THE INTERNATIONAL SPILLOVERS OF US UNCONVENTIONAL MONETARY POLICY

Submitted to

American University of Armenia Manoogian Simone College of Business and Economics

In partial fulfillment of the requirements for the degree of BA in Business

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Yerevan 2017

ABSTRACT

I analyse the response of several developed, emerging, and frontier markets to Fed's unconventional monetary policy announcements, by exercising an event study approach. Since the Fed's QE policy has spilled over internationally, it is worth to understand the channels of transmission and measure the significance of the impact on international markets. My findings suggest that the Fed's policy has had large and significant impact on developed and emerging markets and relatively moderate impact on frontier markets.

Keywords: Unconventional monetary policy, QE, spillover effects, developed, emerging, and frontier markets, event study.

ACKNOWLEDGEMENTS

I want to sincerely thank, Dr Gayane Barseghyan for suggesting to conduct my research in the framework of "Unconventional Monetary Policy," and for supervising this thesis with devotion and care. I would also like to thank the Teaching Associate, Ms Ella Sargsyan for providing assistance with the empirical part of the research. I take responsibility for all the remaining errors.

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1. INTRODUCTION

The global financial crisis had a severe impact on US economy. After taking traditional accommodative measures to stimulate the economy, by the end of 2008, the Fed had reached the zero lower bund (ZLB) and exhausted its counter-cyclical policy measures. To further stimulate the decaling economy, the monetary policymakers had to formulate new and creative measures.





In December 2008, the Fed introduced its unconventional monetary policy, which is also referred to as credit-easing or quantitative easing (QE). It announced to launch the Large Scale Asset Purchase Program (LSAPP), in order to inject liquidity into the financial system and ease the credit conditions (Agostini et al., 2016). The aim of the policy was to reduce the long-term interest rates, increase asset prices (such as stock and bond prices), which in its turn would increase households' wealth and consumption. As a result the real activity would increase.

I estimate ARCH models, to measure the effects of QE and tapering talk on bond markets. I take daily data on 10-year government bond for a sample of developed, emerging, and frontier markets.

My findings suggest that the countries which have well developed financial markets, experience the greatest movements in their bond markets. This further suggests that a developed financial market is a mixed blessing.

The rest of the paper is organized as follows: section 2 presents the literature review, section 3 discusses the channels of policy transmission both in US and foreign markets. Section 4

presents the data and methodology, section 5 analyses the results and findings, and section 6 concludes.

2. LITERATURE REVIEW

Agostini et al. (2016) conduct comparative analysis of QE programs of the four central banks: Fed, Bank of England (BOE), Bank of Japan (BOJ) and European Central Bank (ECB). The authors separately present the QE programs of each central bank, and then make comparisons. The Fed and BOE have conducted the QE program by purchasing mainly government bonds. On the contrary, the BOJ and ECB have directly lent to banks.

Gagnon, Raskin, Remache and Sack (2010) discuss the effectiveness of QE conducted by the Fed. The paper shows that the policy has decreased the long-term interest rates of securities, including the ones, which were not included in the purchase program. They conclude that the duration risk channel is stronger than the signalling channel.

Fratzcher et al. (2013) analyse the international spillovers of US QE in 65 countries. They take daily data on portfolio equity and bond investment flows. The authors find that during the QE1 the government bond yield has declined, end equity markets were improved especially in US relative to other countries. They also find that QE2 has boosted equities worldwide, but the impact of QE2 on yields was heterogeneous across countries.

Krishnamurthy and Vissing-Jorgenson (2011) analyse the effects of QE1 and QE2 on interest rates. They conduct an event study methodology using daily and intraday data and find significant drop in nominal interest rates of safe assets.

Neely (2014) also conducts an event study to evaluate the QE effects on bonds' yields of several advanced economies. He concludes that the unconventional monetary policy has significantly reduced the 10-year government bond yields of those countries and depreciated USD relative to their currencies.

Borallo, Hernando, and Valle['] s (2016) conduct an empirical analysis to estimate the effects of US QE on Latin American countries. They look at the stock and bond markets' movements and find that the QE announcements and "tapering talk" has had large effects on government bond yield and exchange rate fluctuations.

Fleming and Ramolona (1997) analyse Treasury market for one year period (1993-1994) to evaluate the impact of public announcements on bond market movements. They regress

absolute value of log prices for 5 minute interval after the release of announcements on dummies corresponding to the announcement days. The results show that the public announcements which convey news about the economy have a large effect on bond prices.

3. CHANNELS OF TRANSMISSION

3.1 Channels of transmission: US market

The Fed targets to decrease the long-term interest rates. There are 3 main channels, through which QE decreases the long-term interest rates (Agostini et al., 2016). The channels are not mutually exclusive. The most important one is the *portfolio balance channel*. When the Fed purchases a particular asset in a large scale, the investors use the proceeds to acquire new assets in order to return balance to their portfolios. For example, when the Fed purchases treasuries, the investors, buy other long-term treasuries. This happens because, according to preferred habit theory, developed by Modiliani and Sutch (1966), investors prefer one maturity over multiple; moreover, they do not view bank deposits as perfect substitutes to treasuries. As a result the price for treasuries increases and therefore the yield decreases.

The second channel is the *duration risk channel*, which is interconnected to portfolio balance channel. Since the Fed purchases assets which have high duration risk, such as 30-year Mortgage-Backed securities (MBS), it removes the relative supply of duration risk from the hands of investors. As the supply of the riskier long-term assets decreases; so does the risk premium required to hold them, therefore, their yields decreases.

The third main channel is called *signalling channel*. The Fed commits to keep short-term interest rates low for a long period of time. The investors, therefore, form expectations about low federal funds rate for the future. As a result the long-term interest rates decrease.

3.2 Channels of transmission: international markets

The unconventional monetary policy affects not only US economy but has huge international spillovers. Ammer, Pooter, Erceg, and Kamin et al. (2016) identify 3 main channels of spillovers. The first one is the *exchange rate channel*. The QE decreases the home interest rates relative to foreign interest rates, increases the relative supply of local currency, therefore, it depreciates.

The second one is the *domestic demand channel*. Since asset prices increase the households' wealth and consumption increases. This increased demand at home boosts imports, and increases foreign GDP.

The third one is the *portfolio balance channel* (also known a financial spillovers channel). This channel suggests that investors balance their portfolios both with local and foreign assets. Therefore, capital might flow from home country to foreign country, or with the opposite direction. Fratzcher, Duca and Straub (2013) argue that during QE 1 (2007-2009) investors shifted out of emerging market economies (EME) and advanced economies (AE) and turned to US equity and bond funds. By contrast, during the second round of QE (2010), the portfolio balancing occurred in the opposite direction, bringing capital to EMEs.

4. DATA AND METHODOLODY

I analyse the spillover effects of US QE programs on 10-year government bond yield of 10 countries. I take USA, 3 developed markets: Canada, Germany, and New Zealand, 3 emerging markets: Brazil, China, and Czech Republic, and 3 frontier markets: Romania Lithuania, and, Croatia. The country classification comes from MSCI annual classification report (Market classification, 2017).

I take a sample in a way to include countries from each of the 3 classification groups. I take QE announcement dates as presented in Table 1 including the dates till Taper talk period. The dates and program classifications come from Borallo et al. (2016).

The daily data on 10-year government bond for all countries comes from investing.com. I take a sample period from 2008-2016. The period includes the days of QE program announcements and some years more to have a larger sample. Following Neely (2014), I construct one day window and create dummies for each announcement day. I consider the day of the announcement for countries, where the markets have been open during the announcements; otherwise, I take the next day. This means, I consider the day of the announcement for US, Canada and Brazil, and for the rest of the countries, the next day.

Several announcements have been released on Friday and on the next day markets have been closed. So for those countries, where I consider the next day of the announcements, I take the following Monday instead. Some announcement days coincide with market holidays for different countries, I take the following day, when the markets have been open. The crucial assumption is that the announcements are the key economic news during the event window.

To make the US bond yield stationary (Figure 2), I take the first difference (labelled as Change, presented in Figure 3 and Table 2 with basis points). Then I estimate an OLS model by regressing Change on dummies. After this, I estimate an ARMA model, since it fits the data generating process better than the OLS does. Then finding an ARCH effect, I estimate an ARCH model with ARMA disturbances. I repeat the steps for all countries.

Figure 2: USA 10-year government bond yield



Figure 3: USA 10-year government bond yield change (1st difference)



5. RESULTS AND ANAYSES

Ammer et al (2016) argue that the QE actions have had positive international spillovers, in a sense, that the policy pushed the economy at home and abroad at the same direction. As already motioned, the Fed wanted to reduce the long-term interest rates. In Table 2, we can

notice that during 4 out of 5 QE1 announcements, the bond yield has decreased in US. Similar results are noticeable for the other countries, where the direction of bond yield is preliminary downward. In China and Lithuania, however, there is an upward trend.

During the taper talk period, the bond market in US moved in the opposite direction, since the accommodative monetary policy was about to end. From the Table 2 again, we can infer that the direction of bond yield is preliminary upward for all countries. But here again the markets in China and Lithuania move in the opposite direction. These short analyses suggest about the possible relationship between US and foreign bond markets during the unconventional monetary policy period.

The first model, for estimating the relationship is OLS model. I report the results of OLS models (Tables: 3-1, 3-2, 3-3) for comparability purposes, even though; they suffer from serial correlation issue. After estimating ARMA models, I proceed with ARCH models which are more reliable. The results of the ARCH models (presented in Table 4-1; 4-10) are as follows: US, out of 23 dummies, 22 are significant at 1% significance level (later on by significant I refer to 1%, 5% and 10% significance levels), except the dummy corresponding to the announcement on Nov 02, 2010. This might be due to the announcement on Oct 15, 2010. The information could have already been priced into the market.

For Canada, New Zealand, and Germany the number of significant dummies are 20, 18, and, 22 respectively. These countries represent the group of developed markets. The results show that the announcements have significant effects on their bond markets. The next group of countries: Brazil, Czech Republic, and China represent the emerging markets, the number of significant dummies are 15, 10, and, 5 respectively. In the frontier markets, Romania, Lithuania, and Croatia, 4, 12, and, 7 announcements are significant. The results suggest that the spillovers of Fed's monetary policy are huge for developed and emerging markets, comparably moderate for frontier markets.

In developed markets there are many days, which are significant in all countries, since all of them have been significantly affected. In emerging markets, there are 3 days, which are significant for all countries: Nov 02, 2010 (the announcement concerning purchase of additional 600 billions of dollars of long-term Treasury securities), Aug 22, 2012, and Aug 31, 2012 (announcements about the launch of QE3). In frontier markets, only the second announcement of QE1 is simultaneously significant. Overall, there is a heterogeneous response across countries.

Although Ammer et al (2016) suggest that foreign markets move at the same direction as US market does, still there is much evidence that several countries, has both complained from QE policies and also from tapering (Eichengreen, 2016). This happens because; countries do not want their economies to be overheated, since they are afraid of future steep downturn. But since QE takes place, they later complain from tapering, because that brings the downturn in their economies.

Eichengreen and Gupta (2013) argue that the strong macroeconomic fundamentals provide little evidence that countries could remain unaffected from the US policy spillovers. They instead argue, that the size of their financial markets is the most important factor concerning whether the countries would be affected or not. This is because of the portfolio balance channel. As it suggests, the investors bring balance to their portfolios with foreign assets, too. Therefore, they seek for relatively large and liquid financial markets.

So the developed and emerging markets in my sample, with high liquidity have attracted the investors, and as a result the policy has had huge spillovers on their markets. At the same time the frontier markets, Romania, Lithuania, and, Croatia which are relatively small, have been moderately affected.

The size of the financial market is a mixed blessing. On the one hand countries enjoy the benefits of having a developed financial market. On the other hand, foreign shocks spillover on their economies.

6. CONCLUSION

The Fed's unconventional monetary policy has affected both US and international markets. Through event study framework, I analyse the effects of the policy announcements on 10-year government bond yield of several developed, emerging, and frontier markets. My findings show that the development of the financial market is a key determinant of US policy spillovers. The developed and emerging markets in my sample have been greatly affected, whereas the policy has had moderate effects on frontier markets.

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APPENDIX

Table 1: List of Relevant FOMC Statements and Events

FIRST LSAP (QE1)		
Nov 25, 2008	Announcement	The Fed announces the purchase of MBS backed by government agencies, and creation of TALF
Dec 01, 2008	Speech (Austin)	Bernanke hints future Treasury purchase
Dec 16, 2008	FOMC statement	The Fed cuts the target Federal Funds rate to zero
Jan 28, 2009	FOMC statement	The Fed announces PDCF, the TLSF and the AMFL
Mar 18, 2009	FOMC statement	The Fed expands the purchase of MBS and announces that will start to purchase Treasury securities
SECOND LSAP (QE2)		
Aug 10, 2010	FOMC statement	The Fed announces he is willing to buy long-term Treasury securities through reinvestment of payments of its MBS
Aug 27, 2010	Speech (Jackson Hole)	Bernanke's speech at Jackson Hole
Sep 21, 2010	FOMC statement	According to FOMC the short-term interest rate will stay at low levels for a long time
Oct 15, 2010	Speech Indiana	According to Chairman Bernanke, new measures might be necessary
Nov 02, 2010	FOMC statement	The Fed decides to purchase additional 600 billions of dollars of long-term Treasury securities
MATURITY EXTENSION PROGRAM (MEP)		
Aug 09, 2011	FOMC statement	According to FOMC, the short-term interest rate will stay at low levels for a long period of time
Aug 26, 2011	Speech	Bernanke's speech at Jackson Hole
Sep 21, 2011	FOMC statement	The Fed announces its MEP
THIRD LSAP (QE3)		
Aug 22, 2012	FOMC minutes	The Fed will take new measures if necessary
Aug 31, 2012	Speech (Jackson Hole)	Bernanke suggests new QE
Sep 13, 2012	FOMC statement	The Fed announces new QE
EVENTS IN 2013		
Mar 20, 2013	FOMC statement	The Fed will continue its accommodative monetary policy until certain goals of unemployment and inflation are reached
May 01, 2013	FOMC statement	FOMC: accommodative monetary policy will be held for a long period of time
TAPER TALK PERIOD (TTP)		
May 22, 2013	FOMC minutes and testimony	Bernanke suggests the end of expansive monetary policy
Jun 19, 2013	FOMC statement	The Fed suggests that "tapering" could begin next year
Jul 11, 2013	FOMC minutes and Speech (NBER)	Bernanke says that the central bank's monetary easing policy would stay for the foreseeable future
Oct 30, 2013	FOMC statement	The Fed decides to continue its accommodative policy
Dec 18, 2013	FOMC statement	"Tapering" is officially announced

		da	Lealand	lany	_	ı blic	T	ınia	lania	tia
	USA	Cana	New 2	Germ	Brazi	Czecł Repu	China	Roma	Lithu	Croa
QE1										
Nov 25, 2008	-21.8	-10.8	-6	-5.5	2	-3.5	32	-38.5	0	9.7
Dec 01, 2008	-19.6	-17	-15	-8.9	-17	-0.9	10.1	58.4	125	71.1
Dec 16, 2008	-25.5	-12.1	-2	-16.8	26	-4.4	-10	-49.9	301	-186.1
Jan 28, 2009	8.4	6.3	-5	-2.5	-25	0.6	0.1	-38.9	0	0.3
Mar 18, 2009	-46.7	-23.3	-16	-17.1	-43	1.5	12.1	-75	0	0.2
QE1 Sum	-105	-56.9	-44	-50.8	-57	-6.7	44.3	-144	426	-109
QE2										
Aug 10, 2010	-6.1	-4.3	-1	-11.7	-7	-7.1	4	20	-17	-14.8
Aug 27, 2010	16.6	7.9	1	-3	13	-3	4.6	0	5	0
Sep 21, 2010	-12.8	-4.7	-12	-8.9	-5.5	7.1	-6.5	0	-8	-0.3
Oct 15, 2010	6.1	2.9	3	1.8	-11	0	-3	0	-58	-5.3
Nov 02, 2010	-3.6	5.8	10	-4.4	4	-5.5	28	0	0	-0.2
QE2 Sum	0.2	7.6	1	-26.2	-6.5	-8.5	27.1	20	-78	-20.6
MEP										
Aug 09, 2011	-4.1	-3	5	-16.5	3.3	-1.8	-6	0.1	-15	-0.4
Aug 26, 2011	-4.4	-0.8	0	7.4	-18.4	-1.5	4	1	0	0
Sep 21, 2011	-8.1	-7.9	-9	-8.6	16.7	0	1	21.4	-35	7
MEP Sum	-16.6	-11.7	-4	-17.7	1.6	-3.3	-1	22.5	-50	6.6
QE3										
Aug 22, 2012	-10.7	-9.4	-3	-7.9	11	-4.1	4	0	0	0.4
Aug 31, 2012	-8	0.8	-4	4	-14	-3	-20	0	0	0
Sep 13, 2012	-3.7	-2.9	1	14.4	0	8.3	4	-9	0	0
QE3 Sum	-22.4	-11.5	-6	10.5	-3	1.2	-12	-9	0	0.4
EVENTS IN 2013										
Mar 20, 2013	5.4	4.5	6	-2.3	6	0.1	4	14	-17	9.7
May 01, 2013	-4.1	-1.7	-3	-4.3	0	-3.1	-15.5	-25	0	-0.1
2013 Sum	1.3	2.8	3	-6.6	6	-3	-11.5	-11	-17	9.6
ТТР										
May 22, 2013	10.7	5.7	8	3.2	6	6.5	3	-1	0	-0.1
Jun 19, 2013	16.9	9.2	29	10.2	40	22.5	-7	20	-10	9.7
Jul 11, 2013	-10.2	-2.7	0	-7	8	-4	1	-10	0	-0.4
Oct 30, 2013	3.5	1.8	8	-1.1	7	-10.2	6	1	-10	0
Dec 18, 2013	5.9	4.7	0	3.5	-9	8.2	-4	5	0	-0.4
TTP Sum	26.8	18.7	45	8.8	52	23	-1	15	-20	8.8

Table 2: Bond Yield Change (bp) corresponding to the announcement day	ys
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Variables	USA	Canada	New Zealand	Germany
Nov 25, 2008	-0.218***	-0.107**	-0.0587	-0.0537
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Dec 01, 2008	-0.196***	-0.169***	-0.149***	-0.0877*
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Dec 16, 2008	-0.255***	-0.120***	-0.0187	-0.167***
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Jan 28, 2009	0.0841	0.0637	-0.0487	-0.0237
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Mar 18, 2009	-0.467***	-0.232***	-0.159***	-0.170***
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Aug 10, 2010	-0.0609	-0.0423	-0.00871	-0.116**
-	-0.0596	(0.0456)	(0.0476)	(0.0470)
Aug 27,2010	0.166***	0.0797*	0.0113	-0.0287
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Sep 21, 2010	-0.128**	-0.0463	-0.119**	-0.0877*
F , F	-0.0596	(0.0456)	(0.0476)	(0.0470)
Oct 15, 2010	0.0611	0.0297	0.0313	0.0193
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Nov 02, 2010	-0.0359	0.0587	0.101**	-0.0427
1107 02, 2010	-0.0596	(0.0456)	(0.0476)	(0.0427)
Δμα 09. 2011	-0.0409	0.0203	0.0513	0.16/***
Aug 07, 2011	0.0596	-0.0293	(0.0476)	-0.104
Δμα 26, 2011	-0.0390	0.00721	(0.0470)	(0.0470)
Aug 20, 2011	-0.0439	-0.00731	0.00129	0.0733
Sap 21 2011	-0.0390	(0.0430)	(0.0470)	(0.0470)
Sep 21, 2011	-0.0809	-0.0783*	-0.088/*	-0.0847*
Ame 22, 2012	-0.0390	(0.0456)	(0.0476)	(0.0470)
Aug 22, 2012	-0.10/*	-0.0933***	-0.0287	-0.0/7/*
A 21 2012	-0.0390	(0.0456)	(0.0476)	(0.0470)
Aug 31, 2012	-0.0799	0.00869	-0.038/	0.0413
0	-0.0596	(0.0456)	(0.0476)	(0.0470)
Sep 13, 2012	-0.0369	-0.0283	0.0113	0.145***
N 00 0010	-0.0596	(0.0456)	(0.0476)	(0.0470)
Mar 20, 2013	0.0541	0.0457	0.0613	-0.0217
	-0.0596	(0.0456)	(0.0476)	(0.0470)
May 01, 2013	-0.0409	-0.0163	-0.0287	-0.0417
	-0.0596	(0.0456)	(0.0476)	(0.0470)
May 22, 2013	0.107*	0.0577	0.0813*	0.0333
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Jun 19, 2013	0.169***	0.0927**	0.291***	0.103**
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Jul 11, 2013	-0.102*	-0.0263	0.00129	-0.0687
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Oct 30, 2013	0.0351	0.0187	0.0813*	-0.00972
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Dec 18, 2013	0.0591	0.0477	0.00129	0.0363
	-0.0596	(0.0456)	(0.0476)	(0.0470)
Constant	-0.000122	-0.000692	-0.00129	-0.00128
Observations	2,502	2,461	2,187	2,336
R-squared	0.056	0.031	0.038	0.034

		Czech	
Variables	Brazil	Republic	China
Nov 25, 2008	0.0206	-0.0332	0.321***
	(0.229)	(0.0523)	(0.0647)
Dec 01, 2008	-0.719***	-0.00722	0.102
	(0.229)	(0.0523)	(0.0647)
Dec 16, 2008	0.261	-0.0422	-0.0992
	(0.229)	(0.0523)	(0.0647)
Jan 28, 2009	-0.249	0.00778	0.00184
	(0.229)	(0.0523)	(0.0647)
Mar 18, 2009	-0.429*	0.0168	0.122*
	(0.229)	(0.0523)	(0.0647)
Aug 10, 2010	-0.0694	-0.0692	0.0408
	(0.229)	(0.0523)	(0.0647)
Aug 27, 2010	0.131	-0.0282	0.0468
	(0.229)	(0.0523)	(0.0647)
Sep 21, 2010	-0.0544	0.0728	-0.0642
	(0.229)	(0.0523)	(0.0647)
Oct 15, 2010	-0.109	0.00178	-0.0292
	(0.229)	(0.0523)	(0.0647)
Nov 02, 2010	0.0406	-0.0532	0.281***
	(0.229)	(0.0523)	(0.0647)
Aug 09, 2011	0.0336	-0.0162	-0.0592
	(0.229)	(0.0523)	(0.0647)
Aug 26, 2011	-0.183	-0.0132	0.0408
	(0.229)	(0.0523)	(0.0647)
Sep 21, 2011	0.168	0.00178	0.0108
	(0.229)	(0.0523)	(0.0647)
Aug 22, 2012	0.111	-0.0392	0.0408
	(0.229)	(0.0523)	(0.0647)
Aug 31, 2012	-0.139	-0.0282	-0.199***
	(0.229)	(0.0523)	(0.0647)
Sep 13, 2012	0.000557	0.0848	0.0408
	(0.229)	(0.0523)	(0.0647)
Mar 20, 2013	0.0606	0.00278	0.0408
	(0.229)	(0.0523)	(0.0647)
May 01, 2013	0.000557	-0.0292	-0.154**
	(0.229)	(0.0523)	(0.0647)
May 22, 2013	0.0606	0.0668	0.0308
	(0.229)	(0.0523)	(0.0647)
Jun 19, 2013	0.401*	0.227***	-0.0692
	(0.229)	(0.0523)	(0.0647)
Jul 11, 2013	0.0806	-0.0382	0.0108
	(0.229)	(0.0523)	(0.0647)
Oct 30, 2013	0.0706	-0.100*	0.0608
	(0.229)	(0.0523)	(0.0647)
Dec 18, 2013	-0.0894	0.0838	-0.0392
	(0.229)	(0.0523)	(0.0647)
Constant	-0.000557	-0.00178*	-0.000842
Observations	2,161	2,410	2,330
R-squared	0.010	0.015	0.031

Table 3-2: OLS models for emerging markets (*** p<0.01, ** p<0.05, * p<0.1)

Variables	Romania	Lithuania	Croatia
Nov 25, 2008	-0.384	0.00221	0.0979
	(0.240)	(0.616)	(0.139)
Dec 01, 2008	0.585**	1.252**	0.712***
	(0.240)	(0.616)	(0.139)
Dec 16, 2008	-0.498**	3.012***	-1.860***
	(0.240)	(0.616)	(0.139)
Jan 28, 2009	-0.388	0.00221	0.00386
	(0.240)	(0.616)	(0.139)
Mar 18, 2009	-0.749***	0.00221	0.00286
	(0.240)	(0.616)	(0.139)
Aug 10, 2010	0.201	-0.168	-0.147
	(0.240)	(0.616)	(0.139)
Aug 27, 2010	0.00121	0.0522	0.000859
	(0.240)	(0.616)	(0.139)
Sep 21, 2010	0.00121	-0.0778	-0.00214
	(0.240)	(0.616)	(0.139)
Oct 15, 2010	0.00121	-0.578	-0.0521
	(0.240)	(0.616)	(0.139)
Nov 02, 2010	0.00121	0.00221	-0.00114
	(0.240)	(0.616)	(0.139)
Aug 09, 2011	0.00221	-0.148	-0.00314
	(0.240)	(0.616)	(0.139)
Aug 26, 2011	0.0112	0.00221	0.000859
	(0.240)	(0.616)	(0.139)
Sep 21, 2011	0.215	-0.348	0.0709
	(0.240)	(0.616)	(0.139)
Aug 22, 2012	0.00121	0.00221	0.00486
	(0.240)	(0.616)	(0.139)
Aug 31, 2012	0.00121	0.00221	0.000859
	(0.240)	(0.616)	(0.139)
Sep 13, 2012	-0.0888	0.00221	0.000859
	(0.240)	(0.616)	(0.139)
Mar 20, 2013	0.141	-0.168	0.0979
	(0.240)	(0.616)	(0.139)
May 01, 2013	-0.249	0.00221	-0.000141
	(0.240)	(0.616)	(0.139)
May 22, 2013	-0.00879	0.00221	-0.000141
	(0.240)	(0.616)	(0.139)
Jun 19, 2013	0.201	-0.0978	0.0979
	(0.240)	(0.616)	(0.139)
Jul 11, 2013	-0.0988	0.00221	-0.00314
	(0.240)	(0.616)	(0.139)
Oct 30, 2013	0.0112	-0.0978	0.000859
	(0.240)	(0.616)	(0.139)
Dec 18, 2013	0.0512	0.00221	-0.00314
	(0.240)	(0.616)	(0.139)
Constant	-0.00121	-0.00221	-0.000859
Observations	2,410	2,777	2,298
R-squared	0.012	0.011	0.084

Table 3-3: OLS models for frontier markets (*** p<0.01, ** p<0.05, * p<0.1)

Table 4-1: ARCH model for USA (*** p<0.01, ** p<0.05, * p<0.1)

Table 4-1 USA ARCH

	USA
	Coef./Se.
Nov252008	-0 1946***
107232000	(0.02)
Dec012008	-0.1922***
	(0.01)
Dec162008	-0.2538***
	(0.01)
Jan282009	0.1145***
	(0.04)
Mar182009	-0.4769***
	(0.02)
Aug102010	-0.0636***
	(0.01)
Aug2/2010	0.1/15***
Cop 21 2010	(U.UI) 0 1224***
5ep212010	-0.1324
Oct152010	(0.01)
000102010	(0,01)
Nov022010	-0.0197
	(0.02)
Aug092011	-0.0503***
	(0.01)
Aug262011	-0.0436***
	(0.01)
Sep212011	-0.0793***
	(0.01)
Aug222012	-0.1032***
	(0.01)
Aug312012	-0.0793***
	(0.01)
Sep132012	-0.0295***
Max202012	(U.UI) 0.0522***
Maizuzuij	(0.00)
Mav012013	-0 0423***
nayoizoio	(0.01)
Mav222013	0.1000***
	(0.01)
Jun192013	0.1772***
	(0.02)
Jul112013	-0.1055***
	(0.01)
Oct302013	0.0405***
	(0.01)
Dec182013	0.0526***
	(0.00)
Constant	-0.0001
	(0.00)
Arma Lar	- N 200E+++
u.di	-U.28UD*** (0 01)
T.2 ar	(U.UI) _0 0075***
	(0 01)
L.ma	0.2650***
-	(0.01)
L2.ma	0.9854***
	(0.01)
ARCH	
L.arch	0.0381***
	(0.01)
L.garch	0.9538***
	(0.01)
Constant	0.0000
	(0.00)
N	2502
q	0
- chi2	70803 6

Table 4-2		Table 4-3 New Zealand ARC	н	Table 4-4 Germany ARCH			
Canada 							
	Canada Coef./Se.		New Zealand Coef./Se.		Germany Coef./Se.		
				Change			
Change		Change	0.04(2++	Nov252008	-0.0484***		
Nov252008	-0.1042***	NOV252008	-0.0463^^		(0.01)		
Dec012008	(0.00)	Dec012008	-0.1364***	Dec012008	-0.0833***		
Decoi2008	(0 00)	2000120000	(0.01)	- 100000	(0.01)		
Dec162008	-0.1236***	Dec162008	-0.0251***	Dec162008	-0.1/14***		
	(0.01)		(0.00)	.Tan282009	-0 0312***		
Jan282009	0.0688***	Jan282009	-0.0603***	0411202000	(0.01)		
	(0.01)		(0.02)	Mar182009	-0.1671***		
Mar182009	-0.2255***	Mar182009	-0.1676***		(0.01)		
	(0.01)		(0.02)	Aug102010	-0.1159***		
Aug102010	-0.0430***	Aug102010	0.0003		(0.00)		
	(0.00)		(0.02)	Aug272010	-0.0157		
Aug272010	0.0725***	Aug272010	0.0115*	Sep212010	-0.0769***		
0010010	(0.01)	010010	(0.01)	96b717010	(0,01)		
Sep212010	-0.0510^^^	Sep212010	-0.1116***	Oct152010	0.0170***		
Oct152010	(0.00)	Oct 152010	(U.UI)		(0.01)		
000132010	(0.01)	000132010	0.0108	Nov022010	-0.0435***		
Nov022010	0.0575***	Nov022010	0.0053***		(0.00)		
100022020	(0.01)	N0V022010	(0.01)	Aug092011	-0.1719***		
Aug092011	-0.0155	Aug092011	0 0613***		(0.01)		
5	(0.01)	1149052011	(0.01)	Aug262011	0.0850***		
Aug262011	-0.0163	Aug262011	0.0004	0	(0.02)		
	(0.01)		(0.01)	Sepzizoli	-0.0820***		
Sep212011	-0.0777***	Sep212011	-0.0806***	Aug222012	-0.0715***		
	(0.00)		(0.01)		(0.00)		
Aug222012	-0.0926***	Aug222012	-0.0219***	Aug312012	0.0374***		
	(0.00)		(0.00)		(0.01)		
Aug312012	0.0104**	Aug312012	-0.0349***	Sep132012	0.1507***		
. 100010	(0.00)		(0.00)		(0.00)		
Sep132012	-0.0289***	Sep132012	0.0022	Mar202013	-0.0281***		
Max202012	(0.00)		(0.01)	Maw012013	(U.UI) =0.0454***		
Mai202015	(0,0410****	Mar202013	0.0693***	Mayorzors	(0.01)		
Mav012013	-0.0076		(0.01)	May222013	0.0350***		
1147012010	(0.02)	May012013	-0.0339***	-	(0.00)		
May222013	0.0605***	M	(U.UI)	Jun192013	0.1025***		
	(0.00)	May222013	0.081/^^^		(0.01)		
Jun192013	0.1073***	Tup102013	0.2788***	Jul112013	-0.0692***		
	(0.02)	0011192019	(0.02)		(0.01)		
Jul112013	-0.0223***	Ju1112013	0.0083***	Oct302013	-0.0091***		
	(0.00)		(0.00)	Dec182013	(0.00)		
Oct302013	0.0230***	Oct302013	0.0825***	000102010	(0.00)		
	(0.01)		(0.00)	Constant	-0.0015*		
Dec182013	0.048/***	Dec182013	0.0025		(0.00)		
Quanta at	(0.00)		(0.00)				
Constant	-0.0005	Constant	-0.0018*	ARMA			
	(0.00)		(0.00)	L.ar	-0.1817		
ARMA				* 0	(0.70)		
L2.ar	0.6242***	ARMA		L2.ar	-0.1162		
	(0.12)	L.ar	0.3437	T. ma	0 2057		
L2.ma	-0.6715***		(0.38)	21110	(0.70)		
	(0.11)	L.ma	-0.2535	L2.ma	0.0522		
			(0.39)		(0.58)		
ARCH							
L.arch	0.0380***	AKCH	U UD22777	ARCH			
	(0.01)	L.dICH	0.03//^^^	L.arch	0.0298***		
L.garch	0.9524***	I. garch	(U.UI) 0 052/***	T. max -1	(0.01)		
	(0.02)	n.Aaren	(0.01)	L.garch	U.9644***		
Constant	0.0000	Constant	0.0000**	Constant	0 0000		
	(0.00)	00110 00110	(0.00)	00110 00110	(0.00)		
			()		,		
Ν	2461	N	2187				
р	0	p	0	N	2336		
chi2	19028.7	chi2	65540.9	p chi?	32173 1		
		-		L1175	244/3.4		

Table 4-2; 4-4: ARCH models for developed markets (*** p<0.01, ** p<0.05, * p<0.1)

Table 4-5 Brazil ARCH		Table 4-6		Table 4-7	
			АКСН		
	Brazil Coef./Se.		Czech Repu~c Coef./Se.		China Coef./Se.
		Change		Change	
Change	0 1710	Nov252008	-0.0093	Nov252008	0.4076*
NOV252008	-0.1/18		(0.01)		(0.22)
Dec012008	-0.8383***	Dec012008	-0.0072	Dec012008	-0.1505
000012000	(0.17)	- 4 60 0 0 0	(0.01)	Dec162008	(U.16) -0.0338
Dec162008	0.0896	Dec162008	-0.0539***	Dec102000	(0.10)
Jan282009	(0.39)	Jan282009	0.0153	Jan282009	0.1440
	-0.3269**		(0.02)		(0.14)
Mar182009	(0.14)	Mar182009	0.0005	Mar182009	0.0302
	-0.4231***		(0.03)	Aug102010	(0.04)
Aug102010	-0.0900***	Aug102010	-0.0879**	Aug102010	(0.03)
	(0.01)	Aug272010	(0.04)	Aug272010	0.0360
Aug272010	0.1391***	Aug2/2010	(0.02)		(0.03)
	(0.01)	Sep212010	0.0491	Sep212010	-0.0672
Sep212010	-0.0362***	-	(0.03)	Oct152010	(0.06)
	(0.01)	Oct152010	0.0256	000132010	(0.10)
Oct152010	-0.0603		(0.07)	Nov022010	0.2119*
N. 000010	(0.18)	Nov022010	-0.0693***		(0.12)
NOVU22010	0.0534***		(0.01)	Aug092011	-0.1084
aug092011	-0.0032	Aug092011	-0.0039		(0.11)
1149092011	(0 15)	λυσ262011	(0.03)	Aug262011	0.1021
Aug262011	-0.2656	Augzozoli	(0.05)	Cop 212011	(0.06)
	(0.19)	Sep212011	-0.0059	Sepzizoli	-0.0992^
Sep212011	0.1666***	-	(0.01)	Aug222012	0.0323*
	(0.02)	Aug222012	-0.0572***		(0.02)
Aug222012	0.1056***		(0.01)	Aug312012	-0.2319***
	(0.01)	Aug312012	-0.0304***		(0.06)
Aug312012	-0.1397***		(0.01)	Sep132012	-0.0927
	(0.01)	Sep132012	0.0720***	N 000010	(0.08)
Sep132012	0.0580	Mar 202013	(0.01)	Mar202013	0.0352
M	(U.IU)	Mai202013	(0 01)	Mav012013	-0.0627
Mar202013	0.0818**	Mav012013	-0.0205		(0.06)
May012013	-0.0105		(0.04)	May222013	-0.0002
	(0.02)	May222013	0.0887**		(0.01)
May222013	0.0911***		(0.04)	Jun192013	0.0070
	(0.03)	Jun192013	0.1251	- 1110010	(0.04)
Jun192013	0.4388***		(0.16)	Jul112013	0.0573
	(0.03)	Jul112013	-0.0245***	Oct 302013	-0 0714
Jul112013	0.0627***	0+202012	(U.UI)	000002010	(0.09)
	(0.01)	000302013	-0.0844^^^	Dec182013	0.0257
Oct302013	0.1198**	Dec182013	0.0993***		(0.04)
	(0.06)		(0.02)	Constant	-0.0009
Dec182013	-0.0098	Constant	-0.0026***		(0.00)
Constant	(0.13)		(0.00)	3 DM3	
Constant	-0.0028			I. ar	1 6035***
	(0.00)	ARMA		1.41	(0.04)
ARMA		L.ar	1.2280***	L2.ar	-0.3978***
L.ar	0.8515***	T 2	(0.23)		(0.07)
-	(0.03)	LZ.dr	-0.4125	L3.ar	-0.2962***
L2.ar	0.0709**	I. ma	-1.3602***		(0.03)
	(0.03)		(0.22)	L.ma	-1.9261***
L.ma	-0.9457***	L2.ma	0.5715**	T.2 ma	(0.01)
	(0.02)		(0.25)	152 . ma	(0.01)
					····· ,
ARCH	0.005000	ARCH		ARCH	
L.arcn	U.1254***	L.arch	0.1050**	L.arch	0.2174***
Larch	(U.U2)	T	(0.04)		(0.06)
n.garell	(0.02)	L.yarcn	U.8886*** (0 05)	L.garch	0.8101***
Constant	0 0004***	Constant	0.000	Constant	(0.04)
	(0.00)		(0.00)	constant	(0.00)
N	2161	N	2410	N	2330
a	0	р	0	a	0
chi2	5857 8	chi2	1876.0	chi?	5705044 6
					J/UJ044.0

Table 4-5; 4-7: ARCH models for emerging markets (*** p<0.01, ** p<0.05, * p<0.1)

Table 4-8 Romania ARCH		Table 4-9 Lithuania ARCH		Table 4-10 Croatia ARCH	
				Cmasti-	
	Romania Coef./Se.		Lithuania Coef./Se.		Croatia Coef./Se.
		·		Change	
Change Nov252008	-0.0789	Change		Nov252008	-0.7427*
1000252000	(0.23)	Nov252008	1.3615*	D010000	(0.42)
Dec012008 Dec162008	0.6596***	Dec012008	(0.02)	Decuizuus	2.5/05***
	(0.23)	00012000	(1.86)	Dec162008	-0.6590
	-0.7396***	Dec162008	-1.5179		(0.55)
Jan282009	-0.1486		(2.73)	Jan282009	-0.0066
	(0.60)	Jan282009	4.1571**	Mar182009	0.0023
Mar182009	-0.3223		(1.88)		(0.01)
Aug102010	(1.41)	Mar182009	-1.2510	Aug102010	-0.0887
AUGIOZOIO	(1.18)	Aug102010	-0 1199	Aux272010	(0.06)
Aug272010	-0.0021	1149102010	(0.17)	Aug2/2010	(0.03)
	(0.33)	Aug272010	-2.2526**	Sep212010	-0.0146
Sep212010	0.0046	5	(1.08)		(0.03)
Oct152010	(14.84)	Sep212010	-0.1014**	Oct152010	-0.0524***
OCT152010	(2.30)		(0.04)	Nov022010	(0.01)
Nov022010	-0.2555***	Oct152010	-0.3676***	NOV022010	(0.01)
	(0.01)		(0.07)	Aug092011	0.2257**
Aug092011	-0.0570	Nov022010	-0.6420		(0.11)
3	(0.06)		(1.05)	Aug262011	-0.0244
Aug262011	-0.0538	Augu92011	-0.1126^^^	Sep212011	(0.02)
Sep212011	0.1612	Aug262011	0.002	COPETION	(0.28)
-	(0.14)	11492 02011	(0.00)	Aug222012	0.0677
Aug222012	0.0061	Sep212011	-0.2138		(0.11)
	(1.19)	-	(0.16)	Aug312012	-0.1187
Aug312012	-0.0025	Aug222012	0.0169***	Sep132012	(0.08)
Sep132012	-0.0062		(0.00)	000102012	(0.28)
	(0.06)	Aug312012	-0.0006	Mar202013	0.4735**
Mar202013	0.1808		(0.00)		(0.20)
	(0.18)	Sep132012	-0.0029	May012013	0.0102
May012013	-0.3006***	Max202012	(0.02)	Mav222013	0.0152
Maw222013	(0.07)	Marz0z015	-0.0985		(0.05)
	(0.12)	Mav012013	0.0294	Jun192013	0.1787***
Jun192013	0.2033		(0.02)		(0.05)
	(0.13)	May222013	-0.0102**	JULIIZUI3	-0.1330
Jul112013	-0.1920		(0.00)	Oct302013	0.0083
Oct 302013	(0.19)	Jun192013	-0.0434		(0.01)
000002010	(0.08)		(0.05)	Dec182013	0.0925**
Dec182013	0.0505	Jul112013	-0.0155	Constant	(0.04)
	(0.16)		(0.03)	Constant	(0.00)
Constant	-0.0013	Oct302013	-0.1096***		
	(0.00)	Dec182013	(0.02)	ARMA	
ARMA		Decidzois	(0.07)	L.ar	-0.2855***
L.ar	-0.9107***	Constant	-0.0038***	T 2	(0.10)
	(0.15)		(0.00)	L2.d1	-0.1884****
L2.ar	-0.5433***			L3.ar	-0.9031***
T 2	(0.08)	ARMA			(0.14)
uj.di	-0.3360***	L.ar	-0.2364**	L.ma	-0.1547*
L4.ar	-0.1896***		(0.12)	1.2 ma	(0.09)
	(0.04)	L2.ar	-0.1337**	112.11d	(0.04)
L5.ar	-0.1371***	_	(0.05)	L3.ma	0.7720***
_	(0.02)	L.ma	-0.19/5		(0.03)
L.ma	0.3928**		(0.13)	L4.ma	-0.4678***
	(0.13)	ARCH			(0.06)
ARCH		L.arch	0.1281***	ARCH	
L.arch	0.0924***		(0.03)	L.arch	0.4551
	(0.01)	L.garch	0.9007***		(0.35)
L.garch	0.9044***		(0.02)	L.garch	0.6189***
Constant	(0.00)	Constant	0.0001	Constant	(U.∠4) 0.0006
	(0.00)		(0.00)	-	(0.00)
N	2/10			N	2298
 p	8.32e-305	N	2777	р	0
- chi2	1532.0	r chi2	461.7	chi2	132888.7

Table 4-8; 4-10: ARCH models for frontier markets (*** p<0.01, ** p<0.05, * p<0.1)