze the relation between housing prices and credit in the US housing market and find that changes in credit availability is positively (negatively) related to housing prices in the long (short) run. In a structural vector error correction model, Anundsen and Jansen (2013) consider housing market in Norway to examine the same nexus and find a two-way causation between housing prices and credit with a quarterly data over 1986 and 2008. Turk (2015) examines the dynamics of Swedish housing market and finds a significant causality from credit to prices in the short run but the opposite direction in the long run by employing quarterly data over 1980 and 2015 within an error correction framework. In a recent study, Lyons (2018) analyzes the Irish housing market and finds a long run relation between housing prices and credit over the period of 2000 and 2016 by exploiting an error correction framework.

3.2.2 Housing Prices and Sentiment

Recent studies show that there is a remarkable attempt to embed psychology in both finance and economics. Question on whether "sentiment[34]" affects asset prices still remains in existence. Studies show that the current feelings of people have impact on their judgement of future events. Put differently, as stated in the literature, in general, people who have positive (negative) sentiment make optimistic (pessimistic) judgements or choices (Johnson and Tversky, 1983; Cooper et al, 2004; Antoniou et al, 2013). Empirical asset pricing literature consists of many tests to see the role of sentiment effect on pricing behavior of assets[35]. Intangible excessive expectations and judgements, i.e., investors'

[34] There are candidate definitions of what sentiment is. According to Antoniou et al. (2013), sentiment refers to whether an individual, for whatever extraneous reason, feels excessively optimistic or pessimistic about a situation. Sentiment is also defined as the aggregate investor attitude on asset prices in a market (Wang and Hui, 2017).

[35] Cooper et al. (2004) test whether the state of the market has predictive power in explaining momentum profits and find that the profits are significant after up-market. In Antoniou et al. (2013), the proxy for sentiment is the consumer confidence index. They find that momentum profits are significant only when investors are optimistic.

psychology corroborate price appreciation in housing (Clayton, 1997; Case and Shiller, 2003; Clayton et al., 2008; Ling et al., 2014).

Other than stocks market, the housing market has limitations on short-selling and an has illiquid nature. Given these features of housing market, arbitrageurs cannot play significant role as much as they do in the stock markets. Particularly, the response of housing prices to information shocks is slower than to that of stock prices. Therefore, it becomes harder to eliminate the mispricing in the housing market (Hui and Wang, 2014; Hui et al., 2017; Zhou, 2018). Compared to stock markets, housing markets experience disequilibrium more frequently. As suggested by Baker and Wurgler (2006), sentiment has significant impact on class of assets with limit to arbitrage. Thus, there exists an eventual asset price deviation in the housing market caused by sentiment. Moreover, incomplete and asymmetric information in the market may lead investors to display herding behavior and form excessive expectations. In turn, sentiment has impact on the trading volume in the market (Wang and Hui, 2017). Therefore, the deviation of housing prices from fundamental and oversupply in the housing market can be attributed to sentiment (Clayton et al., 2008).

This paper is also related to the literature considering the impacts of sentiment in the housing market. From the theoretical perspective, Dieci and Westerhoff (2012) develop a model of speculative housing market to observe price cycles by introducing behavioral motive. Housing prices are determined by the interaction of supply and demand with the latter one consists of real and speculative part. In their modelling of speculative demand for houses, they assume that there are two components, which capture extrapolation and mean-reversion. These two components are subject to change along the time as changes in market circumstances drive predictions of investors. Some investors

believe that housing prices will converge a fundamental steady state level, while others believe that the prices deviate from the long-run steady state because of the speculative actions regarding the bull and bear markets. The solution to nonlinear dynamic system reveals that the speculative actions interact with the real demand and supply of houses and generate complex price dynamics including fundamental equilibrium and different types of bifurcation schemes[36]. Hui and Wang (2014) collect transaction records in Hong Kong housing market and construct sentiment index. Their hypothesis is that the sentiment has significant impact on prices in both short and long run. Based on Granger causality, he finds significant evidence on short term predictability of sentiment on price, return rate of price and liquidity. To test long run relationship, they estimate a VECM model and find that the sentiment is indicative in the housing market. Moreover, their findings also confirm that the sentiment is the second powerful factor affecting housing prices. Dietzel (2016) tests whether real estate related Google search volume data can be considered as a sentiment index and have predicting power in explaining housing market dynamics in the US from 2004:M1 to 2014:M6 by exploiting a multivariate probit model. Findings of the study suggest that Google search data should be considered as a leading sentiment indicator because it predicts price changes in the housing market. Wang and Hui (2017) employ market sentiment defined by an index, which is calculated based on the trading intensity derived from the transactions in housing market and they find that market sentiment has predictive power in forecasting price. Hui et al. (2017) consider Shanghai housing market to investigate the dynamic impact of sentiment on housing returns. To do so, they decompose market sentiment into buyer-seller and developer sentiment indexes. By using principal component analysis and a VAR model, they find

[36] See Dieci & Westerhoff (2012).

that the buyer-seller (developer) sentiment has a positive (negative) impact on housing returns. Their results suggest optimistic thoughts of developers' increases housing returns. Moreover, they also find sentiment has more explanatory power on housing prices compared to market fundamentals. In another study, by quantifying the qualitative tone of media news on housing over 2000:M1 and 2013:M12, Soo (2018) constructs housing market sentiment and finds significant explanatory power of the sentiment in explaining house prices in the US housing market. The underlying interpretation of housing media sentiment lies on the balance of positive and negative words. Zhou (2018) examines the interaction between housing market sentiment and government interventions in Shanghai housing market. The sentiment index is constructed by principal component analysis of multiple sentiment proxies, i.e., newly opened housing construction area, housing sector investment, median holding period of house sellers, total rea of transacted houses, and the return difference between small- and big-house index. He finds that sentiment moves in the same direction with the contemporaneous returns. Moreover, high sentiment is followed by low returns. Regarding the outcomes on sentiment and government interventions, he finds that tightening policies by the government cannot eliminate optimistic thoughts, but high sentiment has negative impact on the effectiveness of tightening policies.

Given that the recent large volume of capital flows due to expansionary monetary policies in advanced economies, credit conditions get relaxed in Turkey. In turn, housing prices exhibit an appreciation and real estate firms and investors undertake new projects without considering demand and supply interaction. Over optimism in the market accelerates further price increases, which is already increasing, and ends up with excess supply in the housing market (Duca et al., 2010). In turn, unsold stocks in the housing market would possibly result in future price decreases.

Based on the literature and discussion we made above, we test the following general hypothesis: psychological factors and expectations have key roles in explaining the housing market dynamics, particularly the housing prices and supply.

Testing this hypothesis includes following steps; first, we check for the long run relationship among sentiment, housing prices, credit on housing, and supply in the housing market. Second, we observe direction and sign of causalities in pairs of time series. Third, we estimate a dynamic model to get the predictive power of explanatory variables. Finally, by running counterfactual experiments, we determine the possible paths of house prices in association with credit and sentiment.

This paper considers the Turkish housing market as a laboratory to uncover the causal relation among sentiment, housing prices, credit on housing and supply of dwellings between 2010:M1 and 2018:M6. By conducting the autoregressive distributed lag (ARDL) model developed by Pesaran and Shin (1999) and Pesaran et al. (2001), we find that there is long run relation among sentiment, housing prices, credit on housing and supply of housing. Using the Toda and Yamamoto causality test, in addition to causalities running from credit to house prices, we also find causalities running from sentiment to credit and to supply. These findings confirm Hui and Wang (2014) as they suggest that the sentiment should be considered as an essential for an analysis in the housing market. After verifying short term predictability power of sentiment and credit in forecasting house prices and supply, we also clarify the role of sentiment and credit in the long run by estimating a various dynamic OLS regressions. While the credit is the leading long run determinant of supply and prices, the sentiment is also significantly effective on both prices and supply. Additional ad-hoc scenarios present the possible path of house prices

in response to optimistic (pessimistic) environment. We find that credit is the factor at most affecting either paths of house prices.

3.3 Data and Methodology

3.3.1 Data

In this paper, we use monthly data to describe the behavior of housing market from 2010:M1 to 2018:M6. This sample covers the period in which emerging economies experience significant volume of capital flows. We are interested in the dynamics of housing market in Turkey and our main variables are sentiment, housing prices, credit volume on housing, and supply of dwellings. In addition to these variables, we also consider industrial manufacturing index and real effective exchange rate. Inflation adjusted series are used and each series is obtained from the Central Bank of the Republic of Turkey (CBRT) except for the sentiment index released by the EUROSTAT.

We employ hedonic housing price index, ***hpi***. Since the house is a composite good, its individual characteristics describe the utility we get form it. Since hedonic prices reflect the quality and characteristic based value, we use ***hpi*** (2015=100) from CBRT.

Concerning the ***sentiment*** on housing market, we employ seasonally adjusted monthly construction confidence index released by European Commission. Economic Sentiment Index (ESI) provided by EUROSTAT is composed of surveys in industry, construction, retail trade, consumer, and services[37]. The questions in these surveys aim to

[37] For further details, see https://ec.europa.eu/info/sites/info/files/bcs_user_guide_en_0.pdf.

measure expectations and opinions of participants. Since our focus is the construction sector, we provide a brief overview of the survey in construction. Variables covered in the survey are as follows: "building activity, factors limiting building activity, overall orderbooks, firm's employment expectations (following 3 months), and selling prices (following 3 months)". Answers to questions, except for the limiting factors, have three optional scales: "increase" (+), "remain unchanged" (=), or "decrease" (-); "more than sufficient" (+), "sufficient" (=), or "not sufficient" (-). The overall results are transformed into quantitative measure as a balance, i.e., $index = (\#positive - \#negative)/\#answers$. For the interpretation purposes, as in Soo (2018), in case where we have negative values, we adjust our series by adding 100 to make it positive. Particularly, a negative estimate should be interpreted as if it were positive.

Time series behavior of sentiment in housing market is displayed in Figure 3.2. As shown by the trend line, dashed line, there is a pessimistic aggregate attitude in the Turkish housing market. Starting from the beginning of 2018, the pessimism has been strongly felt in the market, as shown by the sharp decline in time series of sentiment index.

In response to unconventional monetary policy decisions in advanced economies, capital flows into emerging economies enhance credit conditions in these economies. Availability of credit increases households' affordability, which would have an impact on housing prices via shifting demand. We believe that the fluctuations in housing prices are mainly devoted to less restricted credit conditions. Therefore, we use real credit volume on housing (***credit***) as the important determinant of housing prices.

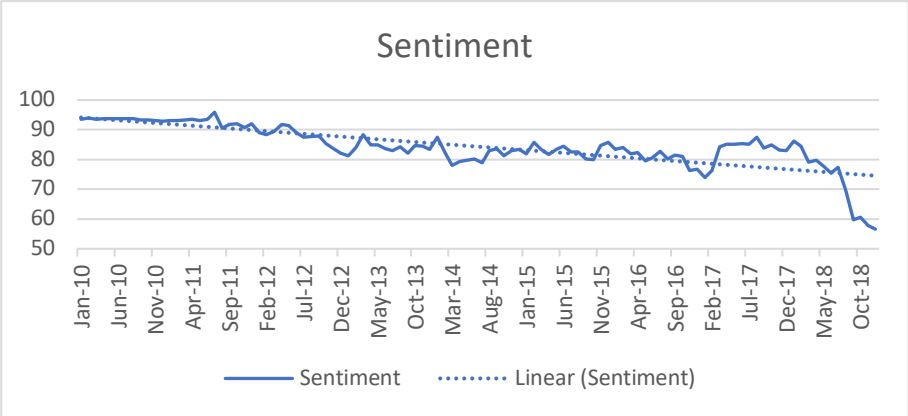

Figure 3.2: Sentiment in Turkish Housing market
(Source: Eurostat)

Credit conditions also have impact on supply side of the housing market through increasing prices. Real estate firms and contractors have optimistic expectations in making profits because they believe that appreciation in housing prices would continue because of the comfortable credit conditions. In determining the housing price, we also consider supply behavior in the housing market. To do so, we calculate supply of new dwellings. To construct the data, we first take monthly housing unit prices (TL/square meter). Then, we obtain monthly dwelling residential buildings floor area (square meter) including one-, two- or more- dwellings. By deflating the multiplication of these two series, we have monthly real value of ***supply***.

We use industrial production index (***ipi***) as a proxy for economic activity. Due to restrictions on data availability, we cannot reach monthly data for gdp per capita and, instead, we use seasonally adjusted ***ipi***, which is obtained from EVDS data store of CBRT. As it is expected, an increase in any of the affordability measures, the prices would increase. To evaluate the effects of competitiveness of domestic currency we use real effective exchange rate, ***reer***. Depreciation in domestic currency would be appealing especially for foreign investors as their purchasing power increases against home currency, which may contribute to price appreciation in housing.

More details on variable construction, summary statistics, and correlation matrix can be found in Appendix.

3.3.2 Methodology and Specification

The model in this paper employs supply as the dependent variable and housing prices, credit volume, industrial production, real effective exchange rate, and sentiment as the regressors. All variables are deflated and in their logarithmic form. The specified model in this paper is as follows:

$$supply_t = \beta_0 + \beta_1 hpi_t + \beta_2 credit_t + \beta_3 ipi_t + \beta_4 reer_t + \beta_5 sentiment_t + \varepsilon_t$$

3.3.2.1 Order of Integration

Stationary tests (Dickey and Fuller, 1979; Phillips and Perron, 1988) are applied to investigate the order of integration of variables, which is decisive part for the analysis of long run relationship. We first conduct Augmented Dickey Fuller (ADF) test stationary test in levels and first differences. As an alternative, we perform Phillips and Perron (1988) test with the same manner to determine order of integration and see if the results are consistent within and across tests.

3.3.2.2 Testing for Long-Run Relationship: Bounds Testing

If there is an uncertainty in terms of order integration of the series, we test whether there is a long run relationship among variable with autoregressive distributed lag

(ARDL) approach offered by Pesaran and Shin (1999) and Pesaran et al. (2001). This method includes bounds testing procedure and is applicable to test for the relationship among variables irrespective of whether they are purely I (0), or I (1), or mixture of I (0) and I (1).

Pesaran et al. (2001) develop an approach to test whether there exists relationship between levels of dependent and independent variables under consideration when there is an uncertainty of order of integration of regressors. In their proposed linear ARDL model, both the dependent variable and regressors are related both contemporaneously and historically.

ARDL representation of specified equation is as follows:

$$\Delta supply_t = c_0 + \sum_{i=1}^{p} c_{1i}\Delta supply_{t-i} + \sum_{i=0}^{p} c_{2i}\Delta hpi_{t-i} + \sum_{i=0}^{p} c_{3i}\Delta credit_{t-i} + \sum_{i=0}^{p} c_{4i}\Delta ipi_{t-i} + \sum_{i=0}^{p} c_{5i}\Delta reer_{t-i} + \sum_{i=0}^{p} c_{6i}\Delta sentiment_{t-i} + \gamma_1 supply_{t-1} + \gamma_2 hpi_{t-1} + \gamma_3 credit_{t-1} + \gamma_4 ipi_{t-1} + \gamma_5 reer_{t-1} + \gamma_6 sentiment_{t-1} + \vartheta_t.$$

The null hypothesis of bounds procedure tests is that there are no levels of relationship. If the computed value of F-statistics falls outside the asymptotic critical value bounds, we can make decision no matter what the cointegration rank of regressors is. The decision on the existence of relationship is made upon two sets of asymptotic critical bounds, which assume that all regressors are either I (0) or I (1).

The null and alternative hypotheses for no long run relationship regarding the ARDL model can be stated as follows:

$$H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0$$

$$H_1: at\ least\ one\ of\ them\ is\ not\ equal\ to\ 0.$$

F- Bounds testing procedure has either of three results;

1. $if\ F-statistics < I\ (0)$, then we fail to reject H_0 and conclude that there are no levels of relation because variables are stationary at levels.

2. $if\ I\ (0) < F-statistics < I\ (1)$, then the test is inconclusive.

3. $if\ I\ (1) < F-statistics$, then we reject H_0 and conclude that the equilibrating relation exists.

If there is a long run relationship among variables verified by the bounds testing procedure, the error correction term can be recovered through the estimation of error correction model (ECM)

$$\Delta supply_t = c_0 + \sum_{i=1}^{p} c_{1i}\Delta supply_{t-i} + \sum_{i=0}^{p} c_{2i}\Delta hpi_{t-i} + \sum_{i=0}^{p} c_{3i}\Delta credit_{t-i} + \sum_{i=0}^{p} c_{4i}\Delta ipi_{t-i} + \sum_{i=0}^{p} c_{5i}\Delta reer_{t-i} + \sum_{i=0}^{p} c_{6i}\Delta sentiment_{t-i} + \emptyset EC_{t-1} + \vartheta_t$$

where $\emptyset$ is the speed of adjustment, which is expected to be negative and statistically significant as it implies the correction of deviations into equilibrium.

2.3.2.3 Causality Tests: Toda and Yamamoto Approach (T-Y)

In this paper we conduct causality test investigated by Toda and Yamamoto (1995) approach to infer the causal relation among housing prices, credit on housing, supply in the housing market, and sentiment. This modified version of Granger causality[38] test considers VAR system in levels. The algorithm is similar to traditional Granger causality

[38] By definition, y is said to Granger-cause x if current or lagged values of y contritubes to a better prediction of future values of x when compared to x alone, other relevant information being used in the prediction. In a formal way, y fails to Granger-cause x if for all $s > 0$ the mean squared error of a forecast of x_{t+s} based on $(x_t, x_{t-1}, ...)$ is the same as the mean squared error of a forecast of x_{t+s} that uses both $(x_t, x_{t-1}, ...)$ and $(y_t, y_{t-1}, ...)$. If one restricts itself to linear functions, y fails to Granger cause x if $MSE\left[\hat{E}(x_{t+s}|x_t, x_{t-1}, ...)\right] = MSE\left[\hat{E}(x_{t+s}|x_t, x_{t-1}, ..., y_t, y_{t-1}, ...)\right]$. For further details, see Hamilton (1994).

test but differs with respect to the lag of VAR, k, depending on the order of maximum order of integration, d_{max}. VAR in levels with a lag of $(k + d_{max})$ is estimated and the coefficients of last lag is dropped. The T-Y method, which improves over traditional granger causality, is applicable whether VAR system may be stationary, integrated or cointegrated of an arbitrary order. Wald test can be used to determine the causal relation among series. The Wald test statistics would be asymptotically chi-square distributed as far as the order of integration of the process does not exceed the lag length of VAR model. To identify causal relation among series of housing price, credit, supply, and sentiment, the VAR models we set up can be described as follows:

Equation 1

$$hpi_t=\alpha_0+\sum_{i=1}^{k}\alpha_{1i}hpi_{t-i}+\sum_{j=k+1}^{d_{max}}\alpha_{2j}hpi_{t-j}+\sum_{i=1}^{k}\omega_{1i}sentiment_{t-i}+\sum_{j=k+1}^{d_{max}}\omega_{2j}sentiment_{t-j}+$$
$$\sum_{i=1}^{k}\beta_{1i}credit_{t-i}+\sum_{j=k+1}^{d_{max}}\beta_{2j}credit_{t-j}+\sum_{i=1}^{k}\gamma_{1i}supply_{t-i}+\sum_{j=k+1}^{d_{max}}\gamma_{2j}supply_{t-j}+u_{1t}$$

Equation 2

$$supply_t=\xi_0+\sum_{i=1}^{k}\xi_{1i}supply_{t-i}+\sum_{j=k+1}^{d_{max}}\xi_{2j}supply_{t-j}+\sum_{i=1}^{k}l_{1i}sentiment_{t-i}+\sum_{j=k+1}^{d_{max}}l_{2j}sentiment_{t-j}+$$
$$\sum_{i=1}^{k}\tau_{1i}hpi_{t-i}+\sum_{j=k+1}^{d_{max}}\tau_{2j}hpi_{t-j}+\sum_{i=1}^{k}\phi_{1i}credit_{t-i}+\sum_{j=k+1}^{d_{max}}\phi_{2j}credit_{t-j}+\epsilon_{1t}$$

Equation 3

$$credit_t=\eta_0+\sum_{i=1}^{k}\eta_{1i}credit_{t-i}+\sum_{j=k+1}^{d_{max}}\eta_{2j}credit_{t-j}+\sum_{i=1}^{k}z_{1i}sentiment_{t-i}+\sum_{j=k+1}^{d_{max}}z_{2j}sentiment_{t-j}+$$
$$\sum_{i=1}^{k}\zeta_{1i}hpi_{t-i}+\sum_{j=k+1}^{d_{max}}\zeta_{2j}hpi_{t-j}+\sum_{i=1}^{k}\theta_{1i}supply_{t-i}+\sum_{j=k+1}^{d_{max}}\theta_{2j}supply_{t-j}+\vartheta_{1t}$$

Equation 4

$$sentiment_t = \eta_0 + \sum_{i=1}^{k} r_{1i} sentiment_{t-i} + \sum_{j=k+1}^{d_{max}} r_{2j} sentiment_{t-j} + \sum_{i=1}^{k} \eta_{1i} credit_{t-i} + \sum_{j=k+1}^{d_{max}} \eta_{2j} credit_{t-j} + \sum_{i=1}^{k} \zeta_{1i} hpi_{t-i} + \sum_{j=k+1}^{d_{max}} \zeta_{2j} hpi_{t-j} + \sum_{i=1}^{k} \theta_{1i} supply_{t-i} + \sum_{j=k+1}^{d_{max}} \theta_{2j} supply_{t-j} + e_{1t}$$

From ***Equation 1***, the null hypothesis is that *sentiment*, *credit*, and *supply* do not granger cause *hpi* if $\omega_{1i} = \beta_{1i} = \gamma_{1i} = 0$. Similar reasoning follows for the rest of the equations, but parameters would change only.

2.3.2.4 Dynamic OLS (DOLS)

For the cointegrating regressions, Saikkonen (1991) and, Stock and Watson (1993) obtain asymptotically efficient estimators via dynamic OLS with a time domain correction. This augmented version of traditional OLS estimator takes endogeneity and serial correlation of independent variables into account by including lead and lag differences of independent variables. Moreover, this procedure is applicable irrespective of order of integrations of variables in small samples. Having said these, we also utilize DOLS estimation to extract long-run coefficients and evaluate predictive power of variables.

3.4 Results

3.4.1 Order of Integration

Table 3.1 displays the result of ADF and PP unit root tests. Regarding the order of independent variables, i.e., *ipi* and *credit*, we have inconclusive results.

Table 3.1: Order of Integration of Variables

	Level		First Difference		
	ADF	PP	ADF	PP	
Variables	Prob.		Prob.		Order
supply	0.0544	0.0000	0.0001	0.0001	Uncertainty
hpi	0.8090	0.8090	0.0000	0.0000	I (1)
reer	0.8944	0.9482	0.0000	0.0000	I (1)
ipi	0.9935	0.0000	0.0153	0.0001	Uncertainty
credit	0.1743	0.0048	0.0577	0.0000	Uncertainty
sentiment	0.2837	0.4794	0.0000	0.0001	I (1)

This table reports the results of stationarity tests. ADF and PP tests are conducted to investigate order of integrations of each variables. I (1) indicates that stationarity is achieved when the its first difference of relevant variable is taken. Uncertainty indicates that stationarity tests have mixed results in determining the order of integration of that variable. More information about the variables can be found in the Appendix.

3.4.2 ARDL Model

Deterministic components are specified based on the unrestricted intercept and no trend, namely, Case III. (Pesaran et al., 2001). To uncover the long run relation, we estimate the ARDL model when *supply* is the dependent variable. Table 3.2 reports the estimation results. The estimates of price and credit are statistically significant; however, the remaining variables are not significant. A 1% increase in housing prices yield a 2.09% increase in stocks, which verifies the link between prices and the supply. Moreover, the coefficient of credit exhibits a strong interaction with the supply of housing. Stocks of dwellings increase by 12.39% when there is a 1% increase in credit, which strongly confirms the sensitivity of supply of housing to credit. Estimate of sentiment also

confirms the significance of sentiment in explaining the supply side in the housing market.

Table 3.2: Estimated ARDL

Variable	*Coefficient*	*Std. Error*	*t-Statistics*	*Probability*
$supply(-1)$	0.18	0.08	2.04	0.044
hpi	2.09	0.94	2.21	0.029
$reer$	0.43	1.51	0.28	0.772
$reer(-1)$	2.9	2.38	1.21	0.226
$reer(-2)$	-4.62	1.51	-3.04	0.003
ipi	1.42	0.45	3.12	0.002
$credit$	12.39	3.56	3.47	0.000
$credit(-1)$	-12.23	3.53	-3.45	0.000
$sentiment$	-1.65	0.89	-1.83	0.069
C	13.51	12.37	1.09	0.277
Obs.	100			
R^2	0.61			
Adjusted R^2	0.57			
F-statistics	15.93			

This table reports estimation results of ARDL (1,0,2,0,1,0), in which the dependent variable is supply. Statistical significance is given by the t-statistics greater than 1.96 in absolute value.

3.4.2.1 Residual Diagnostics

We perform relevant diagnostic tests to check whether the residuals are serially uncorrelated and homoskedastic. Table 3.3 reports the results of diagnostics tests. Values obtained from both tests display a clear picture that we do not have problem with serial correlation and heteroskedasticity. We fail to reject the null hypothesis of LM serial correlation test is that the residuals are serially uncorrelated as the p-value of critical value of F-statistics, 0.98, is greater than 0.05. Residuals are homoskedastic since the p-value of F-statistics is greater than 0.05.

Table 3.3: Diagnostics Tests

Tests	H_0	*F-statistic*	*p-value*	*Decision*
Breusch-Godfrey LM	No serial correlation	0.01	0.98	$Fail\ to\ reject\ H_0$
Breusch-Pagan-Godfrey	Homoskedasticity	0.88	0.54	$Fail\ to\ reject\ H_0$

This table reports the results of diagnostics tests. We check for serial autocorrelations and heteroskedasticity for residuals.

3.4.2.2 Bounds tests for the existence of level relationship

Table 3.4 displays the results of bounds test on the null hypothesis for no levels of relationship among variables,

$$H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = 0$$
$$H_1:\ at\ least\ one\ of them\ is\ not\ equal\ to\ 0.$$

Table 3.4: Bounds Tests

Bounds Tests	H_0	*Value*	*Significance Level*	*I (0)*	*I (1)*	*Decision*
F-Bounds Test	No levels relationship	19.77	10%	2.26	3.35	
			5%	2.62	3.79	
			1%	3.41	4.68	
						$Reject\ H_0$
t-Bounds Test	No levels relationship	-9.28	10%	-2.57	-3.86	
			5%	-2.86	-4.19	
			1%	-3.43	-4.79	
						$Reject\ H_0$

This table reports the results of bounds tests. Value is the F-statistics. I (0) and I (1) are critical values suggested by Pesaran et al. (2001).

F-statistic value 19.77 exceeds I (1) critical value bound, which indicates that a rejection of null that there is no equilibrating relationship. Moreover, the absolute value of t-bounds test statistics is greater than the absolute value of both I (0) and I (1), therefore, we reject the null hypothesis that states that there is no level relationship. Critical values are obtained from Pesaran et al. (2001).

3.4.2.3 Error Correction Model (ECM)

Since bounds testing indicates that there is a long run relation among variables, the following error-correction model is estimated to obtain the error correction term. Table 3.5 displays the results of ECM.

Table 3.5: Estimated ECM

Variable	*Coefficient*	*t-Statistic*	*Prob*
C	13.51	11.13	0.000
$\Delta reer$	0.43	0.30	0.758
$\Delta reer(-1)$	4.62	3.28	0.001
$\Delta credit$	-12.39	5.05	0.000
$\emptyset(-1)$	-0.82	-11.18	0.000
Obs.	100		
R^2	0.63		
Adjusted R^2	0.61		
F-statistics	41.04		

This table reports the estimation results of Error Correction Model (ECM). The coefficient for $\emptyset$ indicates speed of adjustment into equilibrium.

Speed of Adjustment

Since we have the long-run estimates of ARDL model, we can compute how fast the deviations from equilibrium would be adjusted. To do so, we estimate error correction model and find that the speed of adjustment coefficient is negative and highly significant, which is what we expect to have. This estimate indicates an adjustment into equilibrium in the long run. For our analysis, about 0.82% of disequilibrium are corrected for within one month.

3.4.3 Causality Tests: Toda and Yamamoto Approach (T-Y)

Table 3.6 displays the results of Toda-Yamamoto granger causality tests. Results suggest that the credit is found to affect house prices, but the opposite causation is not supported. We also find causations from sentiment to both credit and supply. These results confirm that credit is responsible for the house price appreciations. Moreover, sentiment should be counted as one of the most important factors in the housing market as the sentiment is significant in forecasting supply, which, in turn, has impact on prices. Sentiment has the ability of direct predictive power of credit, which confirms that the investors use past as a guide and shape their expectations accordingly. Figure 3.3 displays a clear picture of directions of statistically significant causalities, as well. Overall, our findings highlight an interconnected action scheme among sentiment, housing credit, housing prices, and supply in the housing market in Turkey.

Table 3.6: The results of T-Y Granger causality tests

Null hypothesis H_0	*Wald chi-square Statistic*	*Prob.*	*Reject* H_0
hpi does not Granger cause $supply$	4.79	0.441	N
$credit$ does not Granger cause $supply$	4.61	0.465	N
$sentimet$ does not Granger cause $supply$	11.8	0.037	**Y**
$supply$ does not Granger cause hpi	7.95	0.158	N
$credit$ does not Granger cause hpi	17.32	0.004	**Y**
$sentiment$ does not Granger cause hpi	7.13	0.21	N
$supply$ does not Granger cause $credit$	6.27	0.28	N
hpi does not Granger cause $credit$	7.31	0.198	N
$sentiment$ does not Granger cause $credit$	13.85	0.016	**Y**
$supply$ does not Granger cause $sentiment$	6.45	0.264	N
hpi does not Granger cause $sentiment$	4.19	0.522	N
$credit$ does not Granger cause $sentiment$	3.21	0.666	N

This table reports the results of causality tests. The test we conduct is, Toda and Yamamoto, a modified version of traditional Granger Causality. The definitions of variables are available in the Appendix.

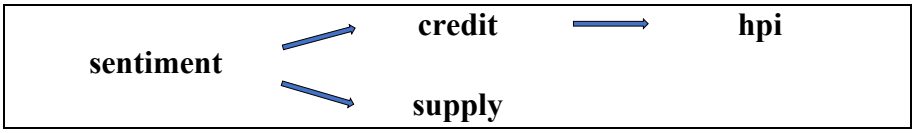

Figure 3.3: The directions of significant causalities among variables

The sign of causalities

It is also important to observe whether the causality is either positive or negative. To test for this situation, we apply Wald coefficient restriction test. To do so, from the VAR estimation results, we first compute the sum of coefficients of lagged series of statistically significant granger causalities and test whether the sum is statistically equal to zero. If we reject the null hypothesis of Wald test that states the restriction is zero, we conclude that the causality is either positive or negative depends on the sign of sum of coefficients. We sum the lagged coefficients of sentiment in VAR equation where the dependent variable is credit. Then, we check whether this sum is statistically different than zero by conducting a Wald test. If the probability of computed test statistics, i.e., chi-square, is less than 0.05, we reject the null and conclude that the sum is not equal to zero, and therefore, the causation is either positive or negative depending on the sign of sum.

Table 3.7: A Wald Test on signs of causalities

Causalities	*Sign of Sum*	*Null hypothesis* H_0	*Chi-square*	*Probability*	*Reject* H_0
$sentimet \rightarrow supply$	negative	$sum\ of\ lagged\ coefficients\ is\ zero.$	0.041	0.83	N
$credit \rightarrow rhhpi$	negative		0.427	0.51	N
$sentimet \rightarrow credit$	negative		4.939	0.02	Y

Table 3.7 provides us information with the results of the significance of the sign of causations. Among the significant causalities obtained from the T-Y approach, we can

conclude that the total impact of causation from sentiment to credit is negative[39] and statistically significant over the horizon. On the other hand, total effect of causations run from housing credit to housing price index, and sentiment to supply do not give us clear picture of the sign since we fail to reject the null hypothesis.

3.4.4 Dynamic OLS

Table 3.8 displays estimation results of dynamic OLS. To evaluate and compare the long run predictive power of sentiment in explaining the evolution of supply and prices in the housing market, we estimate various models. Variables are in logarithmic form.

In panel A (B), we have estimation results of models in which the dependent variable is supply (price). For panel A, in association with other control variables, exchange rates and economic activity, models with housing price, credit, and sentiment have explanatory power by 60%, 62%, and 52% in explaining the variation in supply.

The coefficients of these variables are statistically significant, and signs are what we expected to have. The coefficient of sentiment is -3.07, which implies that a 1% change in sentiment increases supply of dwellings by 3.07%. This result suggests that positive aggregate attitude in the market has positive impact on supply side. In the meantime, we would expect to have 3.78% (1.74%) change in supply when prices (credit) increases by 1%. These results are consistent with the economic theory. As the price of a supplied asset increases, the suppliers aim to produce more of it. Moreover, enhancing funding conditions have positive impact on demand side. To meet the increase in demand, producers increase supply, too. For panel B, affordability measures, namely both credit

[39] See data description of sentiment. Since we modify actual sentiment data for calculation purposes, an estimate with negative sign should be interpreted as if it were positive.

and economic activity play significant role in explaining prices. In addition to explanatory power of variables itself, we have surprising results on coefficients of industrial production index, which we use proxy for economic activity. It is expected to have a positive relation with housing prices in the long run, i.e., as the economy improves, prices would increase as well. However, the negative coefficient may indicate weak local demand and support foreign housing demand[40] in Turkish housing market over our sample. Recently, the housing market in Turkey is actually appealing for foreigners. Overall, our findings confirm the significant role of sentiment not only in the short run but also in the long run in the housing market, which confirms the findings of (Hui & Wang, 2014)

[40] See Wang & Hui (2017).

Table 3.8: Estimates of Dynamic OLS

	Panel A: dependent variable is *supply*						Panel B: dependent variable is *hpi*				
Regressors	1	2	3	4	5	6	1	2	3	4	5
hpi	3.78 [3.071]			3.57 [7.072]							
supply							0.05 [1.64]				
credit		1.74 [4.02]			1.64 [6.32]		0.17 [2.108]	0.27 [4.63]		0.4 [9.1]	
reer	-0.8 [-0.91]	0.79 [0.55]	-0.96 [-1.21]				0.09 [0.509]	0.12 [0.638]	-0.3 [-2.52]		
ipi	1.28 [0.85]	-1.04 [-0.81]	-1.55 [-1.18]				-0.702 [-4.00]	-0.76 [-4.44]	-0.75 [-3.83]		
sentiment			-3.07 [-2.5]			-4.98 [-5.19]			-0.33 [-1.8]		-1.17 [-5.33]
C	4.24 [0.322]	-7.55 [-0.558]	48.99 [10.87]	7.41 [3.22]	-6.85 [-1.41]	45.86 [10.73]	2.77 [1.55]	2.5 [1.37]	10.92 [16.00]	-3.06 [-3.64]	9.78 [9.96]
Obs.	97	97	97	97	97	97	97	97	97	97	97
R^2	0.60	0.62	0.52	0.50	0.53	0.32	0.92	0.91	0.84	0.81	0.54
Adjusted R^2	0.51	0.53	0.41	0.46	0.50	0.27	0.89	0.88	0.80	0.80	0.51

This table reports the estimation results of Dynamic OLS. Panel A (B) includes coefficients of regressions, in which the dependent variable is supply (hpi). For each panels, we use different set of regressors, so we have coefficients for different models. t-statistics are reported in parentheses. We use monthly data covers the period from 2010:M1 to 2018:M6. The definitions of variables are available in the Appendix. Since we modify actual sentiment data for calculation purposes, a coefficient for sentiment with negative sign should be interpreted as if it were positive.

3.4.5 Counterfactual Analyses: Path of House Prices

To evaluate path of house prices, we conduct counterfactual[41] experiments based on an estimated VAR model, in which credit and prices are endogenous and sentiment is exogenous. The forecasted values of price depend on the forecasts of both credit and sentiment. Given that the causality results, we assume that our proxy for sentiment and credit volume on housing in the market behave differently and observe the path of prices under two polar scenarios. Particularly, the VAR-based counterfactual analyses consist of following scenarios starting from June 2017 to April 2019:

1. *Optimistic scenario*: we assume that confidence in the housing market is stronger and credit conditions are more relaxed by 10% than the actual data at hand.
2. *Pessimistic scenario*: In our second simulation, we assume conversely, i.e., people are pessimistic about the housing market and housing credit volume is restricted by 10%.

Our analyses suggest that the sentiment and credit volume on housing have impact on housing prices. The path of house prices differs depending on the state of housing market. The solid lines refer to the baseline, while the lines with circle and cross refer to the corresponding scenarios assuming that there are modifications on sentiment and credit conditions, respectively. In the optimistic (pessimistic) scenario, VAR-based forecast for house prices following a 10% increase (decrease) in sentiment is higher (lower) than the baseline, but not as high (low) as the forecast following a 10% increase (decrease) in credit volume. The counterfactual exercises we conducted confirm substantial impact of

[41] A counterfactual analysis is an answer to the question of 'what would have happened if some of the observed characteristics were different from those prevailing at the time' Michail (2019).

sentiment and credit on house prices. Figure 3.4 and Figure 3.5 exhibit results of counterfactual experiments.

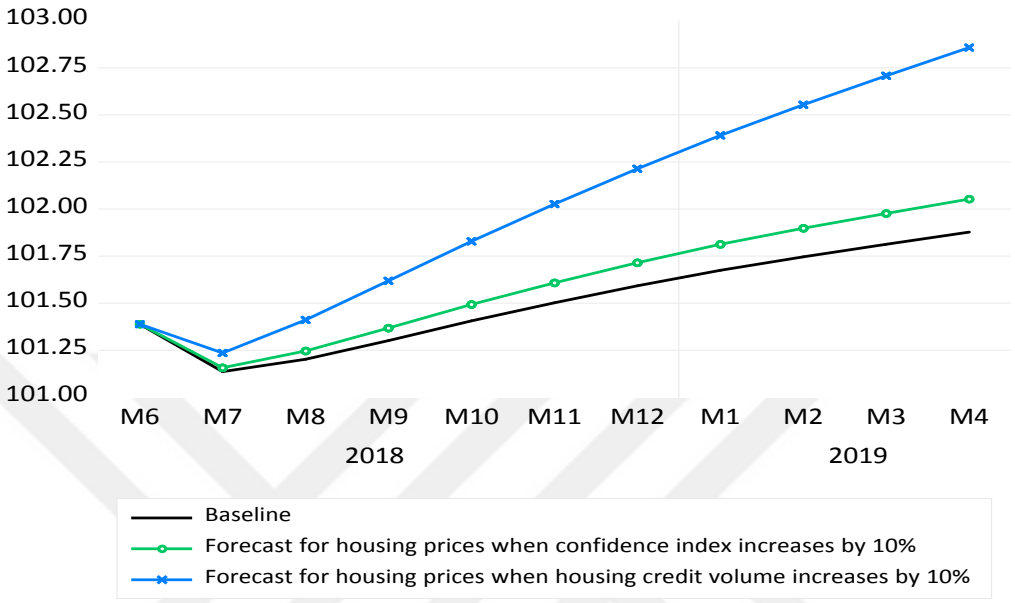

Figure 3.4: Optimistic Scenario

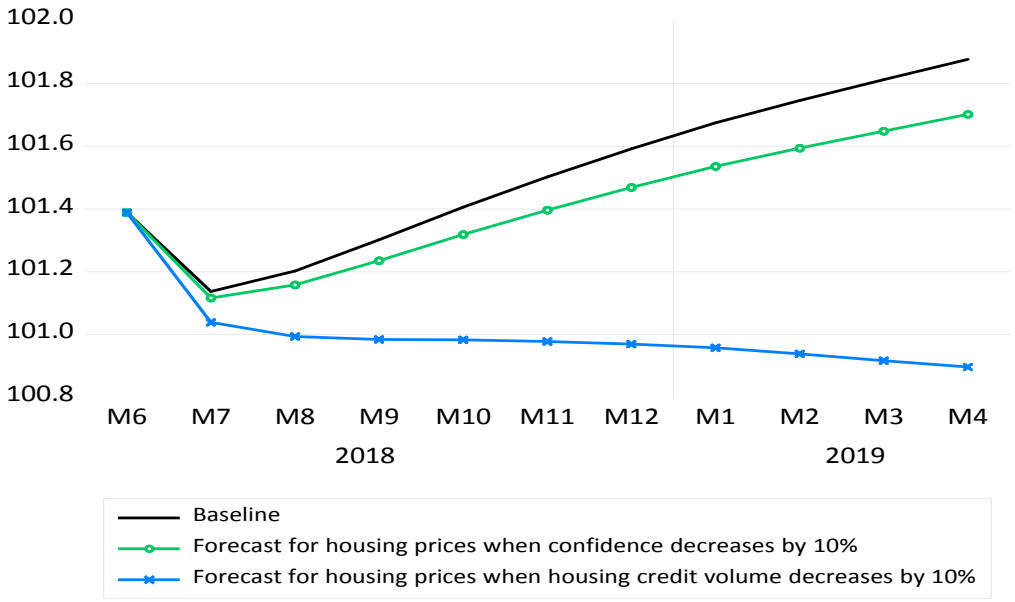

Figure 3.5: Pessimistic Scenario

3.5 Conclusion and Policy Recommendations

In this paper, we investigate the role of sentiment and consider it as a requisite to study the dynamics in the housing market. In this sense, we first analyze and find long run interdependence among housing prices, credit, sentiment, and supply of dwellings by employing bounds test approach. Then, we examine the causal relation among these variables and find that the sentiment has short run forecasting power of price appreciations and excess supply in the housing market. In addition to these causalities, we find significant one-way causation from credit to prices. This result is also consistent with the findings of Carrington and Madsen (2011) Anundsen and Jansen (2013), Lyons (2018). Among these causations, we find a positive causality from sentiment to credit.

For oversupply of housing stocks, we find that the 0.82 % of deviation from equilibrium is adjusted in a month. Moreover, we also show that the sentiment is a significant factor at work in explaining the variations in supply in the long run. These findings are consistent with that of Hui and Wang (2014) and Wang and Hui (2017). Psychological factors have impact on the supply side of the housing market, which, in turn reflect changes in the prices. Our VAR-based counterfactual scenarios conclude that the house price path is more sensitive to changes in credit.

Due to the recent financial crisis triggered from the U.S. housing price bubbles, housing market performance is regarded as a well-accepted indicator for assessing the whole macroeconomic conditions of an economy. Housing sector plays a key role for the stability of the economy because investment in housing comprises a significant part of national wealth. Any imbalance especially in the housing market would jeopardize the health of the economy. Therefore, authorities should carefully watch real estate sector

closely, detect possible imbalances, and conduct appropriate prudential regulations in advance. By doing so, policy makers should conduct appropriate communication with accurate information to shape expectations about the economic conditions.

One of the most important lessons from the financial crisis across the world is that the functioning of the housing market in accordance with monetary and fiscal policy should be seriously taken into account so that the combination of both policies should solve prospective distortions, in advance. To mitigate the financial instability, credit-based funding schemes should be adjusted according to designated leverage ratios and risk history of creditors.

Reforms should be made to manage allowance of investors who would like to enter in the housing market and carry out construction because many investors who have not been in the construction sector before had entered in the housing market. Before allowing investors to carry out construction, in addition to their financial situations, their technical competence should also be evaluated with respect to certain criteria, which are released by an independent merit-based organization in cooperation with the government. Agents in the supply side of the housing sector should provide completion insurance of the construction. Then, authorities let them to sell the stocks once the investors complete their commitments on construction.

Reforms on the infrastructure, land area and demographics should be taken into account, as well. Local governments should consider demographics such as population growth due to migration and birth/death rates and forecast required number of dwellings accordingly to sustain balance between demand and supply of housing as much as

possible. Moreover, starting from local to general, authorities should spend time on determination of right land area to construct the buildings regarding the density of population.

In terms of prices, including the consumer associations, authorities should form independent organization to determine the values for each and every designated regions of cities and set a threshold for the housing prices accordingly. To achieve the transparency, all the transactions should be made through financial institutions under the control of government. In case of Turkey, where the growth in the construction sector takes significant part of overall growth, reforms and policies should be conducted such that construction sector would have positive spillover effects on both production and employment in domestic economy.

3.6 Appendix

Table A3.1: Data Description, Units, and Sources

Variables	Construction	Unit	Source
hpi	Logarithm of real hedonic housing price index deflated by CPI (2015=100)	Index	CBRT
$credit$	Logarithm of real credit on housing deflated by CPI (2015=100)	Million TL	CBRT
$supply$	Logarithm of real investment deflated by CPI (2015=100), which is multiplication of unit price of per meter square and total area of 1 and 2+ dwellings	Million TL	CBRT
$reer$	Logarithm of real effective exchange rate deflated by CPI (2015=100)	Index	CBRT
ipi	Logarithm of seasonally adjusted industrial production index (2015=100)	Index	CBRT
$sentiment$	Balance as the number of positive minus negative answers divided by the total answers	Score	EUROSTAT

Table A3.2: Descriptive Statistics

Variables	Observation	Mean	Std. Dev.	Min	Max
hpi	102	94.75	8.35	83.47	107.63
$credit$	102	1.20E+08	24712785	68330053	1.55E+08
$supply$	102	2.17E+10	1.45E+10	6.17E+09	1.15E+11
$reer$	102	103.5	10.76	77.29	126.29
ipi	102	100.54	9.23	78.12	121.97
$sentiment$	102	85.55	5.26	74	95.9

Table A3.3: Correlation Matrix

Variables	hpi	$credit$	$supply$	$reer$	ipi	$sentiment$
hpi	1					
$credit$	0.91	1				
$supply$	0.48	0.46	1			
$reer$	-0.77	-0.87	-0.35	1		
ipi	-0.47	-0.37	-0.03	0.36	1	
$sentiment$	-0.67	-0.79	-0.30	0.66	0.35	1

CHAPTER IV

THE IMPACT OF GOING PUBLIC ON EMPLOYMENT GROWTH AND USE OF FUNDS: EMPIRICAL EVIDENCE FROM IPO LISTED FIRMS IN TURKEY OVER 2000-2016

4.1 Introduction

What is the impact of going public on firm-level employment growth? During the life of a company, the decision on issuing initial public offerings (IPO) can be counted as one of the most important events. Therefore, the interest of academicians and policymakers on IPOs has been long lasting. Similarly, the dynamics and functioning of labor markets is one of the most important prominent and ageless topics in economics.

The stage of an IPO has effects on corporate governance, financial constraints, information environment, and ownership and capital structure of a firm. However, we have scarce evidence on the effects of going public on labor force of a firm. This is important because human capital is an important source for the value of a firm (Zingales, 2000).

Changing conditions in global economy affects funding schemes of corporations and their employment level. For example, on the heels of financial crisis, to encourage startups and support small businesses, Barrack Obama, former president of the U.S., signed the Jumpstart Our Business Startups (JOBS) Act. According to this law, small businesses and high-growth oriented firms are expected to receive higher cash flows through IPO, which leads them to grow faster and hire more workers.

In this study, we investigate whether IPOs have impact on firm-level employment growth. Moreover, we aim to observe main motivations behind going public for IPO listed firms.

In the IPO literature, there are many attempts to understand the reason behind why firms go public[42]. Issuing offerings and having access to external equity affect firms' assets and capital by relaxing their financial constraints (Carpenter & Rondi, 2006; Pagano, Panetta, & Zingales, 1998; Subrahmanyam & Titman, 1999); innovation activities (Bernstein, 2015); human capital (Babina, Ouimet, & Zurutskie, 2019; Baghai & Silva, 2019; Bernstein, 2015; Borisov, Ellul, & Sevilir, 2019; Carter, Dark, & Singh, 1998; Chemmanur & Paeglis, 2005; Dong, Michel, & Pandes, 2011).

The literature has considered the role of human capital in IPO listed firms in various dimensions. For example, Carter et al. (1998) and Dong et al. (2011) emphasize on the role of underwriters' reputation on the long run performance of IPO stocks and find that good reputation of underwriter has positive impact on the performance of IPO firms. Bernstein (2015), investigates the role of skilled inventors and find that the technology firms, which went to public experience a decrease in the number of skilled workers following the IPO as the quality of innovation declines because of the agency problems between managers and shareholders. The main concern for managers to lose his job when the innovation fails and shareholders blame manager for the failure. Such career concern avoids manager from investing in innovations. The particular interest of the most recent empirical works by Babina et al. (2019)[43] and Borisov et al. (2019)[44] is the

[42] To identify IPO motivations, three approaches are followed in the literature are as follows: 1) Surveys with managers , 2) Prospectus statements, and 3) Accounting information (Andriansyah & Messinis, 2016).
[43] According to a sample of 3,400 observations, firms complete their IPO increase their employment annually by 23% over the three years following the IPO.
[44] An examination on employment dynamics of a sample of 3,654 firms indicates that the average firm in the sample experiences employment growth by 39% during.

employment growth of IPO listing firms. Both papers show that the IPO firms, on average, experience a positive employment growth following their post-IPO period. Their findings are consistent with the ability of a firm to hire more employees after the influx of fresh capital exists. Baghai & Silva (2019) consider the effect of going public on the composition of work force and find that accessing to public equity has a positive effect on professionalism regarding the recruitment process, wages, and human capital. While Babina et al. (2019) and Borisov et al. (2019) consider the impact of IPOs on size of the labor force, Baghai & Silva (2019) highlight the changes in composition of the firm level workforce.

Fresh equity gained at IPO may have impact on the use of funds. The intended use of funds raised at IPO[45] affect firm's performance in the post-IPO periods. This idea indicates that there is an empirical link between fund raised at IPO and corporate decisions[46] (Calomiris, Larrain, & Schmukler, 2018; Erel, Julio, Kim, & Weisbach, 2012; Kim & Weisbach, 2008). The common finding of these studies is the main motivation behind going public is to relax financial constraints and increase capital expenditures.

The literature also sheds light on the heterogenous effects of going public across different stock markets. Country specific empirical studies including the U.S. (Bharat & Kini, 1994); Italy (Carpenter & Rondi, 2006; Pagano et al., 1998), Japan (Takahashi &

[45] According to Andriansyah & Messinis (2016) , the intended use of proceeds is classified under following five categories: 1) Fixed asset investment; 2) Working capital financing; 3) Investment in shares of stocks; 4) Debt repayments; 5) Secondary shares. Moreover, Kim & Weisbach (2008) list potential motives for offerings as follows: 1) Finance investments; 2) Wealth transfer form new shareholders to existing ones; 3) Liquidity for both insiders and the firm.

[46] Kim & Weisbach (2008) analyze how the money created in the offering is used by the firms that raise it. To do so, they consider changes in assets, capital expenditures, acquisitions, inventory, R&D, cash holdings, and the long-term debt using 17226 IPOs and 13142 SEOs from 38 countries between 1990 and 2003. Their estimates indicate that the largest portion of money created in the IPO is dedicated to fund R&D and capital expenditures. Moreover, firms also hold a significant part of money in the form of cash.

Yamada, 2015); Indonesia (Andriansyah & Messinis, 2016); Sweden (Baghai & Silva, 2019) consider the post-IPO performance of firms.

There are voluminous attempts to identify the role of firm age and size in job creation and destruction (Colciago, Lindenthal, & Trigari 2019; Fort, Haltiwanger, Jarmin, & Miranda, 2013; Hopenhayn, 1992; Jovanovic, 1982; Moscarini & Postel-Vinay, 2012; Pugsley & Şahin, 2019) . A recent research by Özlale and Polat (2019) documents a comprehensive summary on the impact of age and size on employment growth both in advanced and developing economies.

While analyzing the role of age and size on employment growth, definition of these two characteristics of firm have distinctive results in the analysis. According to Moscarini and Postel-Vinay (2012) and Colciago et al. (2019) a firm is small/medium/large if it has less than 50 employees/between 50 and 999 employees/more than 1000 employees. Other studies such as Fort et al. (2013) and Pugsley and Şahin (2019) follow different size cut-offs[47]. The age definition in Fort et al. (2013) is as follows: a young (mature) firm is aged between 0 and 4 (more than 5+). However, Pugsley and Şahin (2019) apply a higher age cut-offs, i.e., young (mature) firms are aged between 0 and 10 (more than 11).

Our work contributes to the literature on the effect of going public on the size of employment levels. Our main focus is IPO filing firms listed in BIST. To the best of our knowledge, this study is the first to investigate the impacts of capital raised at IPO date on employment dynamics of firms listed in stock market in Turkey[48]. Particularly, we test

[47]Fort et al. (2013) and, Pugsley & Şahin (2019) define small/medium/large firms with less than 20 employees/between 20 and 499 employees/more than 500 employees.

[48] The Turkish economy owes its high growth rates in the beginning of 2000s to foreign capital flows. However, credit-led growth strategy is accompanied with high unemployment rates. Turkey experienced a jobless-growth period in the post-2001 era (Yeldan & Ünüvar, 2015).

whether accessing equity market through public offerings contribute to job creation[49]. We also contribute to the literature on the use of funds by relying on the accounting information of IPO firms. We extend the uses of funds analyzed in Kim and Weisbach (2008) and consider personnel expenditures. We estimate the fraction of money raised at IPO that is used by firms on expenditures made for personnel. Our empirical tests are rich in terms of size and age classifications, as well. In addition to what Borisov et al. (2019) use as a proxy for the size, sales, we also consider size classification based on the number of employees each firm has. To do so, we consider size definition of Eurostat. Our age cut-off depends on the median aged firm in our sample and we categorize firms young (mature) if their age is below (above) median. We also test for the relationship between labor productivity and firm size.

Our estimation results indicate that firms experience employment growth around their IPOs. However, the source of employment growth is not the external funds raised at IPO date. Tests we conducted suggest that internally generated funds have impact on the changes in firm level employment. As a firm characteristic, younger firms have higher employment growth. We also find that going public has impact on relaxation of financial constraints. Analysis on the use of funds raised at IPO date shows that debt issuance of a firm, on average, increases over the horizon. Firms allocate a significant amount of one unit increase in primary capital on capital expenditures. These results suggest that issuing equity offerings increase ability of borrowing of a firm via debt market. Fresh external

[49]The meagre performance of employment growth leads authorized institutions to support employers by introducing incentives. To create additional employment, Turkish Employment Agency (İŞKUR) provides wage subsidies, premium and tax supports to employers who meet certain conditions. Together with İŞKUR and Social Security Institution play major role in conducting such incentives, which are funded by unemployment insurance fund.

equity raised at IPO date helps firms to increase their physical capital as the borrowing capacity enhances through primary capital.

The remainder of this paper is as follows: Section 2 introduces data and their sources. Section 3 presents the results for our empirical evidence. Finally, Section 4 concludes the paper.

4.2 Data

Our main sample consists of firms listed in BIST that went to public between 2000 and 2016. We extract155 offerings over the sample horizon. Our main source for Turkish firm level data highly rely on financial annual reports and related footnotes retrieved from investor relations, BIST, and Public Disclosure Platform.

Our main variable of interest is the fiscal year end employment levels around IPO year. To disclose the causal relation between going public and employment growth, we need to track periods around IPO year. In this study, in addition to IPO year, we also consider one year back and up to three years ahead of IPO event year. However, it is difficult to find employment level data over our sample period. Therefore, we collect annual employment level data from financial reports by hand. Unfortunately, we have missing values especially for the firms which went to public in early years of our sample horizon.

To investigate channels that establish a link between employment decision and going public, we need firm-specific characteristics. We follow Kim and Weisbach (2008) and Borisov et al. (2019) for these characteristics. Among the firm specific characteristics, we consider age, net sales, expenditures made on capital and personnel,

total assets, debt issuances, cash holdings, funds raised at IPO and internally generated through operating, investment, and financing activities.

We use fiscal year end net sales and number of employees as proxies for size used in the literature. To test whether young firms are in greater need for human capital, we use firm age at the time of issuance. One way for firms to increase their assets is to make expenditures on physical assets. Such firms may require more employees to run their operations. Firms are funded internally or externally and make decisions on where to use these funds. To measure how dependent a firm on external funds is, we construct a variable that captures dependence on equity finance (DEF). Firms are subject to financial constraints. To capture whether relaxation of these constraints have impact on employment decision, we employ primary capital at IPO and cost of credit. Moreover, fresh funds have impact on leverage fluctuations. As funds increase borrowing ability, we take debt issuances into account to test whether funds obtained through IPO are used for either new investments.

4.2.1 Descriptive Statistics

Table 4.1 displays the distribution of offerings, total amount of primary capital, and net sales year by year. To calculate the total amount of funds raised at IPO date, we multiply share price and stocks on IPO trading day. While the total amount of net sales is around 84 billion TL, the total amount of capital raised at IPO date is around 10 billion TL over the sample horizon.

Table 4.1: Number of IPOs, the Amount of Proceeds and Net Sales, year by year

Year	Number of IPOs	Share %	Amount of proceeds at IPOs	Net Sales
2000	31	20	476,559,688.67	2,613,879,105.00
2001	-	-	-	-
2002	4	2.5	32,183,053.61	96,153,347.00
2003	2	1.3	15,708,195.20	25,220,816.00
2004	11	7	310,843,672.82	3,690,526,652.00
2005	6	3.8	723,123,164.40	1,762,286,425.00
2006	10	6.4	676,817,345.87	6,833,342,153.00
2007	7	4.5	2,886,263,449.49	32,957,713,289.00
2008	2	1.3	841,027,114.45	10,476,636,082.00
2009	1	0.6	65,908,620.08	-
2010	22	15	1,721,354,876.38	5,501,210,926.70
2011	23	15	1,511,799,599.12	11,567,792,235.00
2012	15	10	316,408,373.46	3,410,685,874.00
2013	9	6	369,463,313.30	3,452,307,574.00
2014	9	6	224,395,591.80	1,315,535,216.00
2015	2	1.3	6,166,564.71	68,848,598.00
2016	1	0.6	4,433,215.94	190,884,500.00
Total	155		10,182,455,839.30	83,963,022,792.70

This table reports the yearly distribution of IPOs in BIST between 2000 and 2016. The third column reports the share of IPOs. The fourth and fifth columns display total amount capital raised at IPO and net sales in the respective year, respectively.

Table 4.2: Summary Statistics on Main Variables

Variables	Time	Mean	Median	Obs.
Age	IPO	16.01	12.99	155
Primary Capital (Millions)	IPO	65.69	12.19	155
Employment	Pre-IPO	1354.3	166	133
	IPO	1354.8	193	149
	Post IPO (1)	1415	192	149
	Post IPO (2)	1499	207	146
Sales (Millions)	Pre-IPO	523.66	49.71	113
	IPO	693.91	58.51	121
	Post IPO (1)	794.96	76.96	122
	Post IPO (2)	765.76	90.18	123
Assets (Millions)	Pre-IPO	926.65	71.74	155
	IPO	1,078.81	89.3	155
	Post IPO (1)	1,310.43	124.46	155
	Post IPO (2)	1,547.87	134.70	153
Capital Expenditures (Millions)	Pre-IPO	56.44	9.45	149
	IPO	92.30	8.42	154
	Post IPO (1)	153.44	14.81	154
	Post IPO (2)	241.97	17.46	149

This table reports selected summary statistics for main variables used in this study. Age is the difference between IPO event year and founding year of a firm. Primary Capital is the capital raised at IPO event year. Employment is the number of employees of firms in the respective year. Sales is the total amount of year-end annual sales of a firm in the respective year. Assets is the total amount of assets that firms have in the respective year. Capital Expenditures is the total amount of expenditures made by the firms in the respective year. In the second column, Pre-IPO is the year before the IPO event year, IPO is the year in which firm issued offerings, and Post IPO is the subsequent years of IPO event year.

Table 4.2 reports the descriptive statistics for main variables including firm characteristics around IPO event year. An IPO filing firm, on average, is aged at around 16, where the median age is 13. Over 17 years, on average, a firm has 65.7 million TL primary capital. There is an increasing employment growth relative to average number of employees in the pre-IPO year. An IPO firm has 524 million TL and 694 million TL net sales in the pre-IPO and IPO year, respectively. Both assets and capital expenditures display increasing trajectories, with the latter one has a higher growth rate.

In Table 4.3, we document the total employment[50] statistics with growth rates around IPO year. We categorize firms based on median age[51] in our sample. A firms is young (mature) if its age is below (above) median age. Table 4.3 displays the average number of employees and their growth rates relative to pre-IPO year. From Panel A, a firm has, on average, 1,354 employees in its pre-IPO year. The change in employment growth is gradually increasing over a three-year horizon. The average growth rates in Panel B and C imply that young firms have higher employment growth rate relative to mature firms. Figure 4.1 displays the time series of growth rates with respect to age.

[50] See Appendix for employment statistics according to sectors.
[51] See Appendix for employment statistics according to size and age.

Table 4.3: Total Employment Statistics Based on Age

Panel A. Sample	Pre-IPO	IPO	Post-IPO (1)	Post-IPO (2)	Post-IPO (3)
Sum	180122	201867	210825	218826	243401
N	133	149	149	146	145
Average	1354.30075	1354.81208	1414.93289	1498.80822	1678.62759
Δ relative to Pre-IPO		0.04%	4.48%	10.67%	23.95%
Panel B. Young					
Sum	42014	58272	61245	67231	78248
N	67	77	77	76	74
Average	627.074627	756.779221	795.38961	884.618421	1057.40541
Δ relative to Pre-IPO		20.68%	26.84%	41.07%	68.63%
Panel C. Mature					
Sum	138108	143595	149580	151595	165153
N	66	72	72	70	71
Average	2092.54545	1994.375	2077.5	2165.64286	2326.09859
Δ relative to Pre-IPO		-4.69%	-0.72%	3.49%	11.16%

This table reports the total employment statistics and employment growth rates relative to pre-IPO year. Pre-IPO is the year before the IPO event year, IPO is the year in which firm issued offerings, and Post IPO is the subsequent years of IPO event year. A firm is Young (Mature) if its age at IPO event year is below (above) the sample median. Age is the difference between IPO event year and founding year of a firm. In Panel A, employment growth rates around IPO event year are calculated for the whole sample. In Panel B (C), employment growth rates around IPO event year are calculated for Young (Mature) firms.

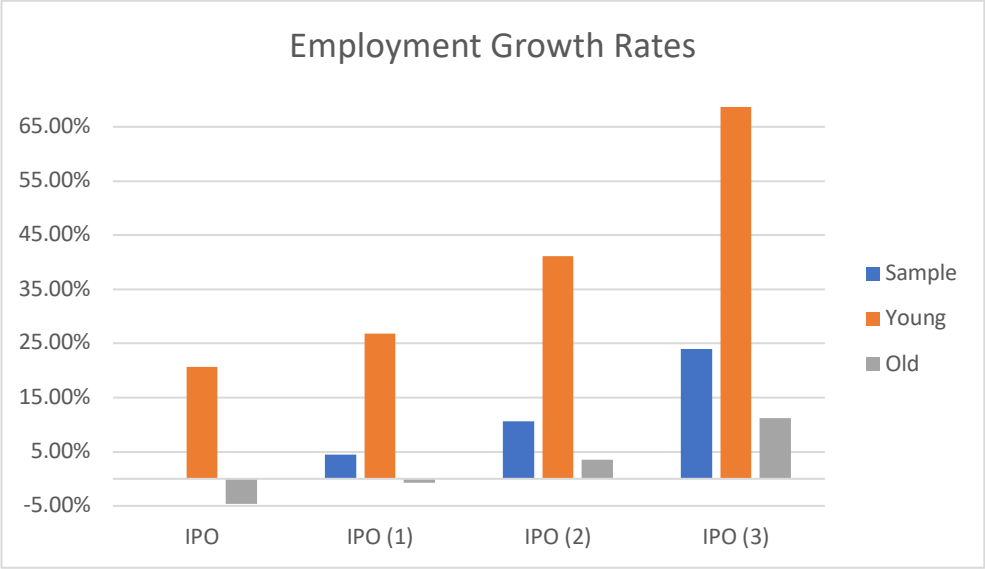

Figure 4.1: Employment Growth Rates around IPO year
(Source: Author's Calculation)

4.3 Results

4.3.1 The employment growth around IPO year

According to empirical literature, establishment of causal relation between going public and employment level is challenging. In this sense, we need to consider employment dynamics over a time interval including pre- and post-IPO periods.

Table 4 presents the formal test results from a panel regression in which the dependent variable is employment growth rate relative to pre-IPO year. For each of the specifications, we create and use dummy variables. We list firms according to their IPO event years and rename these years as t=0 irrespective of actual years. By doing so, we have a common time profile for all firms. To observe the employment dynamics, we expand or time length up to three years ahead of the event year. In the end we have four time series for all firms, and therefore four dummy variables. D (IPO) takes value of one if the firms in their IPO year.

Similar argument follows for the rest of the dummies. For example, D (IPO) +2 is a dummy variable that takes the value of 1 for firm is in their second post-IPO year. To capture size effects, we consider common proxies, sales and number of employees, which have been extensively used in the literature. With this regard, we have a chance to compare the inferences stemming from either of these proxies regarding the size. In case of number of employees, we consider two different categorizations. In the first case, we rely on the median value of number of employees in our sample. We consider firms with number of employees above (below) median as large (small). In the second case, we follow size definitions of Eurostat. We categorize the firms with respect to the number of employees they have. Firms with 1- 49 employees are identified as small (S); 50 to 249

employees are identified as medium (M); and, more than 250 employees are identified as large (L).

The results show that the IPO firms have significant employment growth during the IPO and in their post-IPO years. The employment growth for IPO firms is becomes more pronounced in their second and third post-IPO years. In all columns, positive coefficients for dummies suggest that the employment growth is increasing around IPO event year.

In columns 2 to 6, we control for the size by adding various size measures. When we control for the size proxied by sales, in column 2, we have negative and statistically significant coefficient suggest that small firms tend to have employment growth.

When the size is measured by the number of employees in our sample, we have negative coefficient as shown in column 3. However, this result is statistically insignificant. When we control for the size according to the size intervals depend on the number of employees suggested by the Eurostat, we have statistically insignificant coefficients.

Table 4.4: Annual Employment Changes After the IPO

		1	2	3	4	5	6
D (IPO)	0	0.052**	0.086**	0.067**	0.05***	0.04*	0.06**
		(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
	+ 1	0.056**	0.09**	0.07**	0.05**	0.05**	0.06**
		(0.01)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
	+ 2	0.07***	0.11***	0.08**	0.06**	0.06**	0.08**
		(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
	+ 3	0.072**	0.12**	0.08**	0.07**	0.06	0.08**
		(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Sales			-0.06*				
			(0.02)				
Employee				-0.028			
				(0.02)			
S					0.013		
					(0.02)		
M						0.017	
						(0.02)	
L							-0.025
							(0.01)
Obs.		518	419	518	518	518	518
R-sq		0.07	0.09	0.07	0.07	0.07	0.07

This table reports the estimation results of regressions, in which the dependent variable is annual employment change. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. D (IPO + Y) Y=0,1,2,3 is a dummy variable that takes a value of 1 if a firm in its respective post IPO year. Sales and Employee are two different measures for the size used in this study. Defined by the Eurostat, firms with 1- 49 employees are identified as small (S); 50 to 249 employees are identified as medium (M); and, more than 250 employees are identified as large (L). Clustered robust standard errors are reported in the parentheses. Statistical significance level at *p<0.05, ** p<0.01, *** p<0.001.

4.3.2 Dependence on External Equity Finance

As stated in the literature, one of the key motives to issue offerings is to increase fund opportunities to feed corporate investments. To test whether the link between employment growth and going public depends on external equity finance (DEF), we follow Rajan and Zingales (1998) to construct a measure of equity finance dependence. Firm-level measure of dependence on external equity can be calculated as the ratio of net equity and capital expenditure. It is expected that firms that have employment growth have higher external equity dependence if going public have impact on employment growth. To examine this, we sort firms based on the median value of DEF and create dummy variable D (DEF) that takes the value of 1 if DEF ratio is above median, which

means firm is defined as high dependent on external equity. Moreover, we sort firms by their age and create dummy variable, D (Age), which takes a value of 1 if they are under (above) median and called young (mature). We use D (Age) in order to observe the effect of age of a firm on its employment growth around the IPO event year. We also employ interaction terms between D (DEF) and D (Age) to capture employment growth performance of young IPO firms with high dependence on equity finance around their IPO event year.

Estimation results are displayed in Table 4.5. Coefficients on D (DEF) in the first post-IPO year suggest that firms with high dependence on external equity have positive employment growth. These coefficients on D (DEF) in columns 4 to 6 are statistically significant. These results provide us with some evidence that firms that have higher dependence on external equity finance tend to generate more employment growth after they went to public.

Coefficients on D (Age) in all columns indicate that young firms experience a greater employment growth during and in their post-IPO years. However, the results are statistically significant only in the first-post IPO year. This finding suggests that young IPO-listed firms experience higher employment growth.

Overall, the coefficients on the interaction between D (DEF) and D (Age) show that the effect of high dependence on external equity on employment growth is independent of how mature a firm is. However, only in the first post-IPO year, the interaction is statistically significant with negative coefficients displayed in column 4 and 5. This result suggests that young firms with high dependence on equity finance experience lower employment growth in their first post-IPO year.

Table 4.5: Dependence on Equity Finance

	Δ Employment 0			Δ Employment 0-1			Δ Employment 0-2		
	1	2	3	4	5	6	7	8	9
D (DEF)	-0.00	-0.02	0.01	0.07*	0.1*	0.1*	0.03	0.00	-0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)
D (Age)	0.06	0.06	0.01	0.17*	0.18*	0.16	0.12	0.13	0.12
	(0.05)	(0.06)	(0.05)	(0.07)	(0.08)	(0.08)	(0.07)	(0.08)	(0.09)
D (DEF) x D(Age)	-0.02	-0.02	-0.06	-0.18*	-0.2*	-0.18	-0.12	-0.1	-0.08
	(0.06)	(0.07)	(0.07)	(0.08)	(0.1)	(0.1)	(0.08)	(0.1)	(0.1
Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Obs.	131	104	99	131	104	104	126	104	103
R-sq	0.02	0.04	0.3	0.07	0.08	0.1	0.03	0.05	0.06

This table reports the estimation results of regressions, in which the dependent variable is annual employment change. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. In Columns 1-3, the dependent variable is the change in employment in the IPO event year relative to pre-IPO year. In Columns 4-6, the dependent variable is the change in employment in the first post IPO year relative to pre-IPO year. In Columns 7-9, the dependent variable is the change in employment in the second post IPO year relative to pre-IPO year. D (DEF) is a dummy variable that takes a value of 1 if the dependence on external finance of a firm is above sample median. D (Age) is a dummy variable that takes a value of 1 if the age of a firm is below sample median. D (DEF) x D (Age) is the interaction term between D (DEF) and D (Age). The control variables are Sales and change in Sales. More detailed descriptions of variables are available in the Appendix. Robust standard errors are reported in the parentheses. Statistical significance level at *p<0.05, ** p<0.01, *** p<0.001.

4.3.3 Channels: Financial Constraints

On the IPO day, firms access public and sell their shares. This process results in a fund flow into firm, which relaxes their financial constraints. Capital raised at IPO day creates an immediate relaxation on financial constraints of a firm. In addition to an immediate infusion of capital, an IPO firm has an ability to access debt market upon going public. Issuing initial public offerings enhances firm's ability to borrow (Pagano et al., 1998). To test whether relaxation of constraints has impact on employment growth for a firm, we consider capital raised at IPO day and relative cost of credit (RCC), which are suggested by Borisov et al. (2019). The constructions of these two measures are described in Appendix. If these two underlying channels are effective, we expect them to have a positive relation with employment growth. Table 4.6 displays the estimation results.

Young firms experience higher employment growth in their first post-IPO years. Coefficients on D (Age) in columns through 5 to 9 are statistically significant. This result

highlights the job creation impact of young firms (Özlale & Polat, 2019). In all specifications, the coefficients on Capex/Assets are positive and statistically significant. We have significant evidence on firms with more investment in capital have positive employment growth. This finding suggests that an increase in physical capital requires more labor to operate them. Surprisingly, the coefficients on proceeds are insignificant. This result suggests that capital raised at IPO do not have impact on employment growth for a firm. On the other hand, firms face low cost of credit have employment growth during their IPO year. These results together confirm the findings of Pagano et al. (1998), who suggest that going public increases firm's ability to borrow. In columns 4, 8, and 12, we include interactions between D (Age) x Proceeds, and D (Age) x RCC to observe how relaxation of financial constraints in younger firms have impact on employment growth. However, we find statistically insignificant results. These suggest that the impact of either of channels is independent of the age of the firm.

As stated previously, an IPO would allow firm to access debt market by increasing its borrowing ability. Moreover, IPO firms also have access to equity market in the post IPO years. The ability of accessing both markets would have impact on employment growth. To test whether labor decision of a firm is affected through these markets, we consider debt capital and equity capital of each firms. We normalize each forms of capital by pre-IPO total assets. Appendix presents the detailed constructions of these variables. The results of estimation are displayed in Table 4.7. As shown in columns 3, 7, and 11, coefficients on Debt/Assets are positive statistically significant. These findings suggest that debt capital allows firm to increase its employment. With its ability to borrow, firm would increase its expenditures on physical capital, in turn, increase the number of workers it hires. On the other hand, we have statistically insignificant coefficient for Equity/Assets. Accessing equity market does not have impact on employment growth. In

the same table, we also test for the effect of internally generated funds. To do so, we consider pre-IPO asset growth rate for each of the firms. If employing pre-IPO asset growth changes the estimation results, we conclude that internally generated funds have impact on employment growth. In columns 2, 6, and 10, we observe the effect of inclusion of pre-IPO asset growth in models where we have capital expenditures. In this case, the effect of capital expenditures on employment growth changes. We also have some changes regarding the coefficients on Debt/Asset and Equity/Asset in columns 4, 8, and 12. These results together suggest that internally generated funds in the pre-IPO period have impact on employment growth.

Table 4.6: Relaxation of Financial Constraints

	Δ Employment 0				Δ Employment 0-1				Δ Employment 0-2			
	1	2	3	4	5	6	7	8	9	10	11	12
D (Age)	0.05	0.03	0.02	0.03	0.08*	0.05*	0.06*	0.08*	0.06	0.02	0.03	0.09*
	(0.03)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.04)
Capex/Assets		0.006***	0.006***	0.006***		0.001***	0.001***	0.001***		0.00***	0.00***	0.00***
		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)
Primary Capital			-0.008	0.005			-0.00	0.06			0.01	0.17
			(0.02)	(0.06)			(0.03)	(0.06)			(0.04)	(0.11)
RCC			-0.01***	0.02			-0.07	0.00			-0.05	-0.05
			(0.00)	(0.02)			(0.05)	(0.02)			(0.02)	(0.03)
D (Age) x RCC				-0.04				-0.1				-0.00
				(0.02)				(0.07)				(0.05)
D (Age) x Primary Capital				-0.01				-0.09				-0.2
				(0.06)				(0.07)				(0.12)
Obs.	132	131	113	113	132	131	114	114	129	126	111	111
R-sq	0.02	0.6	0.8	0.8	0.03	0.5	0.6	0.6	0.02	0.5	0.6	0.6

This table reports the estimation results of regressions, in which the dependent variable is annual employment change. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. In Columns 1-3, the dependent variable is the change in employment in the IPO event year relative to pre-IPO year. In Columns 4-6, the dependent variable is the change in employment in the first post IPO year relative to pre-IPO year. In Columns 7-9, the dependent variable is the change in employment in the second post IPO year relative to pre-IPO year. D (Age) is a dummy variable that takes a value of 1 if the age of a firm is below sample median. Capex/Assets is the ratio between total expenditures made on capital up to the relevant horizon and the book value of pre-IPO asset. Primary Capital is the capital raised at the IPO event date. RCC is the relative cost of credit of a firm in the relevant horizon. More detailed descriptions of variables are available in the Appendix. D (Age) x RCC and D (Age) x Primary Capital are interaction terms between D (Age) and RCC and D (Age) and Primary Capital. Robust standard errors are reported in the parentheses. Statistical significance level at *p<0.05, ** p<0.01, *** p<0.001.

Table 4.7: Effect of Pre-IPO Growth

	Δ Employment 0				Δ Employment 0-1				Δ Employment 0-2			
	1	2	3	4	5	6	7	8	9	10	11	12
Capex/Assets	0.005***	0.05			0.001***	0.02			0.00***	0.001		
	(0.00)	(0.04)			(0.00)	(0.01)			(0.00)	(0.001)		
Debt/Assets			0.006***	-0.017			0.001***	0.002			0.00***	-0.00
			(0.00)	(0.02)			(0.00)	(0.00)			(0.00)	(0.00)
Equity/Assets			0.16	0.03			-0.03	0.1			-0.00	0.004
			(0.08)	(0.09)			(0.06)	(0.07)			(0.00)	(0.01)
Δ Pre-IPO Asset		-0.005*		-0.003*		-0.01***		-0.01***		-0.01***		-0.01***
		(0.002)		(0.00)		(0.00)		(0.00)		(0.00)		(0.00)
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	131	87	125	83	131	87	125	83	126	84	120	80
R-sq	0.6	0.03	0.6	0.03	0.5	0.07	0.5	0.06	0.5	0.06	0.5	0.05

This table reports the estimation results of regressions, in which the dependent variable is annual employment change. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. In Columns 1-3, the dependent variable is the change in employment in the IPO event year relative to pre-IPO year. In Columns 4-6, the dependent variable is the change in employment in the first post IPO year relative to pre-IPO year. In Columns 7-9, the dependent variable is the change in employment in the second post IPO year relative to pre-IPO year. Capex/Assets is the ratio between total expenditures made on capital up to the relevant horizon and the book value of pre-IPO assets. Debt/Assets is the ratio between total debt issuance up to relevant horizon and the book value of pre-IO assets. Equity/Assets is the ratio between total equity issuance up to relevant horizon and the book value of pre-IO assets. To check for the robustness of the impact of the external funds on employment growth in a firm, we add change in pre-IPO Asset growth. In doing so, we investigate whether internally generated funds have impact on employment growth. Δ Pre-IPO Asset is the pre-IPO asset growth rate. The control variables are Sales and change in Sales. More detailed descriptions of variables are available in the Appendix. Robust standard errors are reported in the parentheses. Statistical significance level at *p<0.05, ** p<0.01, *** p<0.001.

4.3.4 Labor Productivity

This section provides us with evidence on the relation between labor productivity and firm size. To investigate the pattern of the relation for IPO listed firms in Turkey, we compute labor productivity for each of the firms. Our measure on labor productivity is the ratio between net sales in the respective year and number of employees. Since we have year-end number of workers, we take average number of employees in the respective year and previous year. To capture the size effect, we categorize firms based on median sales and create dummy variable that takes value of 1 if the volume of firm's net sales is above median. To control for the age of the firm, we follow similar construction of D (Age) as in previous estimations.

Table 4.8 displays the estimation results. The coefficients on D (Age) positive and statistically significant. This result suggests that younger firms have higher labor productivity, which is consistent with the finding of Haltiwanger (2011). Our main focus is on the coefficients on D (Sales), which indicate how size is related to labor productivity. In columns 2, 5, and 8, we have positive and statistically significant coefficients on D (Sales). Results highlight a strong relation between firm size and labor productivity as shown by Leung, Meh, and Terajima (2008). Large firms have higher labor productivity. Over time, the magnitude of the size-labor productivity relation decreases. Interaction term, D (Age) x D (Sales) captures the role of young firms with higher net sales on labor productivity around their IPO. The interaction is positively related to labor productivity.

Table 4.8: Labor Productivity

	Labor Productivity 0			Labor Productivity 1			Labor Productivity 2		
	1	2	3	4	5	6	7	8	9
D (Age)	0.84*	1.11**		0.85*	1.02**		0.79*	0.92**	
	(0.34)	(0.34)		(0.33)	(0.33)		(0.334)	(0.31)	
D (Sales)		1.46***			1.19***			1.02**	
		(0.34)			(0.33)			(0.31)	
D (Age) x D (Sales)			1.56**			1.4**			1.36**
			(0.53)			(0.47)			(0.43)
Obs.	115	115	115	116	116	116	117	117	117
R-sq	0.05	0.19	0.1	0.05	0.16	0.1	0.05	0.14	0.1

This table reports the estimation results of regressions, in which the dependent variable is labor productivity. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. D (Age) is a dummy variable that takes a value of 1 if the age of a firm is below sample median. D (Sales) is a dummy variable that takes a value of 1 if the total sales of a firm are above sample median. D (Age) and D (Sales) is the interaction term. More detailed descriptions of variables are available in the Appendix. Robust standard errors are reported in the parentheses. Statistical significance level at *p<0.05, ** p<0.01, *** p<0.001.

4.3.5 Use of Funds

In this section, by using the data on median sized firm in our sample, we estimate and compare the impact of one-unit increase in both funds raised at IPO and net cash flows excluding primary capital on a variety of uses of funds, i.e., expenditures (capital expenditures, personnel expenditures, debt issuances) and asset-based variables (assets and cash accumulation) over different time lengths, one to four years.

To analyze the use of funds, we follow methodology in Kim and Weisbach (2008).

Our estimation results rely on the following regressions:

$$Y = \alpha + \beta_1 log\left[\left(\frac{primary\ capital}{Pre-IPO\ Assets}\right)+1\right] + \beta_2 log\left[\left(\frac{other\ sources}{Pre-IPO\ Assets}\right)+1\right] + \beta_3 log[Pre-IPO\ Assets] + \varepsilon$$

where $Y = \begin{cases} log\left[\left(\frac{X_t - X_0}{Pre-IPO\ Assets}\right)+1\right] \text{ for } X = \text{asset} - \text{based variables.} \\ log\left[\left(\sum_{i=1}^{t} \frac{X_i}{Pre-IPO\ Assets}\right)+1\right] \text{ for } X = \text{expenditures.} \end{cases}$

and

$$other\ sources = log\left[\left(\sum_{i=1}^{t} \frac{totalsources\ of\ funds_i - primary\ capital}{Pre-IPO\ Assets}\right)+1\right].$$

Primary capital is the funds raised at IPO date. Other sources can be obtained by subtracting the primary capital from total sources of funds of each firms that went to public. Total sources of funds (net cash flows), which is retrieved from the footnotes of

financial annual reports, is the sum of flows from operating, investing, and financing activities. To minimize the outliers, both the dependent and independent variables are normalized by pre-IPO total assets.

Table 4.9: The effect of one-unit change in primary capital on selected items

Items	t	α	t-stat	β_1	t-stat	β_2	t-stat	β_3	t-stat	Obs.	Primary
Assets	1	0.384	2.78	0.367	2.67	0.103	2.9	-0.037	-2.37	76	1.2926825
	2	0.289	1.78	0.749	3.07	0.186	2.58	-0.0216	-1.17	79	2.02488239
	3	0.352	1.43	1.088	2.29	0.232	1.01	-0.0249	-0.9	84	2.88378909
	4	0.594	1.87	0.827	2.16	0.178	1.94	-0.0413	-1.15	85	2.60666686
Cash	1	0.00035	0.01	0.025	0.51	0.007	1.36	-0.00015	-0.02	76	0.07304283
	2	-0.094	-1.21	0.19	1.91	0.085	1.85	0.01	1.24	79	0.59068728
	3	0.27	1.02	0.076	0.41	-0.026	-0.44	-0.03	-1	85	-0.0987571
	4	-0.0041	-0.05	0.169	1.54	0.002	0.1	0.001	0.1	88	0.15903619
Capex	1	0.0261	0.26	0.106	0.44	0.0398	0.67	0.00297	0.27	75	0.39218285
	2	-0.26	-1.1	0.67	1.64	0.0513	0.59	0.038	1.5	78	0.83695159
	3	0.063	0.11	1.268	1.46	0.16	0.44	0.005	0.09	84	2.36088941
	4	-0.065	-0.11	1.372	2.01	0.146	0.94	0.03	0.44	87	2.38366769
Perex	1	0.07	2.69	-0.017	-0.66	0.01	2.29	-0.006	-2.29	71	0.06181715
	2	0.143	3.04	-0.056	-0.91	-0.0002	-0.03	-0.0138	-2.6	75	-0.0529715
	3	0.228	3.66	-0.06	-0.71	0.017	0.61	-0.0219	-3.02	80	0.05093966
	4	0.309	4.15	-0.07	-0.83	0.0076	0.52	-0.0297	-3.34	81	-0.0194402
Debt	1	-0.773	-2.44	-0.392	-0.89	-0.116	-1.07	0.111	3.1	74	-0.9350203
	2	-0.469	-1.08	0.141	0.25	0.154	1.17	0.0928	1.89	72	0.8414195
	3	0.0373	0.06	0.892	0.93	0.463	0.95	0.0482	0.7	78	3.55131776
	4	0.337	0.48	0.679	0.86	0.363	1.4	0.0332	0.41	81	3.63486893

This table reports the estimation results of regressions, in which the dependent variable changes for asset-based variables and items on expenditures. The sample includes IPO listed firms in BIST. The sample period is from 2000 to 2016. Last column displays the implied changes in the independent variables listed under Items in the first column when the primary capital increases by one-unit.

Table 4.9 reports the estimation results for each of the use of funds, for various time intervals from one year to four years. The estimated coefficients on primary capital are positive except for the regression results, in which the dependent variable is expenditures made on personnel. The coefficients on primary capital are all positive and statistically significant in equations where we estimate the asset variable only. The relatively larger coefficients on assets, cash holdings, and capital expenditure show that funds generated through IPO are likely to be used for abovementioned items as priority. When we consider the comparison of coefficients on debt, we find that the fresh funds through IPO increase borrowing ability of firms to finance new investments.

In Table 4.9, we also report the implied changes in the items from one unit increase in funds[52]. Overall results suggest that the expenditures on capital and assets are doubled in response to one-unit increase in primary capital. In line with these changes, the issuance of primary capital raises debt. The interpretation would be as follows: the infusion of new funds increases the credibility of firms. Since the borrowing constraints get relaxed, in turn, firms spend more on capital. The change in asset variable is therefore expected as the book value of assets increase once the new source of funds is introduced. Moreover, as the expenditures on capital increase, the assets that the firm has increase as well. Implied changes in personnel expenditure have mixed implications. Over time, a very small negligible fraction of primary capital is used to finance the expenditures made on

[52]The effect of one unit increase in funds raised at IPO on assets at t=1 can be calculated as follows: From sample distribution, in addition to coefficients from table 10, we use median primary capital (12.18), median pre-IPO total assets (71.74), and total resources as the sum of cash or cash equivalent funds from operating, investing, and financing activities (3.02). All units are in national currency, TL, in millions. Given these numbers in, we obtain predicted value as 0.17 from regression equation. The predicted change is $71.74(exp^{0.17} - 1) = 13.67$. We then increase primary capital by one unit and calculate the predicted change under this new scenario. Our calculation yields 14.96. The difference between these two predicted values, 1.29, is the effect of one unit increase in primary capital on assets at t=1.

personnel. For the cash item, the estimates show that largest fraction of one unit increase in primary capital is kept in first post-IPO year. Over a four-year interval, firms, on average, keep 16% of one unit increase in IPO proceeds as cash.

4.4 Conclusion

There is a dense literature on IPO. However, there is little known about the impacts of going public on employment performance of firms, especially regarding developing economies. This study provides empirical evidence on this issue by addressing 155 IPO listed firms in BIST over the period between 2000 and 2016. We use micro data from the annual financial reports and find a number of meaningful results regarding the changes in employment level.

Our findings suggest that IPO firms, on average, experience employment growth during their IPO year and in their post-IPO periods as found in Borisov et al. (2019) and Babina et al. (2019). However, we find that employment growth should not be attributed to the direct effect of capital raised at IPO. Relaxation of financial constraints through going public helps firm to access debt market, which improves its ability of borrowing. As the firm's capacity of borrowing increases, it invests more in physical capital. In turn, the firm needs more employees to run its operations. These results are in line with the findings of Pagano et al. (1998) and Kim and Weisbach (2008). Moreover, we investigate that a part of the employment growth should be linked to internal asset growth, too. Our estimation results highlight the role of young firms in generating higher employment growth as argued in Özlale and Polat (2019). Regarding the direction of the relationship between labor productivity and firm size, we find that the larger firms have higher labor productivity. This result is also consistent with the literature (Leung et al., 2008).

Our analysis on the use of external funds raised at IPO date verifies our results, as well. One-unit change in primary capital results in an increase in capital expenditures and debt levels, which implies financing capital investment motive of IPOs.

Quantity alone should not be the priority in the IPO market. Therefore, regulators should impose requirements that enhance quality of IPOs and provide incentives for growth. If the IPO market were intended to contribute job creation, allowing firms to access public equity market with less restrictions may be conditioned on a promise to increase employment level in prospectus.

4.5 Appendix

Table A4.1: Variables with Their Definitions

Variables	Definitions
ΔEmployment (0-Y) Y=0,1,2,3	Change in the natural logarithm of number of employees in respective year relative to pre-IPO year.
D (IPO + Y) Y=0,1,2,3	Indicator variable that is 1 if the firm is in the respective year, and 0 otherwise.
D (Age)	Indicator variable that is 1 if the difference between the founding year and the IPO event year is below median, and 0 otherwise.
Primary Capital	Natural logarithm of one plus capital raised at IPO divided by pre-IPO total assets.
Sales	Natural logarithm of net sales.
Assets	Natural logarithm of assets.
ΔPre-IPO Asset	Natural logarithm of ratio of the difference between book value of assets in the closest reporting date and assets in the pre-IPO fiscal year ending relative to the book value of assets in the pre-IPO fiscal year ending.
PEREX	Natural logarithm of the ratio between the expenditures made on personnel and book value of pre-IPO assets. Numerator is the sum of personnel expenditures up to relevant year.
Capex/Assets	Natural logarithm of the ratio between the expenditures made on capital and book value of pre-IPO assets. Numerator is the sum of capital expenditures up to relevant year.
Debt/Assets	Ratio between total debt issuance up to relevant year and book value of pre-IPO assets.
Equity/Assets	Ratio between total equity issuance up to relevant year and book value of pre-IPO assets.
D (DEF)	Indicator variable that is 1 if the firm's dependence on equity is above median, and 0 otherwise. DEF is calculated as the ratio between equity over capital expenditure in the relevant year.
RCC	Relative cost of credit.
Cash flow	Natural logarithm of sum of cash or cash equivalents from operating, investing, and financing activities.
Cash	Natural logarithm of cash left over after expenses paid.

Table A4.2: Distribution of Number of Firms and Total Employment According to Sectors

Sector		Pre-IPO	IPO	Post-IPO (1)	Post-IPO (2)	Post-IPO (3)
Manufacturing	Sum	19123	21413	22504	27088	27716
	N	40	45	45	44	45
	Average	478.075	475.844444	500.088889	615.636364	615.911111
	Δ relative to Pre-IPO		-0.47%	4.60%	28.77%	28.83%
	Share	10.62%	10.61%	10.67%	12.38%	11.39%
Real Estate & Construction	Sum	27939	30957	32202	32887	39090
	N	17	19	19	18	17
	Average	1643.47059	1629.31579	1694.84211	1827.05556	2299.41176
	Δ relative to Pre-IPO		-0.86%	3.13%	11.17%	39.91%
	Share	15.51%	15.34%	15.27%	15.03%	16.06%
Financial Institution & Banking	Sum	37895	41709	45761	48227	60234
	N	21	22	22	22	24
	Average	1804.52381	1895.86364	2080.04545	2192.13636	2509.75
	Δ relative to Pre-IPO		5.06%	15.27%	21.48%	39.08%
	Share	21.04%	20.66%	21.71%	22.04%	24.75%
Wholesale	Sum	23161	26155	28153	29753	30206
	N	12	14	14	14	14
	Average	1930.08333	1868.21429	2010.92857	2125.21429	2157.57143
	Δ relative to Pre-IPO		-3.21%	4.19%	10.11%	11.79%
	Share	12.86%	12.96%	13.35%	13.60%	12.41%
Technology	Sum	1526	1971	2263	2373	2483
	N	10	12	12	12	11
	Average	152.6	164.25	188.583333	197.75	225.727273
	Δ relative to Pre-IPO		7.63%	23.58%	29.59%	47.92%
	Share	0.85%	0.98%	1.07%	1.08%	1.02%
	Total Shares	60.87%	60.54%	62.08%	64.13%	65.62%
Rest[53]	Sum	70478	79662	79942	78498	83672
	N	33	37	37	36	34
	Average	2135.69697	2153.02703	2160.59459	2180.5	2460.94118
	Δ relative to Pre-IPO		0.81%	1.17%	2.10%	15.23%
	Total Shares	39.13%	39.46%	37.92%	35.87%	34.38%
Total	Sum	180122	201867	210825	218826	243401
	N	133	149	149	146	145
	Average	1354.30075	1354.81208	1414.93289	1498.80822	1678.62759
	Δ relative to Pre-IPO		0.04%	4.48%	10.67%	23.95%

[53] Agriculture, Auto, Communication, Electricity, Energy, Health, Holding and Investment, Insurance, Management Service, Mining, Services, Sport Services, Tourism, Transportation.

Table A4.3: Distribution of Number of Firms and Total Employment According to Age and Size

Panel A. Young Firms

Size		Pre-IPO	IPO	Post-IPO (1)	Post-IPO (2)	Post-IPO (3)
1 to 9	Sum	68	57	56	55	64
	N	13	10	10	10	12
	Average	5.23076923	5.7	5.6	5.5	5.33333333
	Δ relative to Pre-IPO		8.97%	7.06%	5.15%	1.96%
	Share Emp	0.16%	0.10%	0.09%	0.08%	0.08%
	Share Firm	19.40%	12.99%	12.99%	13.16%	16.22%
10 to 49	Sum	456	468	468	453	375
	N	16	17	17	16	12
	Average	28.5	27.5294118	27.5294118	28.3125	31.25
	Δ relative to Pre-IPO		-3.41%	-3.41%	-0.66%	9.65%
	Share Emp	1.09%	0.80%	0.76%	0.67%	0.48%
	Share Firm	23.88%	22.08%	22.08%	21.05%	16.22%
50 to 249	Sum	3037	3163	3573	3474	3674
	N	22	25	26	25	26
	Average	138.045455	126.52	137.423077	138.96	141.307692
	Δ relative to Pre-IPO		-8.35%	-0.45%	0.66%	2.36%
	Share Emp	7.23%	5.43%	5.83%	5.17%	4.70%
	Share Firm	32.84%	32.47%	33.77%	32.89%	35.14%
250 to 999	Sum	3475	5109	4634	4916	4626
	N	6	13	11	11	10
	Average	579.166667	393	421.272727	446.909091	462.6
	Δ relative to Pre-IPO		-32.14%	-27.26%	-22.84%	-20.13%
	Share Emp	8.27%	8.77%	7.57%	7.31%	5.91%
	Share Firm	8.96%	16.88%	14.29%	14.47%	13.51%
1000 +	Sum	34978	49475	52514	58333	69509
	N	10	12	13	14	14
	Average	3497.8	4122.91667	4039.53846	4166.64286	4964.92857
	Δ relative to Pre-IPO		17.87%	15.49%	19.12%	41.94%
	Share Emp	83.25%	84.90%	85.74%	86.77%	88.83%
	Share Firm	14.93%	15.58%	16.88%	18.42%	18.92%
Total	Sum	42014	58272	61245	67231	78248
	N	67	77	77	76	74
	Average	627.074627	756.779221	795.38961	884.618421	1057.40541
	Δ relative to Pre-IPO		20.68%	26.84%	41.07%	68.63%

Panel B. Mature Firms

Size		Pre-IPO	IPO	Post-IPO (1)	Post-IPO (2)	Post-IPO (3)
1 to 9	Sum	18	21	20	20	22
	N	4	4	5	5	5
	Average	4.5	5.25	4	4	4.4
	Δ relative to Pre-IPO		16.67%	-11.11%	-11.11%	-2.22%
	Share Emp	0.013%	0.015%	0.013%	0.013%	0.013%
	Share Firm	6.06%	5.56%	6.94%	7.14%	7.04%
10 to 49	Sum	186	219	271	255	268
	N	6	7	9	8	8
	Average	31	31.2857143	30.1111111	31.875	33.5
	Δ relative to Pre-IPO		0.92%	-2.87%	2.82%	8.06%
	Share Emp	0.13%	0.15%	0.18%	0.17%	0.16%
	Share Firm	9.09%	9.72%	12.50%	11.43%	11.27%
50 to 249	Sum	2260	3301	2372	2718	2620
	N	18	22	16	17	18
	Average	125.555556	150.045455	148.25	159.882353	145.555556
	Δ relative to Pre-IPO		19.51%	18.08%	27.34%	15.93%
	Share Emp	1.64%	2.30%	1.59%	1.79%	1.59%
	Share Firm	27.27%	30.56%	22.22%	24.29%	25.35%
250 to 999	Sum	3475	5109	4634	4916	4626
	N	11026	11083	11185	9505	9641
	Average	22	22	24	21	21
	Δ relative to Pre-IPO		0.52%	-7.49%	-2.88%	1.43%
	Share Emp	7.98%	0.52%	-7.01%	-9.69%	-8.40%
	Share Firm	33.34%	7.72%	7.48%	6.27%	5.84%
1000 +	Sum	124618	128971	135732	139097	152602
	N	16	17	18	19	19
	Average	7788.625	7586.52941	7540.66667	7320.89474	8031.68421
	Δ relative to Pre-IPO		-2.59%	-3.18%	-6.01%	3.12%
	Share Emp	90.23%	89.82%	90.74%	91.76%	92.40%
	Share Firm	24.24%	23.61%	25.00%	27.14%	26.76%
Total	Sum	138108	143595	149580	151595	165153
	N	66	72	72	70	71
	Average	2092.54545	1994.375	2077.5	2165.64286	2326.09859
	Δ relative to Pre-IPO		-4.69%	-0.72%	3.49%	11.16%

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