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ASYMMETRIC EFFECTS OF U.S. MONETARY POLICY...

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ASYMMETRIC EFFECTS OF U.S. MONETARY POLICY ON STOCK
MARKET VOLATILITY: AN ANALYSIS USING ASYMMETRIC GARCH
MODEL

A Master's Thesis

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By

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ECONOMICS
İHSAN DOĞRAMACI BILKENT UNIVERSITY
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By Ubaid Ur Rehman

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics

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ABSTRACT

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This thesis examines the asymmetric effects of U.S. monetary policy and interest rates on the volatility of returns in the stock market of emerging countries using an asymmetric generalized autoregressive conditional heteroscedasticity model. The model incorporates the interest rate movements in the U.S. in the conditional variance equation and uses a dummy to explicate the asymmetric response of the volatility of the returns. Using daily returns data of 14 indices from a selection of countries and creating a dummy variable for the daily federal funds rate, the results show that the response of volatility to the contractionary movement in interest rate is significantly higher than the expansionary movement. The results also the differences in the response across the countries given the heterogeneity in global trade integration, financial structure, and financial developments. Moreover, the high-frequency identification of monetary policy surprises is also used for the analyses of the response of monetary policy. This exercise shows that the markets perceive the contractionary policy differently and differentiate between growth shocks and pure monetary policy shocks as well as the information effect of the FOMC decisions on the meeting dates.

Keywords: Financial markets, GARCH models, Macroeconometrics, Monetary policy, Volatility

ÖZET

ABD PARA POLİTİKASININ HİSSE SENEDİ PİYASASI OYNAKLIĞI ÜZERİNDEKİ ASİMETRİK ETKİLERİ: ASİMETRİK GARCH MODELİ İLE BİR ANALİZ

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Bu tez, ABD para politikası ve faiz oranlarının gelişmekte olan ülkelerin hisse senedi piyasalarındaki getiri oynaklığı üzerindeki asimetrik etkilerini asimetrik genelleştirilmiş otoregresif koşullu değişen varyans modeli kullanarak incelemektedir. Model, ABD'deki faiz oranı hareketlerini koşullu varyans denklemine dahil etmekte ve getirilerin volatilitésinin asimetrik tepkisini açıklamak için bir kukla kullanmaktadır. Seçilen ülkelerden 14 endeksin günlük getiri verileri kullanılarak ve günlük federal fon oranı için bir kukla değişken oluşturularak elde edilen sonuçlar, oynaklığın faiz oranındaki daraltıcı harekete tepkisinin genişletici harekete göre önemli ölçüde daha yüksek olduğunu göstermektedir. Sonuçlar, küresel ticaret entegrasyonu, finansal yapı ve finansal gelişmelerdeki heterojenlik göz önüne alındığında, ülkeler arasındaki tepkideki farklılıkları da ortaya koymaktadır. Ayrıca, para politikası sürprizlerinin yüksek frekanslı tespiti de para politikasının tepkisinin analizi için kullanılmıştır. Bu uygulama, piyasaların daraltıcı politikayı farklı algıladığını ve büyüme şokları ile saf para politikası şokları arasında ayırım yaptığını ve FOMC kararlarının toplantı tarihlerindeki bilgi etkisini göstermektedir.

Anahtar Kelimeler: Finansal piyasalar, GARCH modelleri, Makroekonometri, Para politikası, Volatilité

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TABLE OF CONTENTS

ABSTRACT	i
ÖZET	ii
ACKNOWLEDGMENTS	iii
TABLE OF CONTENTS.....	iv
LIST OF TABLES.....	v
LIST OF FIGURES	vi
CHAPTER 1: INTRODUCTION	1
CHAPTER 2: LITERATURE REVIEW	4
CHAPTER 3: DATA AND METHODOLOGY	9
CHAPTER 4: RESULTS.....	17
CHAPTER 5: ROBUSTNESS CHECKS.....	28
CHAPTER 6: CONCLUSION	31
REFERENCES	32
APPENDIX	37

LIST OF TABLES

TABLE 1: DESCRIPTION OF SAMPLE INDICES	9
TABLE 2: SUMMARY STATISTICS OF DAILY RETURNS (PERCENTAGE POINTS)	10
TABLE 3: RESULTS OF ESTIMATED GJR-GARCH (1,1) MODEL	15
TABLE 4: ESTIMATION RESULT OF THE PROPOSED MODEL.....	17
TABLE 5: RESULTS FOR THE F-TEST OF ASYMMETRIC EFFECTS.	22
TABLE 6: PSEUDO R2 FOR THE EQUATIONS (3) AND (4)	23
TABLE 7: ESTIMATION RESULTS USING MONETARY POLICY SURPRISES FOR DUMMY	25
TABLE 8: ESTIMATION RESULTS USING FORWARD GUIDANCE FACTOR FOR DUMMY.....	27
TABLE 9: ESTIMATION OF EQUATION (4) WITH WTI OIL PRICE DUMMY.....	29
TABLE 10: TRADE INTENSITY (CALCULATED AS AN AVERAGE OF USD- INVOICED EXPORTS AND IMPORTS PROPORTION THROUGHOUT THE SAMPLE PERIOD.	37
TABLE 11: EQUATION (4) ESTIMATES FOR SELECTED SUBSAMPLES.....	38

LIST OF FIGURES

FIGURE 1: HIGHEST AND LOWEST RETURNS OVER THE SAMPLE PERIOD. .	13
FIGURE 2: HISTOGRAM OF THE RETURNS DATA.	14
FIGURE 3: ESTIMATED COEFFICIENT OF THE INTEREST RATE DUMMY.	21
FIGURE 4: USD-DENOMINATED TRADE INTENSITY (MEASURED AS THE PROPORTION OF TRADE INVOICED IN USD).	22
FIGURE 5: MONETARY POLICY SURPRISES	24
FIGURE 6: DFF (DAILY FEDERAL FUNDS RATE), DTB3 (3-MONTH TREASURY BILL RATE), DGS2 (2-YEAR TREASURE NOTE).....	28
FIGURE 7: DAILY RETURNS OF SAMPLE INDICES (1997-2019).....	41
FIGURE 8: AUTOCORRELATION PLOTS OF ABSOLUTE DAILY RETURNS.	47
FIGURE 9: BOX-PLOT GRAPH OF DAILY RETURNS OF SAMPLE INDICES.	48
FIGURE 10: SHARE OF EXPORTS TO THE US.	49
FIGURE 11: SHARE OF IMPORTS FROM THE US.	49

CHAPTER 1

INTRODUCTION

The dynamic interplay between monetary policy and financial markets is a critical area of economic research, particularly regarding the transmission mechanisms that influence real economic activity. A pivotal aspect of this relationship is the concept of asymmetric effects, where changes in monetary policy, especially those unexpected by market participants, lead to varying responses in financial markets and the broader economy. In emerging markets, the impact of U.S. monetary policy changes can be profound due to deregulation of financial markets which has led to increased financial globalization and interconnectedness. This globalization has allowed investors to move their capital around in search of higher returns on their investments while minimizing the risks. There exists sufficient evidence in the literature for the co-movement of risky asset prices, capital flows, and financial aggregates which indicate that investors and market participants' philosophy of "flight to safety" in times of distress such as the Asian Financial Crisis. Miranda-Agrippino and Rey (2019) highlight the role of U.S. monetary policy and the global financial spillover effects using a global VAR and jointly estimating the response of monetary, financial, and real variables in the U.S. as well as other countries.

Miranda-Agrippino et al. (2020) provide evidence for the international risk-taking channel and show that US monetary policy tightening leads to capital outflows in emerging markets. Gopinath (2015) argues for the role of the U.S. dollar as a reserve currency and the consequent effects of U.S. monetary policy across countries via trade channels and exchange-rate pass-through. Using the data from Boz et al. (2022), which present a panel data set of invoicing countries in global trade, I look at the case where the use of USD for invoicing the trade with the trading and the correlation with the estimated parameter of U.S. interest rate. The analysis confirms the dominant role of the U.S. dollar as the currency for invoicing used for trade. The extensive use of the U.S. dollar amplifies the

spillover effect of the monetary policy changes and pass-through channel of trade, capital flows, and exchange rates. The result conforms with the theoretical and empirical results of Gopinath (2015).

This thesis assesses the asymmetric spillover effects of U.S. interest rates and monetary policy changes on stock market volatilities using an asymmetric GARCH model. The use of a GARCH model allows us to model the volatility clustering property of the financial markets data. Mandelbrot (1963) defines volatility clustering as

“large changes tend to be followed by large changes, of either sign and small changes tend to be followed by small changes.”

Moreover, the GARCH model allows us to look at the level of persistence in the returns in the short-term and long-term by looking at the estimated parameters of ARCH and GARCH. A distinct focus of this thesis is the analysis of the asymmetrical impact on volatility in the EMEs. The use of asymmetric GARCH carries significance in terms of assessing the dynamics of perceived risk in the emerging stock market. The negative shock pushes investors to look for alternative investment options and pull out the investment to minimize the risk. The focus on asymmetrical aspects is aimed at understanding the intricate patterns and potential contagion effects of the changes in U.S. monetary policy.

The role of U.S. interest rate and monetary policy on the stock market volatility carries importance for investors, market participants as well as policymakers. For emerging countries, the financial development of the stock market and other financial markets is looked upon as an indicator of economic optimism (Bhowmik and Wang, 2020). Furthermore, the existing literature provides the argument and evidence of the stock market returns and volatility levels correlating with real economic activity (Laopodis and Papastamou, 2016; Pethe and Karnik, 2000; Berger and Roman, 2018). By examining the asymmetric effect of interest rate changes on stock market volatility, this thesis aims to provide insights into how emerging markets can better navigate the complexities of global macro-financial interdependencies and enhance economic stability through informed

policy measures. Central banks and prudential regulators have shown interest in understanding the transmission channels and dynamic propagation of such spillovers to financial markets into the real economy as it hampers the social welfare of the agents as well as the optimal allocation of economic activity.



CHAPTER 2

LITERATURE REVIEW

Monetary Policy and Stock Market Returns

The effect of policy decisions of advanced economies on emerging markets economies (EMEs) is well-documented in the literature. Diebold and Yilmaz (2009) present the case for financial market interdependence among equity markets using a spillover index. The empirical results show that there are bursts of volatility spillovers throughout the sample period. Using seven advanced countries and twelve emerging markets economies, the estimation results provide clear evidence of volatility spillover from the U.S. to the emerging economies due to shocks in U.S. stock market returns, which itself could be due to U.S. interest rate surprises as documented (Kuttner (2001), Gurkaynak et al. (2005)). Bhattarai et al. (2020) provide evidence for spillover effects of US uncertainty shock. The authors conclude that a US uncertainty shock decreases EME asset prices and raises EME country spreads. Using a multi-country VARX model, Lastaukas and Nguyen (2023) confirm that US monetary policy uncertainty contributes to the global slowdown as well as to the global financial cycle. The US equity prices' drop is spilled globally, including the euro area, with a particularly strong impact in Latin America. The paper also presents the results that show that uncertainty brings about greater impacts in periods of economic distress than in tranquil periods, hinting at an asymmetric effect of uncertainty and shocks. Furthermore, recent findings point towards pronounced changes in the international transmission of US monetary policy throughout the sample period, especially so for the reaction of international output, equity prices, and exchange rates against the US dollar (Cuaresma et al., 2019). The paper also provides empirical evidence that a contractionary shock to US monetary policy tends to imply a persistent global contraction in real activity and a drop in international consumer and equity prices. Ng (2000) uses the bivariate GARCH (1,1) model to model the joint process of returns for the Tokyo Stock Exchange and S&P 500 indices and allow the shocks in Japan and the U.S. to affect the equity returns in Pacific-Basin economies. Considering these existing studies, an essential direction of

inquiry concerns the asymmetric effect of U.S. monetary policy on emerging economies. Ivrendi and Guloglu (2012) focus on the Asian countries: South Korea, Malaysia, Singapore, and Thailand; to provide evidence of the interaction between changes in monetary policy regimes and stock prices by using a Markov regime-switching ARCH model. The authors find an asymmetric relationship between different phases of monetary policy and stock market volatility. The probability of monetary policy being in a stable regime when stock prices are in a low-volatility regime is found to be very high for all the countries studied. However, the probability of monetary policy being in an unstable regime when stock prices are in a regime of unstable volatility is found to be very low for South Korea, but moderate for Malaysia and Singapore.

Lastaukas and Nguen (2023) provide a theoretical framework that uses the New Keynesian model and incorporates stochastic volatility to analyze the spillovers of monetary policy in a multi-country setting. The model shows that contractionary monetary policy shocks make households form expectations more heavily influenced by the possibility of future adverse shocks. Iliopoulos et al. (2021) present a theoretical framework to model international spillovers and international transmission of shocks. The paper uses a standard two-country RBC model with “home information bias” which takes into account the information bias in agent’s expectations under a New Keynesian open-economy model. The paper’s theoretical results are supported by the empirical evidence. The analysis also shows the asymmetry in capital movements due to the production efficiencies.

Channels of Transmission

Numerous studies have primarily focused on the trade and exchange rate channels of the international transmission of monetary policy (Habib and Veditti, 2019, Jorda et al., 2019) relative to the global financial markets channel. Bernanke and Gertler (1989) present the credit channel which puts the agency problem as a key to the business cycle amplification. Moreover, the effect of US monetary policy tightening is faced by the international markets as documented by Kalemli-Ozcan (2019). The results show that US monetary policy shocks widen the US-UK short-term interest rate differential. Miranda-Agrippino

et al., (2020) Hansen show that the complex global network and interdependencies among the financial markets can aggregate the spillover effects of US monetary policy regardless of exchange rate regimes.

Ramey and Ramey (1994) investigate the relationship between macroeconomic volatility and economic growth across different countries. The authors find a strong negative correlation between volatility and growth, suggesting that higher volatility in economic activity, including stock market volatility, can have adverse effects on growth. They argue that volatility disrupts investment decisions, reduces productivity, and increases uncertainty, which in turn hampers economic growth. Schwert (1989) examines the impact of stock market volatility on real economic activity, finding that increased volatility is associated with declines in consumer spending and business investment. The paper finds stronger evidence that stock return volatility predicts industrial production volatility for the 1891–1987 and 1920–1952 periods and that it increases during the periods of recessions. More recently, Baker et al. (2016) developed an Economic Policy Uncertainty (EPU) index and used it to track macroeconomic policy-related uncertainty. The paper concludes that policy uncertainty is associated with greater stock price volatility and reduced investment and employment in policy-sensitive sectors.

Volatility and GARCH models

The empirical evidence for the role of stock market volatility on real economic variables has motivated the evolution of volatility models. Ding et al. (1993) use Monte Carlo simulations to show that the GARCH specification produces the autocorrelation and volatility clustering pattern that could be seen in the financial data. Moreover, the autocorrelation analyses show that the stock market returns series (calculated as log difference of closing prices on two consecutive days) is not i.i.d. process. The results support that the arrival of information influences the price of the asset and the return in the next period would be conditional on the information available. GARCH models have been applied extensively to analyze financial time series data. The risk-return tradeoff in the financial markets puts much emphasis on modeling the conditional variance and volatility. The generalization of ARCH models proposed by Bollerslev (1986) provided

an analytical tool to treat conditional variance as something that can be modeled and forecasted. Further developments of GARCH models look to incorporate structural variables to derive the economic intuition behind the estimation results. Bollerslev et al (2015) present a structural factor GARCH model to predict the long-run returns of the S&P500 market portfolio. The authors use a variety of factors such as dividend-price ratio and the variance risk premium. The use of the GARCH model helps to elucidate the underlying economic mechanisms. The results show that persistence exists in the long-run expected growth component and the asymmetric information effect in short-run volatility dynamics. Hansen and Lunde (2005) present a detailed comparison of 330 GARCH models in terms of their ability to describe the conditional variance. The results show that GARCH-(1,1) outperforms the other models in the analysis of the DM-USD exchange rate and daily IBM returns. However, in the same paper, the authors show that GARCH-(1,1) is inferior to the models that can account for leverage effects. This motivates the use of the GJR-GARCH-(1,1) model and modifies it to account for US monetary policy surprises and analyze the extent to which these surprises explain the volatility in financial markets of emerging countries. Kang and Yoon (2007) provide evidence for the long-memory property of the volatility in the Korean stock market by using GARCH, IGARCH, and fractionally integrated GARCH (FIGARCH) models. The results support that volatility follows a long memory process in the Korean stock market.

Measures of Monetary Policy

One of the key aspects in such empirical investigation of the information effect of monetary policy is the identification of monetary policy shocks and the estimation of the surprise component. Due to the simultaneity in the movements of financial variables such as asset returns and policy rates, the conventional strategies of identification and VAR analysis (Bernanke and Blinder 1992, Christiano, Eichenbaum, and Evans 1996) present biased estimates of responses (Rudebusch, 1998). Therefore, it is important to isolate the exogenous monetary policy shock and recover the information effect in the investigation of its impact on financial variables. Jarocinski and Karadi (2020) propose separating monetary policy shocks from contemporaneous information shocks by analyzing the high-frequency co-movement of interest rates and stock prices in a narrow window around the

policy announcement. Kuttner (2001) separates the monetary policy surprises into anticipated and unanticipated components using federal funds futures market data. The author argues that fed funds futures represent the market's expectation about the future path of the interest rate. The results show that the response of yields on bonds of different maturities is significantly larger than when estimation is done using only the changes in interest rates. The introduction of using Fed funds futures rate for monetary policy surprises renewed attention to the information effects of monetary policy decisions on macroeconomic variables using high-frequency identification of monetary policy surprises. Gurkaynak, Sack, and Swanson (2005) make use of high-frequency intraday data and tight windows around the FOMC announcements to observe the movements in returns of different assets. Their strategy eliminates the problem of the simultaneous response of policy variables and financial markets variables as well as identifying the monetary policy surprise that is cleansed from any other significant macroeconomic news released that day. The authors use principal component analysis to estimate target and path factors. They refer to the path factor as the forward guidance that the Fed uses to indicate the future movement of interest rates. Their results show a significant variance in the Fed funds futures is due to the FOMC meeting announcements.

The review of the existing literature above motivates the need to investigate further the spillover effects of U.S. monetary policy. The heterogeneity among emerging economies in terms of their monetary policy stance, macroeconomic conditions, and financial market structure could produce asymmetric effects stemming from the same movement in the U.S. interest rate. Moreover, using the high-frequency daily data for effective federal funds rate aims to reduce the problem of shock identification associated with using VAR methods such as sign restrictions, and ordering of variables. The use of GARCH specification to model the behavior of financial markets provides an intuitive way to investigate the asymmetric response to policy shocks within and across countries.

CHAPTER 3

DATA AND METHODOLOGY

The sample of countries covers a selection of emerging and developing countries as per the IMF classification¹ and based in different geographical regions. The data for stock indices is collected from the Bloomberg terminal. Table 1 below shows the list of countries and the respective indices.

Table 1: Description of sample indices

Country	Index	Ticker
Argentina	S&P Merval Index	MERV
Brazil	Bovespa Index	IBOVESPA
Chile	Santiago Stock Exchange General Index	S&P CLX IGPA
China	Shanghai Stock Exchange Composite Index	SSEC
India	Bombay Stock Exchange SENSEX	BSESN
Indonesia	Jakarta Composite Index	JKSE
South Korea	Korea Composite Index	KOSPI
Mexico	Mexico Bolsa Index	MEXBOL
Emerging Market Economies	Morgan Stanley Composite Index-Emerging Economies ²	MSCEM
Pakistan	Karachi Stock Exchange All Share Index	KSI
Poland	Warsaw Stock Exchange Index	WIG20
Saudi Arabia	Tadawul All Share Index	TASLSR
United States	Standard and Poor's 500	S&P500
Thailand	Stock Exchange of Thailand Index	SET.BK

The sample period chosen is from 1 January 1997 to 31 December 2019. The daily returns are calculated as a percentage difference of the closing prices at time t and $t-1$. The choice of using percentage returns instead of log returns is due to the presence of large changes which could deter the log approximation. Moreover, the selected time span covers various

¹ <https://www.imf.org/en/Publications/WEO/weo-database/2023/April/groups-and-aggregates#a5>

² EM countries include: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Kuwait, Malaysia, Mexico, Peru, Philippines, Poland, Qatar, Saudi Arabia, South Africa, Taiwan, Thailand, Turkey and United Arab Emirates.

economic episodes such as the Asian Financial Crises, and the “Great Moderation” which refers to the period of low volatility in the U.S. between the mid-1980s and the global financial crisis in 2007. Table 2 provides descriptive statistics of the daily returns (percentage points) series.

Table 2: Summary Statistics of daily returns (percentage points)

Panel A: Full Sample 1997-2019

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Argentina	5999	.088	2.647	-100	17.488	-9.566	352.063
Brazil	5999	.043	2.243	-16.742	18.928	.116	10.402
Chile	5999	.033	1.122	-14.115	12.528	-.181	17.496
China	5999	.043	1.743	-16.394	30.987	.707	25.073
India	5999	.052	1.485	-12.238	17.744	.008	10.988
Indonesia	5999	.056	1.499	-11.955	14.028	.04	11.884
Korea	5999	.032	1.73	-11.961	12.232	-.017	7.821
Mexico	5999	.054	1.375	-13.337	12.923	.226	11.256
MSCI	5999	.021	1.173	-9.512	10.598	-.369	10.432
Pakistan	5999	.06	1.476	-12.378	13.612	-.137	9.023
Poland	5999	.043	1.395	-12.66	14.489	.005	11.424
Saudi Arabia	5999	.037	1.35	-12.62	17.821	-.594	20.15
SP500	5999	.033	1.247	-11.984	11.58	-.174	12.988
Thailand	5999	.022	1.508	-14.84	12.019	.162	11.776

Panel B: Subsample for the period 1997-1999

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Argentina	782	-.102	4.293	-100	12.26	-16.194	376.718
Brazil	782	.054	2.83	-12.817	18.928	.393	10.13
Chile	782	.044	1.466	-7.379	8.731	.42	7.895
China	782	.144	2.632	-16.394	30.987	1.729	30.24
India	782	-.013	1.673	-8.461	7.296	.04	5.917
Indonesia	782	.012	1.839	-11.955	14.028	.358	15.128
Korea	782	-.107	2.261	-8.642	8.617	.224	5.512
Mexico	782	.064	1.84	-13.337	12.923	.289	13.475
MSCI	782	.011	1.252	-7.156	4.887	-.631	6.787
Pakistan	782	-.061	1.98	-12.378	13.612	.021	9.131
Poland	782	.098	1.932	-9.775	14.489	.332	9.43
Saudi Arabia	782	.021	.637	-2.898	4.13	.757	8.705
SP500	782	.091	1.197	-6.866	5.115	-.359	6.488
Thailand	782	-.067	2.522	-9.542	12.019	.888	5.615

Panel C: Subsample for the period 2003-2006

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Argentina	1042	.14	1.676	-8.366	6.275	-.356	5.205
Brazil	1042	.181	1.8	-7.488	6.066	-.398	4.169
Chile	1042	.114	.854	-4.971	3.004	-.528	5.636
China	1042	-.057	1.419	-6.334	9.857	1.056	9.352
India	1042	.107	1.304	-12.238	8.295	-.97	13.341
Indonesia	1042	.09	1.324	-10.357	4.532	-.665	8.15
Korea	1042	.09	1.685	-7.01	8.378	-.135	4.55
Mexico	1042	.097	1.097	-5.291	3.852	-.232	4.546
MSCI	1042	.114	.925	-4.74	4.141	-.686	6.045
Pakistan	1042	.214	1.528	-7.449	8.879	-.242	6.015
Poland	1042	.107	1.049	-3.342	3.654	.003	3.825
Saudi Arabia	1042	.116	1.1	-6.523	9.198	.128	16.406
SP500	1042	.056	.713	-3.473	2.612	-.061	3.896
Thailand	1042	.075	1.335	-14.84	11.157	-.841	22.498

Panel D: Subsample for the period 2007-2009

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Argentina	783	.035	2.252	-12.148	10.995	-.356	7.326
Brazil	783	.114	3.181	-16.742	18.079	.036	8.858
Chile	783	.046	1.349	-6.025	12.528	.594	14.38
China	783	.1	2.198	-8.841	9.455	-.258	5.175
India	783	.044	2.157	-12.203	6.991	-.34	5.285
Indonesia	783	.048	1.808	-10.375	7.921	-.554	8.605
Korea	783	.017	1.861	-10.33	12.232	-.177	8.7
Mexico	783	.042	1.861	-7.008	11.005	.42	7.152
MSCI	783	.028	1.898	-9.512	10.598	-.169	8.276
Pakistan	783	-.042	1.719	-5.863	8.605	-.183	4.648
Poland	783	-.026	1.692	-7.955	6.273	-.249	4.936
Saudi Arabia	783	.06	2.287	-12.008	17.821	-.37	11.075
SP500	783	-.023	1.902	-9.035	11.58	.071	8.793
Thailand	783	.045	1.655	-10.497	7.841	-.546	8.303

Panel E: Subsample for the period 2013-2014

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Argentina	521	.177	2.495	-10.093	8.676	-.327	4.377
Brazil	521	-.062	1.688	-6.078	8.357	.343	5.522
Chile	521	.001	.732	-2.767	3.134	-.058	3.982
China	521	-.021	1.067	-5.299	4.325	.055	5.231
India	521	.085	.976	-4.083	3.809	.016	4.873
Indonesia	521	.039	1.138	-5.584	4.649	-.314	5.823
Korea	521	.015	.884	-2.749	3.238	.273	4.205
Mexico	521	.026	.843	-3.913	2.862	-.025	4.154
MSCI	521	-.016	.768	-4.043	2.976	-.156	4.704
Pakistan	521	.156	.797	-3.158	2.72	-.273	4.675
Poland	521	.055	.906	-5.214	2.924	-.609	6.906
Saudi Arabia	521	.069	.707	-4.121	2.897	-.774	9.039
SP500	521	.032	.776	-3.941	3.903	-.28	5.989
Thailand	521	.018	.827	-4.727	2.875	-.362	5.484

The selected stock indices show kurtosis values higher than 3 which is an indication that the returns series has fat tails which is a main characteristic of financial markets data. Figure 7 presents a snapshot of stock market returns for the selected countries. For the given sample period, we can observe that the stock market returns are clustered throughout the period. South Korea, Thailand, and Indonesia show extreme volatility and clustering during the Asian Financial Crises. For Pakistan, the second half of the year 1999 was impacted due to the political turmoil followed by conflict with the neighboring country India. Similarly, the impact of the global financial crisis of 2008 could be seen in all the stock markets leading to high volatility. Volatility clustering of the daily returns is evident in Figure 7 in the appendix. Large changes in the daily returns are followed by large changes and small changes are followed by small changes in all the sample indices. The autocorrelation plots of the absolute returns confirm the presence of volatility clustering (Cont, 2007). The absolute return plots in Figure 8 show the returns are highly correlated which means large returns are followed by large returns and small returns are followed by small returns and hence the volatility clustering in the data.

Figure 1 shows the highest and lowest return for the sample indices throughout of the sample period. Argentina’s lowest return is observed on 30 November 1998 which also marks the begging of a debt spiral and beginning of a depression in the Argentinian Economy (Helleiner, 2005).

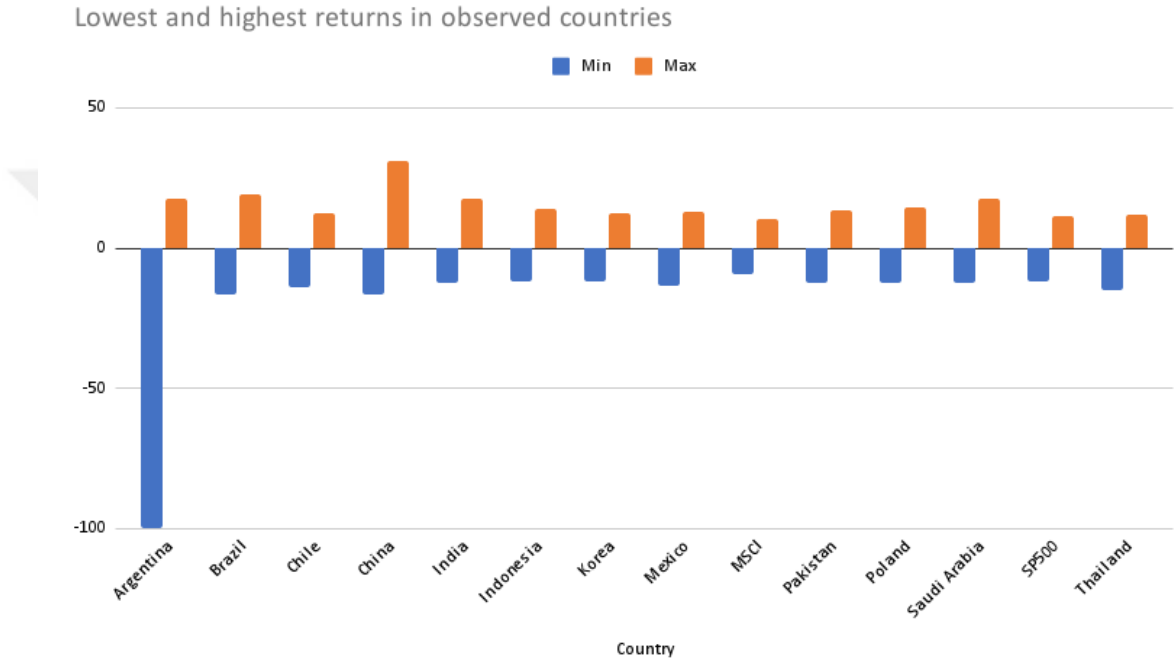


Figure 1: Highest and Lowest Returns over the sample period.

Figure 2 below shows the histogram plots for the observed data. The returns exhibit the fat tails which is a well-known considered primary characteristic of the returns in the stock market.

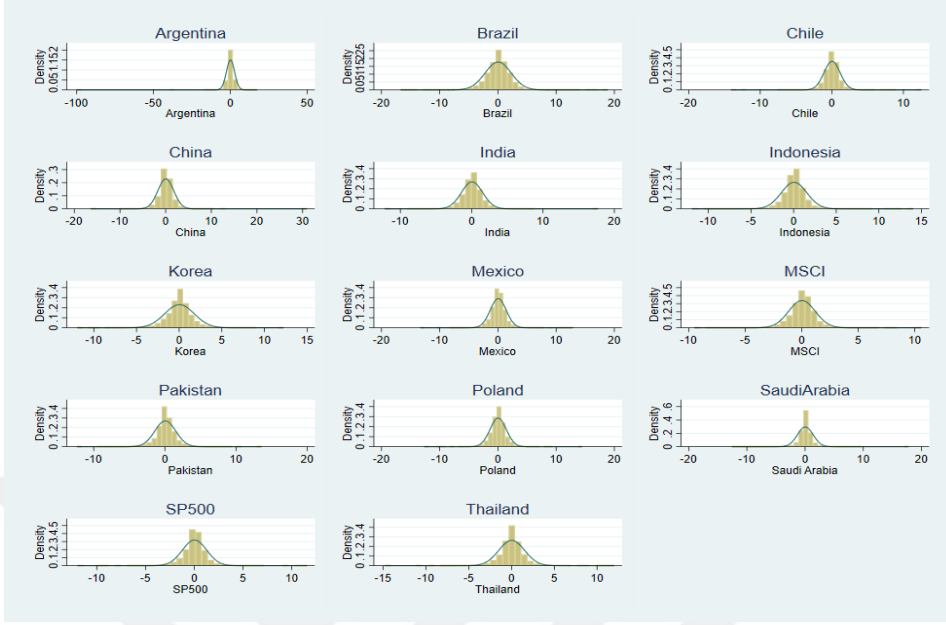


Figure 2: Histogram of the returns data.

The stock market return is given as the percentage difference of closing price at daily intervals and is characterized by equation 1 and the conditional variance is given by equation 2.

$$r_t = \mu + \varepsilon_t \quad (1)$$

$$\varepsilon_t = \sigma_t z_t, \quad z_t \sim \mathcal{N}(0,1) \text{ i. i. d.} \quad (2)$$

I propose to use the GJR-GARCH (1,1) specification as the base case to model the asymmetric effects in the volatility of asset markets' returns. GJR-GARCH (1,1) is given by the following equation:

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{\{\varepsilon_{t-1} < 0\}} + \beta \sigma_{t-1}^2 \quad (3)$$

Where $\omega > 0$, $\alpha > 0$, $\beta > 0$, and $\alpha + \beta + 1/2 \gamma < 1$ are the conditions necessary for the variance to be positive. γ captures the presence of asymmetric effects in the conditional volatility in the above specification and I is the indicator function which is 1 when the ε

at time t-1 is negative. The positive sign of γ indicates that the negative news at time t-1 affects the time t variance more than the positive news³.

Table 3: Results of estimated GJR-GARCH (1,1) model

Country	ω	α	γ	β
Argentina	0.087***	0.002***	-0.035***	-0.409***
Brazil	0.056***	0.385***	0.283***	0.081***
Chile	0.035***	0.510***	0.280***	0.105***
China	0.018	0.258***	-0.002	0.090***
India	0.052***	0.399***	0.176***	0.059***
Indonesia	0.053***	0.620***	0.307***	0.105***
South Korea	0.027	0.435***	0.188***	0.122***
Mexico	0.045***	0.489***	0.308***	0.154***
MSCI	0.036***	0.295***	0.173***	0.038***
Pakistan	0.090***	0.511***	0.239***	0.087***
Poland	0.041***	0.342***	0.182***	0.037***
Saudi Arabia	0.059***	0.798***	0.573***	0.131***
SP500	0.032***	0.519***	0.367***	0.139***
Thailand	0.035*	0.402***	0.139***	0.123***

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

Table 3 shows the effect of past shocks on conditional variance. The significant coefficient α for all the sample indices shows that the past shocks affect conditional variance and volatility significantly.

asymmetry in the volatility of stock market returns. Brazil, India, Mexico, and Saudi Arabia are countries with higher leverage effects than the other countries. The positive sign of the asymmetry coefficient, γ , indicates that a negative shock increases the volatility or the conditional variance of the returns. Moreover, the significant coefficient β is the evidence for the persistence of volatility over time. The significant coefficient γ provides confirms the presence of asymmetry in the volatility of the stock market return. A negative past shock increases the volatility more than a positive past shock. This asymmetry is present in all the sample indices except China which has an insignificant coefficient.

³ In the context of the GARCH family of models, the terms “shock” and “news” are used interchangeably and refer to the error term. Hence, a “negative shock” refers to the ε_t . From equation (1), $\varepsilon_t = r_t - \mu$ which are proxied by estimated residuals from equation (1).

Proposed Model

To incorporate the impact of the U.S. monetary policy, I aim to use the daily Federal Reserve funds rate as a proxy for short-term U.S. monetary policy. It reflects the overnight rate at which banks lend to each other and hence influencing the short-term interest rates. In the next section, I perform the same analysis using the monetary policy surprises (Bauer and Swanson, 2023) to take into account revisions in investors' expectations.

I begin by introducing an additional term in the equation (3) of the original GJR-GARCH. This dummy term takes the value equal to 1 when the change in Federal funds rate is positive and 0 other. Then the modified GJR-GARCH-(1,1) equation would be

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{\{\varepsilon_{t-1} < 0\}} + \beta \sigma_{t-1}^2 + \phi I_{fedrate_t < 0} \quad (4)$$

Equation (4) is estimated using maximum likelihood estimation. This approach is particularly beneficial when dealing with data that exhibit fat tails, which is the case for financial markets data (Escanciano, 2009). The maximum likelihood function for equation (4) is given by:

$$l(\theta) = -\frac{T}{2} \ln(\nu) - \frac{T}{2} \ln(\pi) + \frac{1}{2} \sum_{t=1}^T \ln(\sigma_t^2) + (\nu + 1) \sum_{t=1}^T \ln \left[1 + \frac{\varepsilon_t^2}{(\nu \sigma_t^2)} \right] \quad (5)$$

where $\theta = \{\alpha, \beta, \gamma, \phi\}$ are the parameters to be estimated. The STATA program uses a Berndt–Hall–Hall–Hausman (BHHH) algorithm (Hall et al., 1974) which uses outer product of the gradient and bases its approximation on the information matrix and ν refers to degrees of freedom. In the above equation 4, ϕ refers to the role that the interest rate in the U.S. plays in stock market volatility. The addition of the dummy variable for the negative movement in the daily effective federal funds rate allows us to capture the effect of investors' asymmetric reaction to the movement of interest rate in the U.S. at a high frequency. Using the movement in the daily interest rate shows the effect of US monetary policy on foreign stock markets and the persistence of these effects via the GARCH model.

CHAPTER 4

RESULTS

Table 4 shows the estimation results of the proposed model. The additional coefficient ϕ shows the asymmetric effect of the movements in the effective federal funds rate which we take as a measure of monetary policy. The positive sign of ϕ indicates that an increase in the effective federal funds rate results in the higher volatility of stock market returns as compared to a decrease in the rate. The coefficients $\omega, \alpha, \gamma, \beta$ refer to the constant, ARCH, asymmetric, and GARCH effects respectively. The significant level of ϕ at 1% for all the sample countries shows that the movement in the stock market is significantly impacted by interest rates in the United States and the impact is asymmetric. The estimated coefficient ϕ differs across the emerging countries explaining the differences in the financial market's structure.

Table 4: Estimation result of the proposed model.

Country	ω	α	γ	β	ϕ
Argentina	0.110***	0.267***	-0.005	-0.001	0.861***
Brazil	0.059***	0.384***	0.280***	0.092***	0.201***
Chile	0.034***	0.513***	0.280***	0.107***	0.101***
China	0.017	0.260***	0.004	0.109***	0.148***
India	0.054***	0.408***	0.180***	0.113***	0.414***
Indonesia	0.049***	0.606***	0.328***	0.137***	0.471***
South Korea	0.026	0.406***	0.172***	0.210***	0.795***
Mexico	0.044***	0.482***	0.311***	0.196***	0.505***
MSCI	0.043***	0.301***	0.173***	0.059***	0.334***
Pakistan	0.094***	0.493***	0.228***	0.123***	0.477***
Poland	0.040***	0.334***	0.169***	0.116***	0.431***
Saudi Arabia	0.058***	0.799***	0.576***	0.129***	-0.152***
SP500	0.035***	0.522***	0.368***	0.155***	0.295***
Thailand	0.036***	0.428***	0.188***	0.170***	0.595***

(Stars denote statistical significance: *** 1%, ** 5%, * 10% significance level)

Argentina has struggled with the economic crises historically. Given the economic meltdown and the loss in the credibility of the Argentinian Peso, the Argentinian stock market demonstrates the highest volatility to movement in federal fund rates. A negative movement of the fed funds rate causes a significant jump in the daily volatility of the index. In 2001, the Argentinian peso lost the peg against the US dollar and defaulted on US\$ 95 billion worth of debt (Helleiner, 2005). The trend has continued with increased inflation rate and countless different unofficial exchange rates. The worsening economic outlook exhibits on stock market volatility where investors are prone to extreme swings in the stock market.

Brazil's reaction to the interest rate changes is one of the lowest among the sample countries. The Brazilian economy could see capital outflows and investor sentiment wavering amidst a contraction in U.S. interest rate. Moreover, the trade channel plays an important role in the case of Brazil. Figure 4 shows that Brazil has a trade intensity of approximately 90% which means that 90% of the total trade (export and import) is invoiced in the U.S. dollar. The high dominance of the U.S. dollar in trade invoicing transmits the effect of the U.S. monetary policy to the stock market as the investors see it as having an impact on demand for Brazilian goods and consequently future expected cash flows.

Chile presents an interesting case. Similar to Brazil, Chile has high trade intensity (91%) but the estimated coefficient for the U.S. interest rate is lower than Brazil. This result could be attributed to several factors. Firstly, Chile has diversified trade relations. Table 10 in the appendix shows that Chile's share of annual exports to the U.S. has remained below 20% from 1997 to 2019, hence reducing the transmission of U.S. monetary policy via trade channel.

China's relatively low coefficient could be attributed to the strict capital controls imposed by the government that limit the flow of capital (Lovchikova & Matschke, 2024). These macroprudential policies act as a buffer to external events, consequently minimizing the impact of U.S. monetary policy. Another factor that plays an important role is the

diversification of the economy across various sectors therefore reducing the volatility caused by any specific external industry or sector.

India is a rapidly growing economy and a lucrative option for investors. The growth of the stock market in terms of market participants, trading volume, and deregulation contributes to the extent to which the stock market responds to external factors. The estimated coefficient for India is 0.414 percentage points higher volatility in response to a contraction. This indicates the Indian stock market responds to the U.S. interest rates and the element of “flight to safety” remains among the investors. Moreover, due to the high level of trade intensity, the argument could be made that a significant trade channel exists. A growing economy like India heavily depends on the import of raw materials and energy to support the manufacturing sector⁴ as well as catering to the demand for imported consumer goods by the growing middle class.

Indonesia has a similar estimated coefficient to India and that could be explained by similar factors. Indonesia has high trade intensity, a major export and import share to the U.S., and a key market share of commodity exports.⁵

South Korea is classified as an emerging market by IMF however Bloomberg still keeps it under the emerging market classification. Nonetheless, it is interesting to analyze the Korean stock market and compare it to geographically close countries such as Indonesia and Thailand. The estimated coefficient for Korea is the second highest among the sample countries. Given the high dependence of the Korean economy on exports, the U.S. monetary policy tightening results in fluctuation in global demand for Korean exports resulting in uncertainty about future expected cashflows and investment as well as exchange rate pass-through, leading to high volatility.

⁴ <https://wits.worldbank.org/countrysnapshot/en/IND>

⁵ <https://wits.worldbank.org/countrysnapshot/en/IDN>

Mexico's large coefficient is expected given the close ties of the Mexican economy to the U.S. economy in terms of trade flows, investment, and remittances from Mexican expatriates working in the U.S. These economic relations with the U.S. provide multiple channels for the transmission of monetary policy to the Mexican stock market. The asymmetric nature of the response is characterized by investors reacting to the movement in interest rate contemporaneously to minimize the risk.

Pakistan is a relatively unstable emerging economy due to various domestic and external factors. The large response of the stock market to the U.S. interest rate shows the risk aversion of investors to the Pakistani stock market.

Poland is a relatively stable emerging economy. Despite being a part of the European Union, it has a large response to the movement in U.S. interest rate. This could be due to the global financial market integration (Miranda-Agrippino and Rey, 2020) which can affect the capital flows and investors' perceived risk.

Among the results in Table 3, the result for **Saudi Arabia** is unexpected. A negative coefficient indicates that a monetary tightening reduces volatility. This result could be attributed to several factors. Among the emerging markets, Saudi Arabia is considered a safe haven given its substantial reserves, strong economy, and stable U.S. dollar exchange rate (Nguyen et al., 2020). Investors with an appetite for investment in emerging markets could choose Saudi Arabia which is considered less volatile.

Figure 3 highlights the difference in the reaction of stock markets across the sample countries. On the days when the change in effective federal funds rate is negative, the volatility of the stock market is higher by 0.861 percentage points for Argentina. Similarly, the volatility is higher by only 0.148 percentage points for China which is evidence of Chinese stock market strength and stringent capital controls imposed by the regulatory authorities.

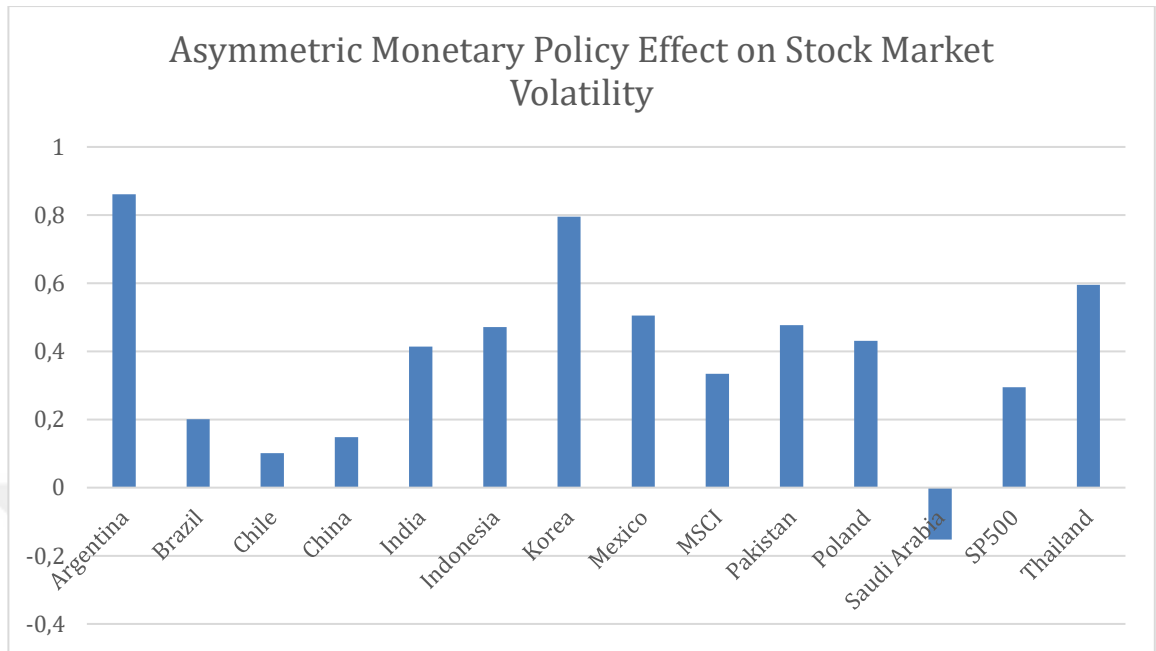


Figure 3: Estimated coefficient of the interest rate dummy.

Figure 4 shows the level of USD-denominated trade intensity of the countries included in the sample. Apart from Mexico, India, Pakistan, South Korea, and Thailand display a high USD-trade intensity as well as a large response of stock market volatility to movement in interest rates, ranging from 0.40 to 0.70 percentage points increase in the volatility.

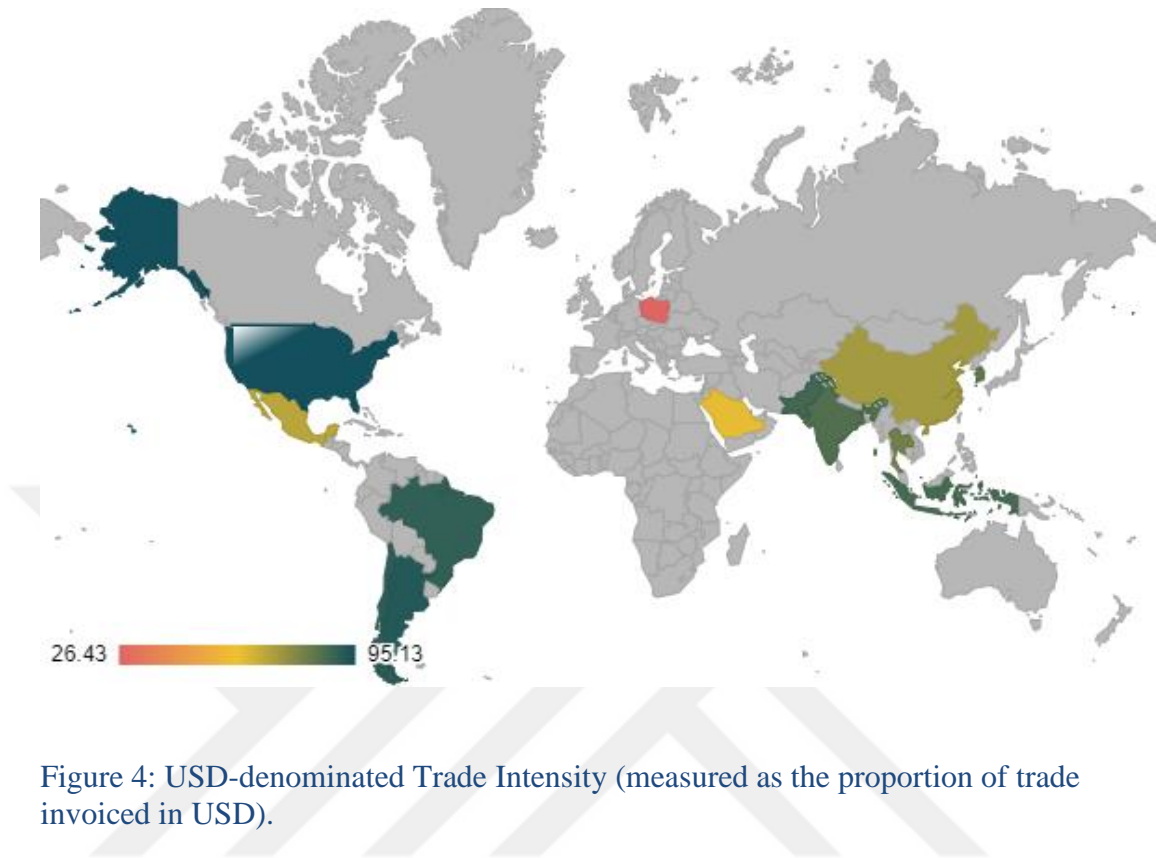


Figure 4: USD-denominated Trade Intensity (measured as the proportion of trade invoiced in USD).

Table 5 shows the result of the joint test for the asymmetric effects coming from the previous day's return and the interest rate.

$$H_0 : \gamma + \phi = 0$$

$$H_1 : \gamma + \phi \neq 0$$

Table 5: Results for the F-test of asymmetric effects.

Country	Argentina	Brazil	Chile	China	India	Indonesia	South Korea	Mexico	MSCI	Pakistan	Poland	Saudi Arabia	SP500	Thailand
χ^2	755.85	5.83	17.27	13.68	25.02	11.90	204.01	23.35	20.18	27.24	39.92	275.59	3.51	140.49
p-value	0.00***	0.02**	0.0***	0.0***	0.0***	0.00***	0.0***	0.0***	0.0***	0.0***	0.0***	0.0***	0.06**	0.00***

***1%, ** 5%, * 10%

The above results show that we can reject the null hypothesis that there is no asymmetric effect for all the sample countries, which implies that the coefficients ϕ and γ are not correlated and significantly impact the volatility of stock market returns.

Table 6 presents the measured pseudo-R² and log-likelihood ratio test for the models estimated by equations (3) and equation (4) to observe the improvement in the model's fit by introducing monetary policy in the volatility equation.

Table 6: Pseudo R2 for the equations (3) and (4)

Country	(1)	(2)	(3)	(4)	(5)
	R ²	Adjusted R ²	R ²	Adjusted R ²	Likelihood Ratio χ^2
Argentina	0.0127	0.0125	0.0126	0.0125	358.41***
Brazil	0.0125	0.0123	0.0007	0.0006	19.33***
Chile	0.0460	0.0456	0.0002	0.0001	4.54**
China	0.0169	0.0167	0.0004	0.0003	9.79***
India	0.0260	0.0257	0.0033	0.0032	69.66***
Indonesia	0.0418	0.0415	0.0043	0.0042	91.07***
Korea	0.0190	0.0187	0.0102	0.0101	236.11***
Mexico	0.0257	0.0254	0.0051	0.0050	103.73***
MSCI	0.0196	0.0139	0.0031	0.0030	57.77***
Pakistan	0.0337	0.0334	0.0047	0.0046	97.99***
Poland	0.0233	0.0230	0.0036	0.0035	73.88***
Saudi Arabia	0.0650	0.0648	0.0005	0.0004	9.83***
SP500	0.0399	0.0395	0.0020	0.0019	37.87***
Thailand	0.0269	0.0267	0.0068	0.0067	145.40***

Column (1)-(2) for equation (3), model without any monetary policy variable. Column (3)-(4) for equation (4), the model with monetary policy variable. Column (5) LR test for equation (3) and equation (4) *** p < 0.01, ** p < 0.05, * p < 0.1.

Although pseudo-R² is small for the sample countries, it is positive for all countries. This shows that the inclusion of the monetary policy in the volatility equation improves the goodness-of-fit. I formally tested this using a log-likelihood Ratio test. The last column of Table 6 shows the test statistic for the log-likelihood ratio test. The last column shows that the null hypothesis is rejected at a 1% significance level for all countries but Chile for which it is rejected at a 5% significance level. These results show that the inclusion of monetary policy in the volatility equation significantly improves the explanation of variation in asymmetric response of the volatility in the stock market.

Monetary Policy Surprises

Following the discussion in the literature review section, throughout the last decade, studies have focused on the identification strategies for the surprise component of the monetary policy. To assess the impact of monetary policy surprises on emerging stock markets' volatility, I employ the monetary policy surprises to analyze the effect on stock market volatility. Using the same specification as equation (4), I replace the dummy for fedrate with the dummy for monetary policy surprises. Therefore,

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{\{\varepsilon_{t-1} < 0\}} + \beta \sigma_{t-1}^2 + \phi I_{mps_t < 0} \quad (6)$$

where $I_{mps} = 1$ if the monetary policy surprise is positive and 0 otherwise. Figure 5 plots the monetary policy surprises on FOMC meeting dates.

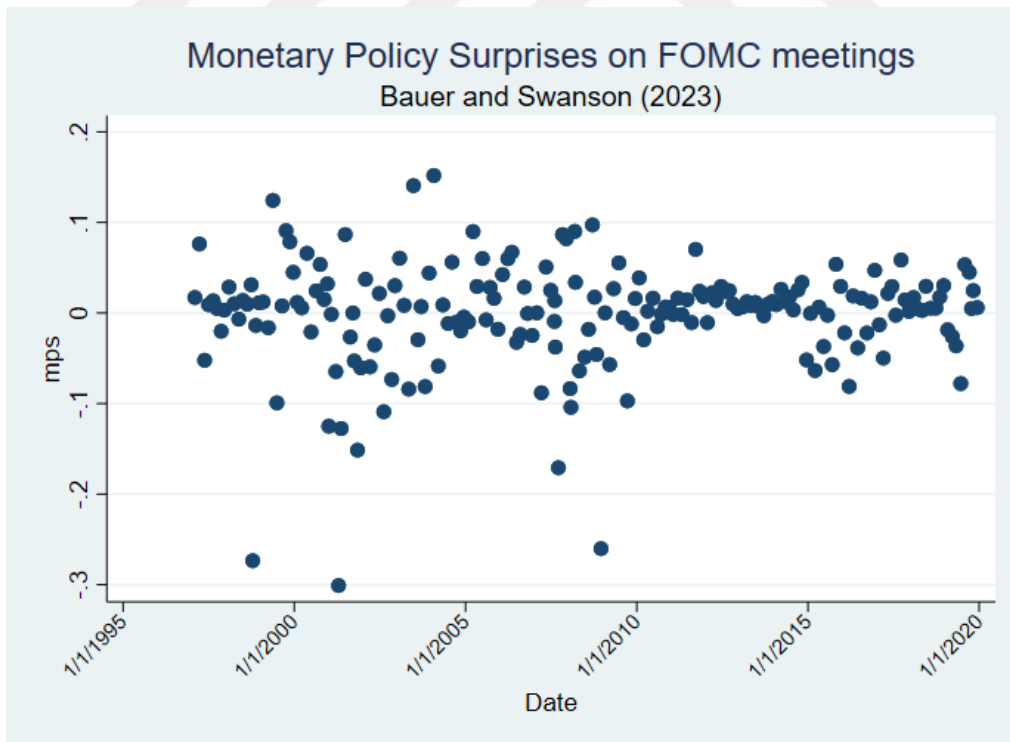


Figure 5: Monetary Policy Surprises

Using the computed monetary policy surprises for the dummy variable, table 7 shows the reaction of volatility in the stock market of the selected countries.

Table 7: Estimation results using monetary policy surprises for dummy.

Country	ω	α	γ	β	ϕ
Argentina	0.096***	0.191***	-0.013	-0.003*	-0.537***
Brazil	0.057***	0.386***	0.284***	0.084***	-0.388***
Chile	0.035***	0.504***	0.279***	0.104***	0.522***
China	0.018	0.257***	-0.001	0.091***	-0.109
India	0.052***	0.399***	0.176***	0.064***	-0.502***
Indonesia	0.053***	0.621***	0.308***	0.106***	-0.095
South Korea	0.027	0.435***	0.181***	0.124***	-0.368***
Mexico	0.045***	0.491***	0.313***	0.153***	0.189*
MSCI	0.037***	0.309***	0.187***	0.045***	-0.422***
Pakistan	0.089***	0.508***	0.232***	0.085***	0.577***
Poland	0.040***	0.342***	0.182***	0.041***	-0.332***
Saudi Arabia	0.059***	0.798***	0.573***	0.132***	-0.012
SP500	0.032***	0.518***	0.368***	0.142***	-0.872***
Thailand	0.036*	0.402***	0.139***	0.123***	0.023

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

Table 7 reveals interesting insights about the behavior of the stock market to monetary policy surprises. The estimated coefficient ϕ differs in sign across the countries while still being significant for the majority of the countries in the sample. The differences point out how the investors perceive the monetary policy surprises. Countries like Chile, Mexico, and Pakistan see an increase in the volatility of stock market returns following the surprises whereas China, Indonesia, Saudi Arabia, and Thailand do not have a significant effect on the stock market volatility. The remaining countries have a negative sign and statistically significant coefficient for the dummy for monetary policy surprises. Drawing on the literature (Hoek et al., 2022; Akinci and Queralto, 2019) the positive response of equity markets can be associated with changes in U.S. monetary policy due to positive growth shocks which contain information about the future. The positive growth shocks can boost emerging markets' profits, growth, and exports, counteracting the channels that cause adverse effects. Moreover, the results where the volatility reduces following a

monetary policy surprise is in line with the “fed information effects” literature. Miranda-Agrippino and Ricco (2021) show that the transmission of monetary policy is clouded by the information effects contained in the fed speeches and announcements. Altavilla et al. (2019) present similar findings to the ECB Governing Council Policy meeting dates and the movement of Euro Stoxx50. A positive response of stock prices reflects an information shock whereas the days when stock prices move in the opposite direction to monetary policy these are indications of monetary policy shocks.

Similar to the monetary policy surprises contained in the FOMC meeting announcement, the literature puts forward the argument that these announcements contain information regarding the future path of the interest rate and the Federal reserves’ commitment to this future path i.e. forward guidance. Swanson (2021) identifies and estimates the effects of unconventional monetary policies followed during the zero lower bound (ZLB) period between January 2009 and October 2015 namely “forward guidance” and “large-scale asset purchases (LSAPs)”. The FOMC communication regarding the future path of the federal funds rate contains important news for investors in emerging economies. The “hawkish” or “dovish” path would influence the investment decisions hence impacting the volatility of stock market returns in the emerging countries. Table 8 below shows the estimation results for equation (6) but instead of the dummy for surprises, I create the dummy for the estimated forward guidance factor (Swanson, 2021) which takes the value of 1 if it is positive and 0 otherwise.

Table 8: Estimation results using forward guidance factor for dummy.

Country	ω	α	γ	β	ϕ
Argentina	0.1274***	0.3418***	0.0611**	0.0962***	-0.7304***
Brazil	0.056***	0.386***	0.284***	0.082***	-0.224
Chile	0.035***	0.509***	0.277***	0.106***	-0.339***
China	0.018	0.258***	0.003	0.092***	-0.708***
India	0.053***	0.399***	0.176***	0.060***	-0.289*
Indonesia	0.053***	0.619***	0.304***	0.102***	0.253***
South Korea	0.027	0.436***	0.188***	0.123***	-0.270
Mexico	0.045***	0.490***	0.311***	0.154***	0.146
MSCI	0.037***	0.301***	0.180***	0.041***	-0.208
Pakistan	0.087***	0.509***	0.233***	0.084***	0.882***
Poland	0.041***	0.342***	0.182***	0.037***	-0.026
Saudi Arabia	0.058***	0.793***	0.570***	0.132***	-0.397***
SP500	0.031***	0.519***	0.368***	0.141***	-0.532***
Thailand	0.036*	0.401***	0.138***	0.122***	0.203

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

The results in Table 8 are similar to the results reported in Table 7. The effect of forward guidance is heterogeneous across the indices in the sample as well as significantly asymmetrical in some of the indices. The estimated effect of the forward guidance factor on SP500 volatility conforms to the results reported by Swanson (2021) about SP500 returns. A positive forward guidance factor indicates a hawkish path for the U.S. interest rates which could attract the investors to look for alternative markets to diversify the risk. Moreover, the exchange rate channel creates opportunities for export-dependent emerging economies as the higher dollar value makes their exports cheaper hence increasing the future expected profits. For Pakistan, the stock market volatility increases following a contractionary forward guidance implication. Given the import dependence and high foreign debt servicing, the trade channel and exchange rate channels create a negative environment for investment. This deters the investors' confidence, resulting in higher volatility.

CHAPTER 5

ROBUSTNESS CHECKS

The original model uses daily movements in federal funds rate to construct the dummy variable. As I discussed different measures of monetary policy and the use of high-frequency data for the identification of monetary policy surprises, this section presents estimation results for two different measures of monetary policy: three-month T-bills and two-year T-bills.

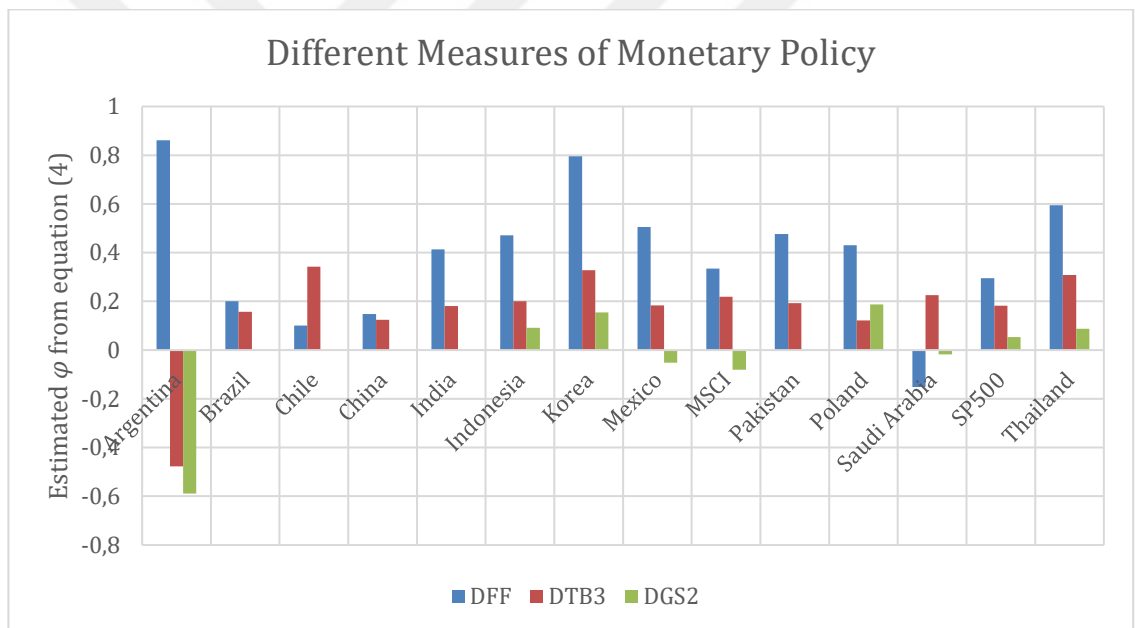


Figure 6: DFF (Daily Federal Funds rate), DTB3 (3-month Treasury bill rate), DGS2 (2-year Treasury Note)

The results in Figure 6 are qualitatively similar while the magnitudes differ from the original model where daily funds rate (DFF) was used. The coefficient for the 2-year effect is smaller for all countries than the coefficient when we use the daily funds rate. Using the two-year bill rate as a proxy for the long term, it is evident that the stock market volatility responds less asymmetrically than the other two measures of monetary policy. For the three-month interest rate, the asymmetric response of volatility is less than the daily funds

rate except for Chile. The estimated coefficient is negative for Argentina for both the three-month interest rate and the two-year interest rate which is surprising. The contractionary movement in medium and long-term interest rates convey different message for market participants in Argentina. Similarly, the response of volatility in Mexico, MSCI, and Saudi Arabia indices to the two-year interest rate measure of monetary policy is negative however the magnitude is small.

Moreover, given the importance of oil for the emerging market, the prices of oil serve as an indicator for the direction of the economy. Oil is one of the key commodities that is of utmost importance for the economic machinery in emerging markets. However, the role of the oil market as a financial instrument also could not be ignored. Investors use financial instruments with oil being an underlying asset to diversify their portfolios and hedge the risks. Therefore, it is interesting to see how volatility responds to the movement in oil prices. I use the daily spot price of WTI crude oil and create the dummy variable which takes the value of 1 if the price change is positive and 0 otherwise. Table 9 below shows the results for equation (4) estimated using an oil price dummy.

Table 9: Estimation of equation (4) with WTI oil price dummy.

Country	ω	α	γ	β	ϕ
Argentina	1.463***	0.212***	-0.002	-0.003	0.591***
Brazil	1.380***	0.381***	-0.279***	0.085***	-0.098***
Chile	-0.258***	0.511***	-0.281***	0.105***	0.048***
China	0.759***	0.259***	0.003	0.072***	0.127***
India	0.480***	0.400***	-0.181***	0.065***	-0.079***
Indonesia	0.269***	0.620***	-0.308***	0.104***	0.050***
South Korea	0.704***	0.435***	-0.188***	0.122***	-0.008
Mexico	0.234***	0.494***	-0.309***	0.158***	-0.087***
MSCI	0.140***	0.287***	-0.164***	0.043***	-0.120***
Pakistan	0.354***	0.512***	-0.237***	0.089***	-0.040
Poland	0.312***	0.347***	-0.192***	0.028***	0.177***
Saudi Arabia	0.055***	0.800***	-0.571***	0.130***	-0.120***
SP500	0.011	0.520***	-0.369***	0.140***	-0.062***
Thailand	0.408***	0.402***	-0.139***	0.123***	-0.005

The response of volatility to oil price movement is still asymmetric however the sign of the coefficient differs across the indices. This result is similar to Table 7 where using

monetary policy surprises I show that the market takes the movements in oil prices with different expectations for the future. In the case of oil-producing countries, such as Saudi Arabia and Mexico, the increase in price of oil means higher revenues and exchange rate appreciation (Osmanbeyolgu, 2022). This translates to the positive sentiment in the stock market resulting in lower volatility of the returns. Being one of the highly industrialized economy, the Chinese stock market responds significantly and asymmetrically to the movement in oil prices. The 1% increase in oil price results in 0.127 percentage points higher volatility than a decrease in the oil prices. Similarly, Brazil being the net exporter of crude oil, the response of the Brazilian stock market is asymmetric in the opposite direction to the oil price movement.

CHAPTER 6

CONCLUSION

The thesis aims to use the asymmetric GARCH model to assess the impact of movements in interest rates in the U.S. on the stock market returns in emerging countries. Using a sample of 14 stock market indices from EMEs and the effective daily federal funds rate data, the GJR-GARCH model allows us to model the behavior of the volatility of stock market returns and show that the impact is not symmetric. The increase in the interest rate results in a higher volatility than the decrease in all countries. The use of high-frequency data allows us to investigate how investors perceive the movements in interest rates which could affect the stock market returns via various channels. Moreover, the use of monetary policy surprises on FOMC meeting dates provides insights into how the same surprise could be perceived differently across different stock markets. These differences occur from the possible information effect contained in the monetary policy announcements. Moreover, the results confirm the hypothesis that negative news contributes to the risk-aversion of investors in the emerging market given the characteristics of stock indices in those countries and look for safer options, leading to an increase in volatility. Lastly, the use of the GARCH model eliminates the problems associated with the use of model such as that of the ordering of the variables and the use of assumptions for the identification of shocks, potentially minimizing the biasedness of the results.

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APPENDIX

Table 10: Trade Intensity (Calculated as an average of USD-invoiced exports and imports proportion throughout the sample period.)

Country	Trade Intensity
Argentina	92.5
Brazil	90.2
Chile	91.1
China	72.6
India	85.3
Indonesia	87.0
Korea	83.0
Mexico	69.3
Pakistan	87.7
Poland	26.4
Saudi Arabia	62.4
United States	95.1
Thailand	80.5

Table 11: Equation (4) estimates for selected subsamples.

Sub-Sample 2003-2005

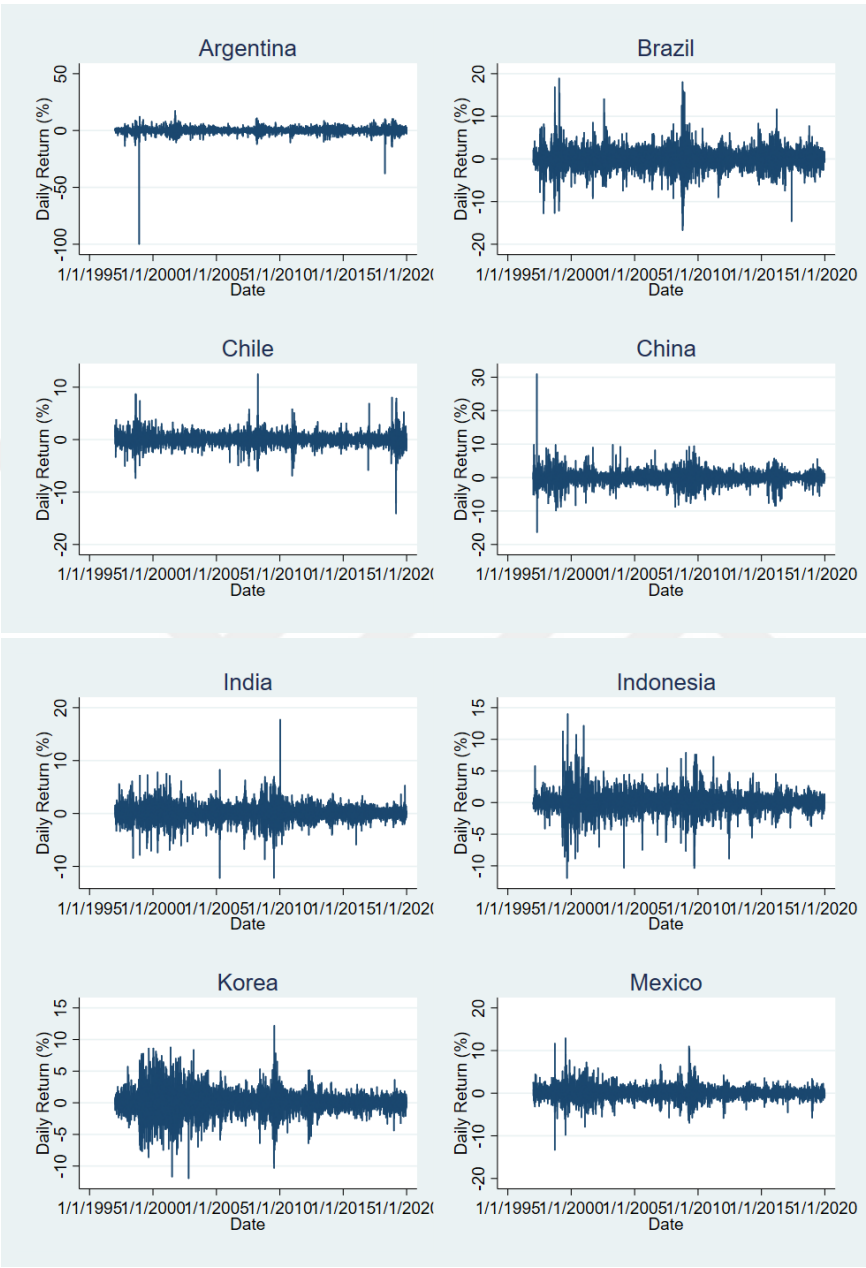
Country	ω	α	γ	β	ϕ
Argentina	0.144***	0.195***	0.198***	0.224***	0.100
Brazil	0.202***	0.124***	0.151***	0.003	0.129*
Chile	0.131***	0.535***	0.492***	0.071*	-0.105
China	-0.069	0.038	-0.061	-0.075	0.067
India	0.116***	0.337***	0.266***	0.048	0.405***
Indonesia	0.112***	0.292***	0.302***	0.047	-0.097
Korea	0.087	0.100***	0.023	0.081	0.108
Mexico	0.112***	0.289***	0.258***	0.036	-0.114
MSCI	0.132***	0.148***	0.052	-	0.114*
				0.085***	
Pakistan	0.228***	0.790***	0.452***	-	-0.056
				0.069***	
Poland	0.117***	0.042	0.063	0.270***	0.172*
Saudi Arabia	0.103***	0.647***	0.313***	0.096***	-0.052
SP500	0.056***	0.041	0.133***	0.005	0.099
Thailand	0.074*	0.300***	0.207***	0.203***	-
					0.389***

Sub-Sample 2007-2009

Country	ω	α	γ	β	ϕ
Argentina	0.060	0.426***	0.330***	0.093***	0.040
Brazil	0.134	0.319***	0.193***	0.063	0.148***
Chile	0.076*	0.723***	0.636***	0.167***	0.189***
China	0.077	0.134*	-0.003	0.045	-0.285***
India	0.070	0.593***	0.436***	0.067	-0.578***
Indonesia	0.097	0.740***	0.613***	0.082***	-0.027
Korea	-0.018	0.297***	0.221***	0.018	0.138***
Mexico	0.036	0.373***	0.400***	0.177***	-0.342***
MSCI	0.072	0.292***	0.103	0.058*	0.118
Pakistan	0.024	0.601***	0.436***	0.078	-0.202***
Poland	-0.009	0.140***	0.141***	-0.023	-0.106
Saudi Arabia	0.169***	0.781***	0.682***	0.123***	-0.272***
SP500	-0.039	0.440***	0.306***	0.199***	0.135*
Thailand	0.048	0.565***	0.452***	0.240***	0.222***

Sub-Sample 2013-2015

Country	ω	α	γ	β	ϕ
Argentina	0.225***	0.264***	0.177	-0.010	0.007
Brazil	-0.076	0.104***	0.123***	-0.399***	0.001
Chile	0.009	0.190***	0.124	-0.027	0.296*
China	-0.017	0.135	0.178***	0.221***	-0.030
India	0.074*	0.012	-0.065	-0.026	0.124
Indonesia	0.054	0.251***	-0.113	-0.174***	0.191*
Korea	0.010	0.037	0.093	0.390***	-0.173
Mexico	0.022	0.275***	0.136	0.192*	0.002
MSCI	-0.021	0.035	-0.077	-0.287***	0.102
Pakistan	0.180***	0.435***	0.440***	0.095	-0.084
Poland	0.060	0.393***	0.195*	0.051	0.118
Saudi Arabia	0.075***	0.296***	0.306***	-0.025	-0.077
SP500	0.026	0.649***	0.548***	0.162***	0.460***
Thailand	0.009	0.081	0.106	-0.262***	0.016



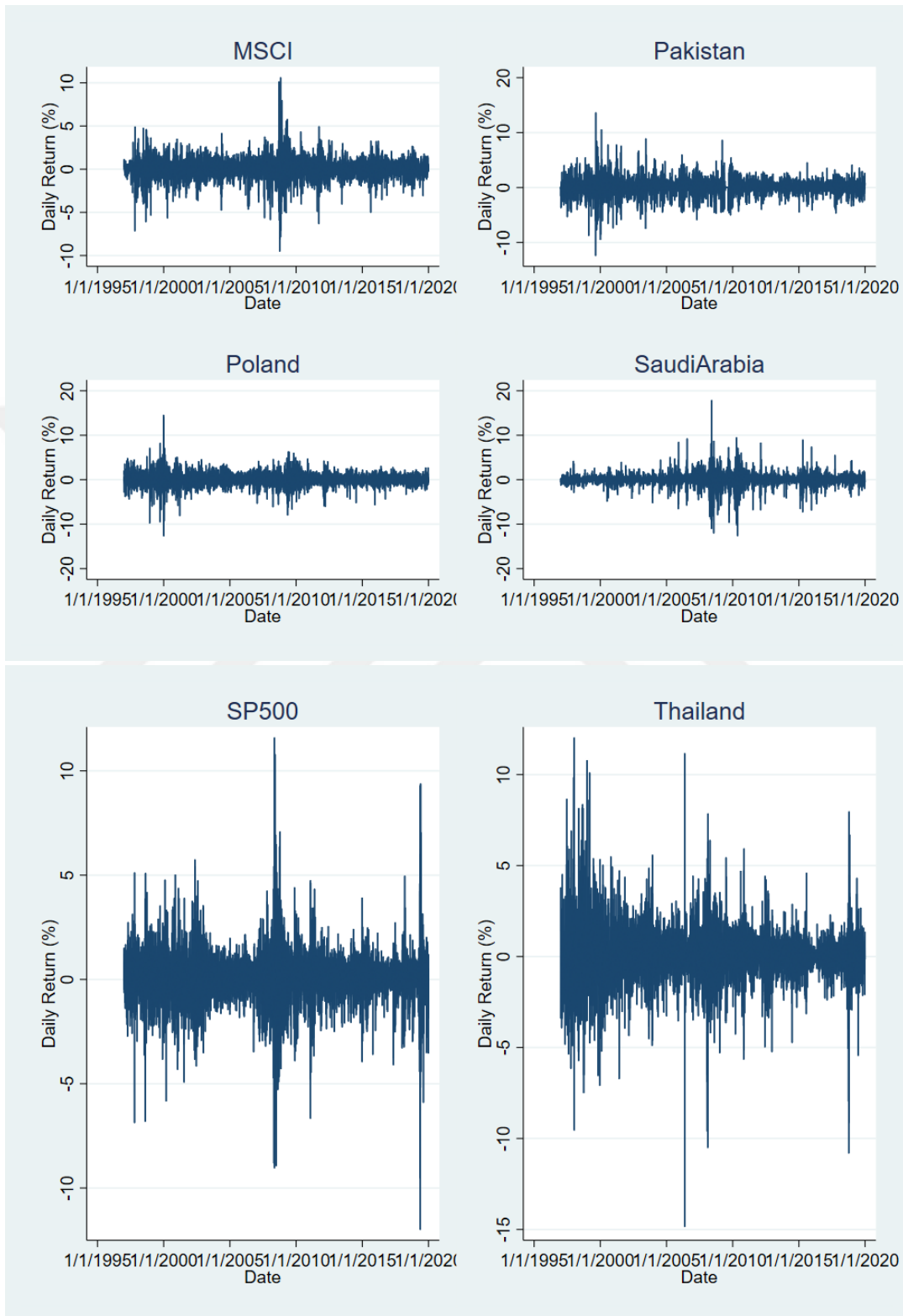
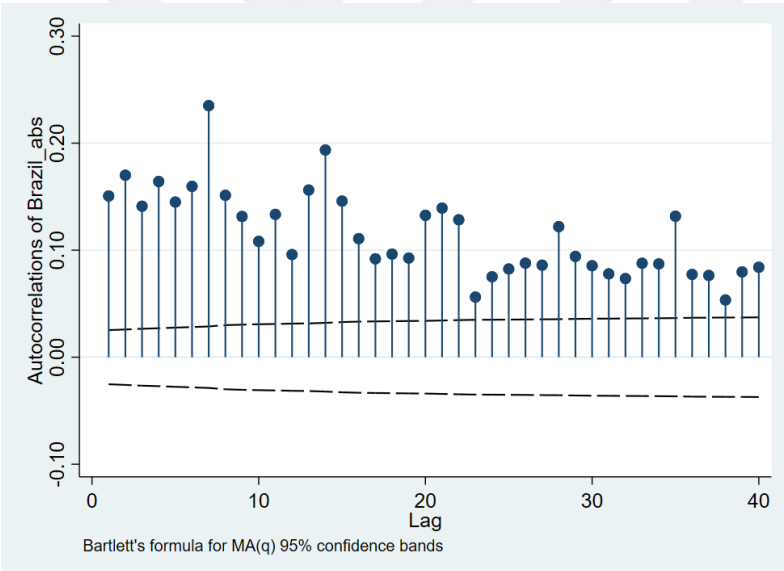
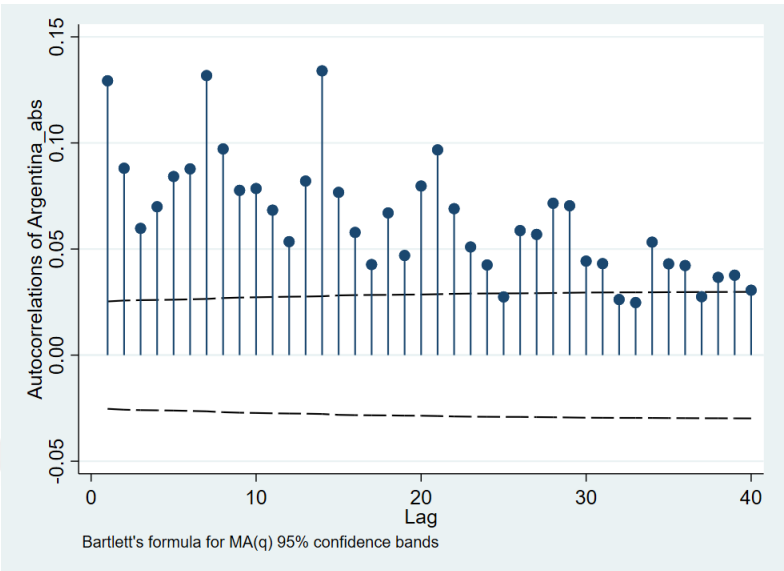
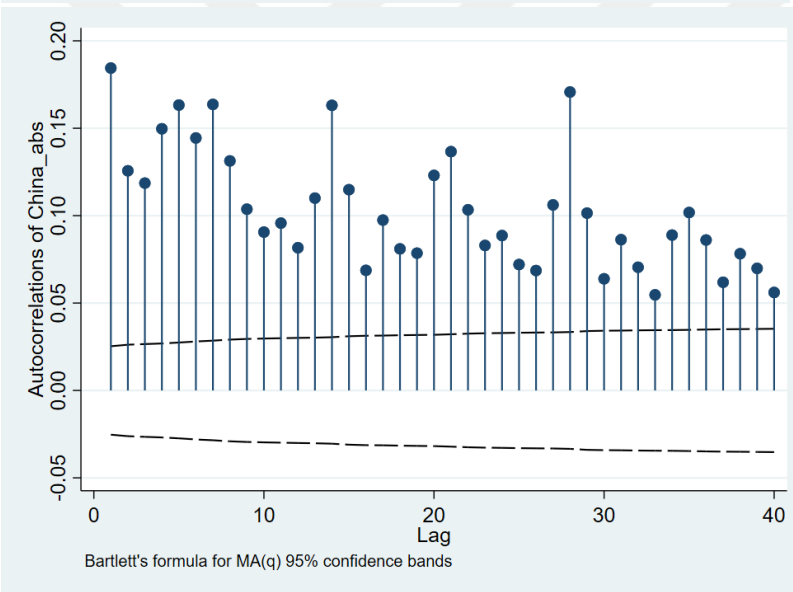
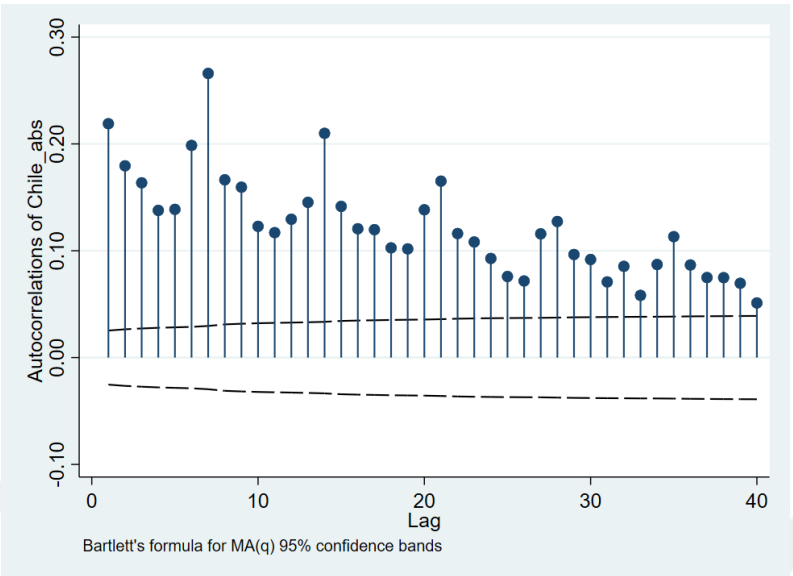
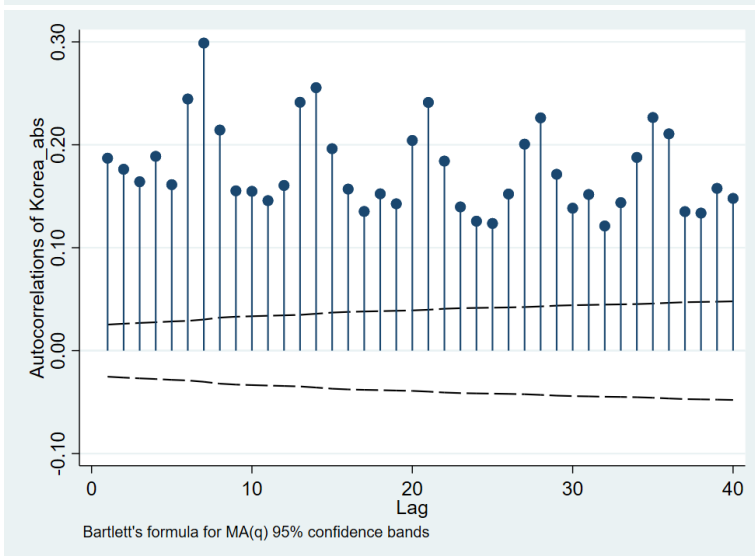
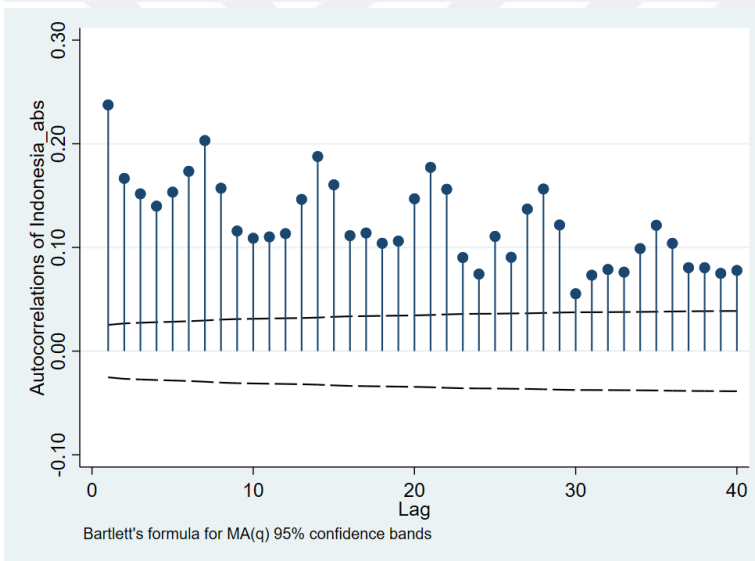
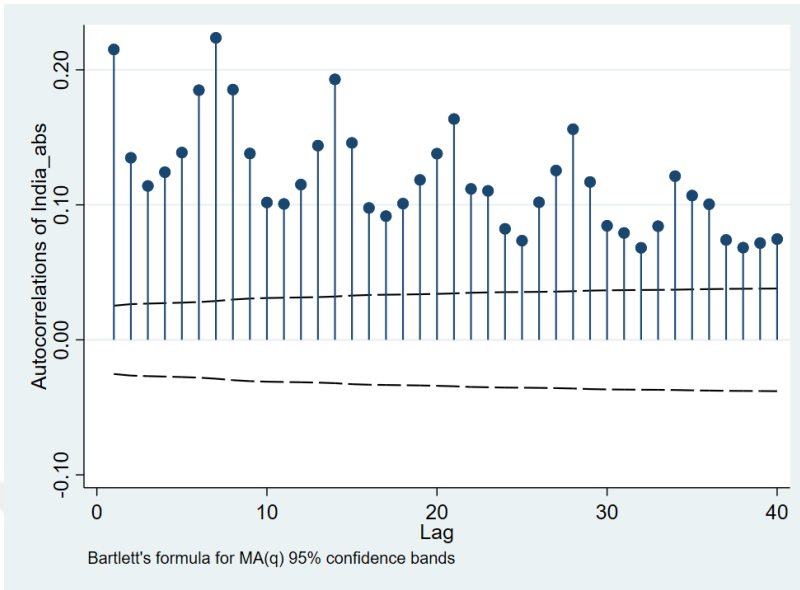
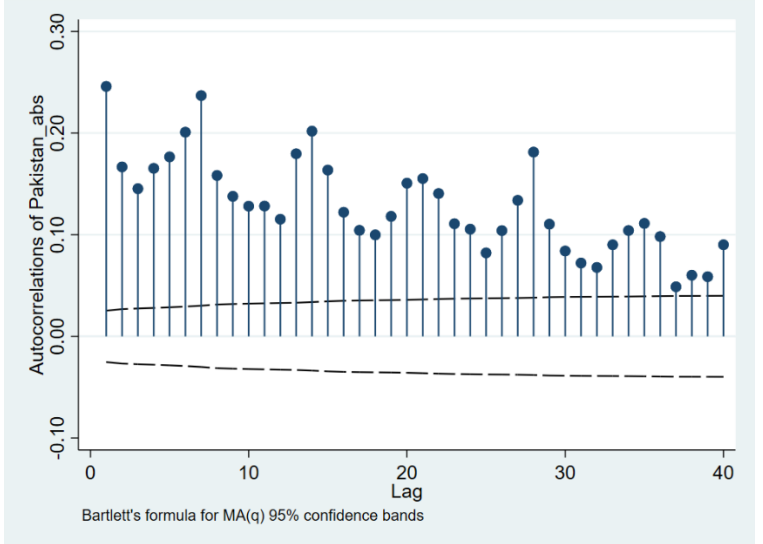
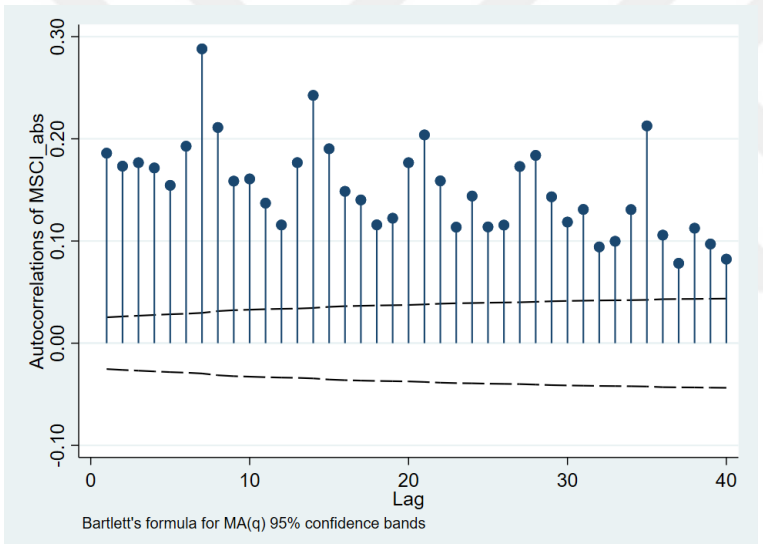
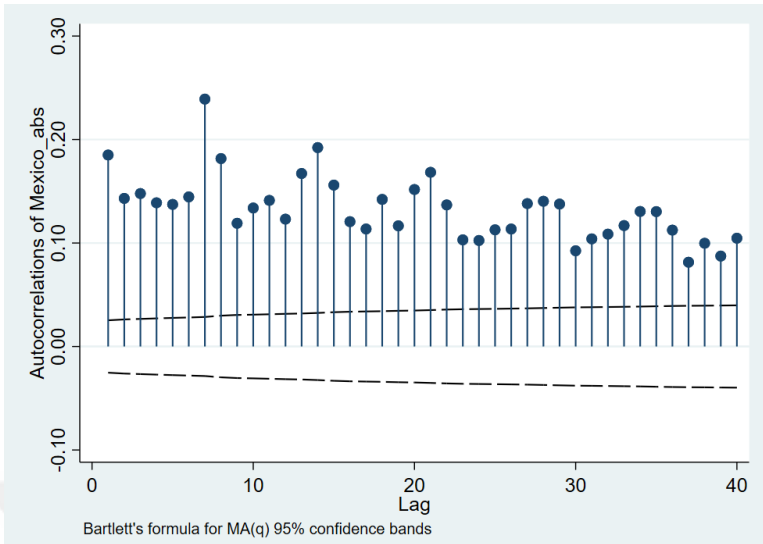


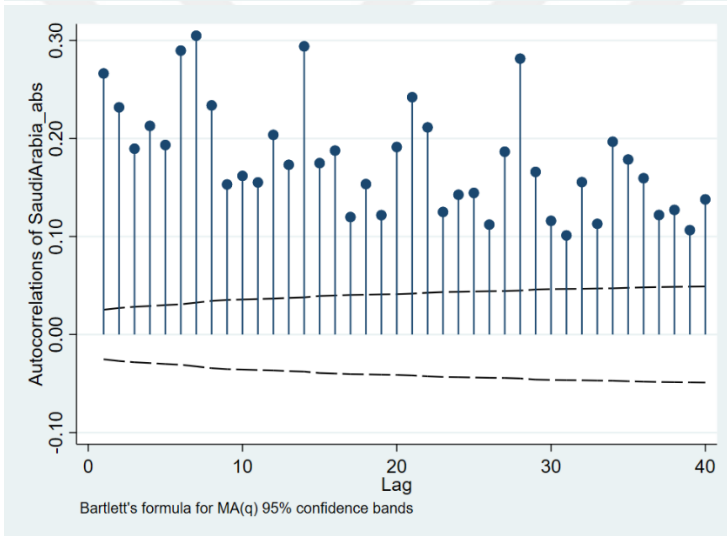
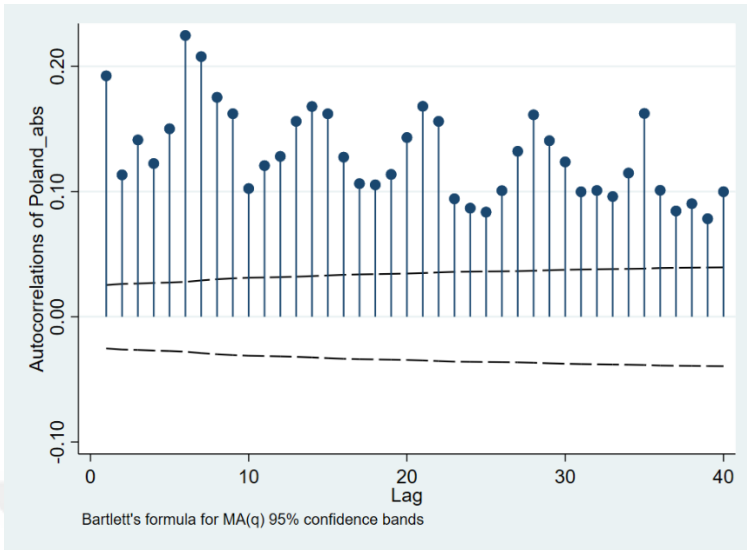
Figure 7: Daily returns of sample indices (1997-2019).











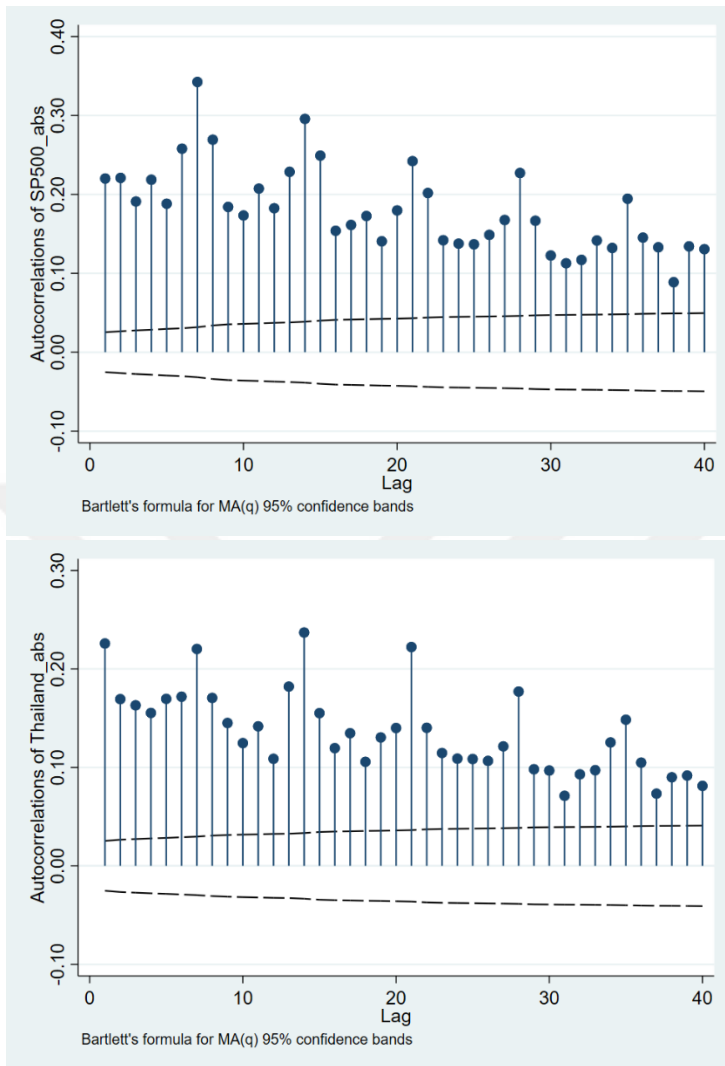


Figure 8: Autocorrelation plots of absolute daily returns.

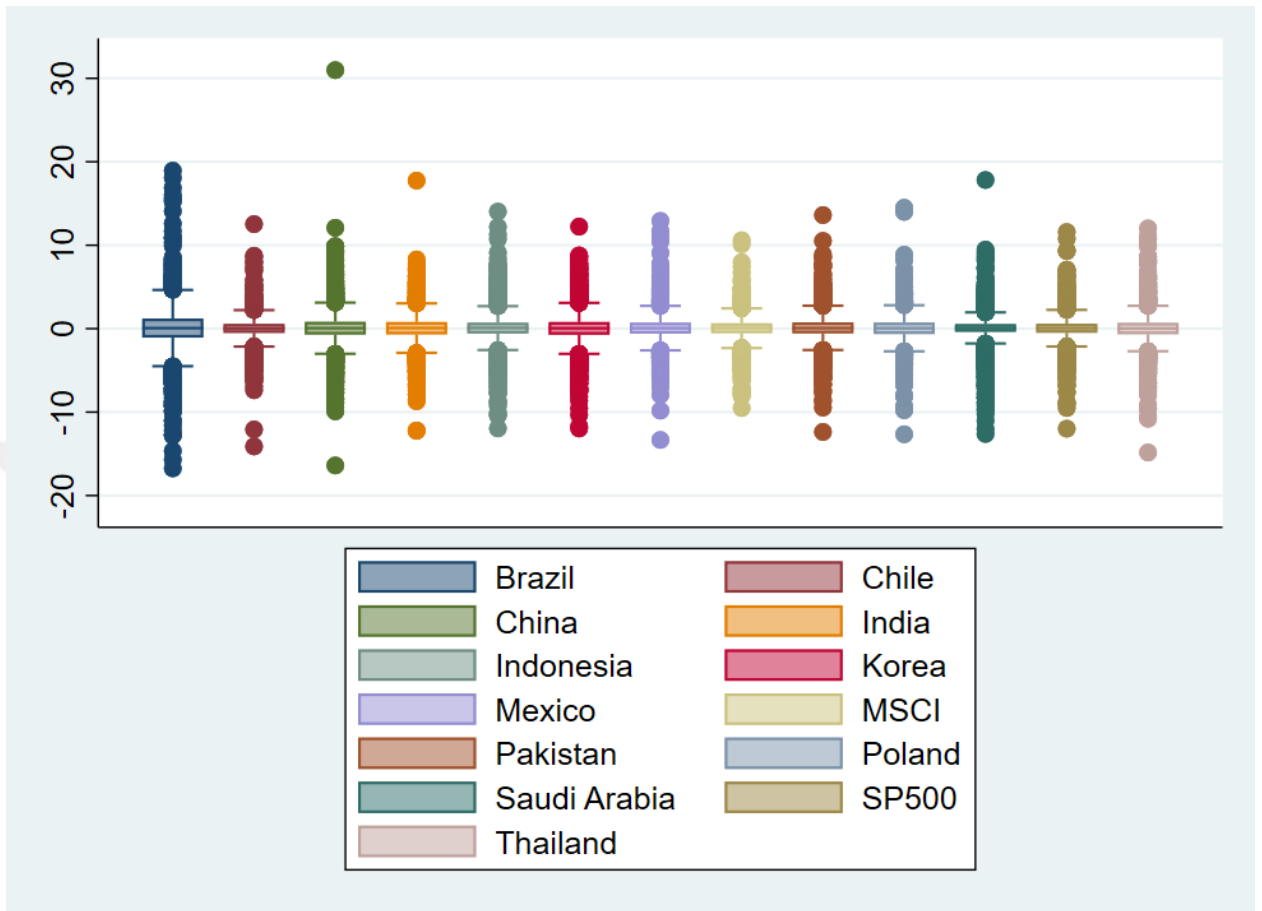


Figure 9: Box-Plot graph of Daily returns of sample indices.

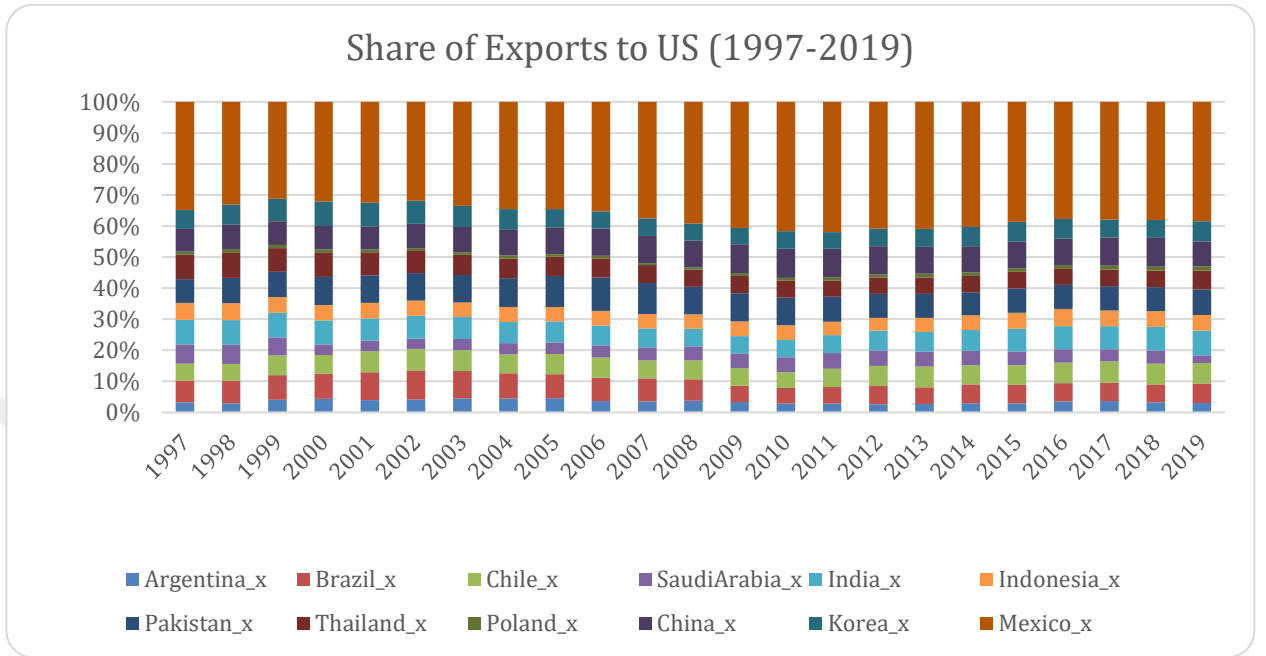


Figure 10: Share of Exports to the US.

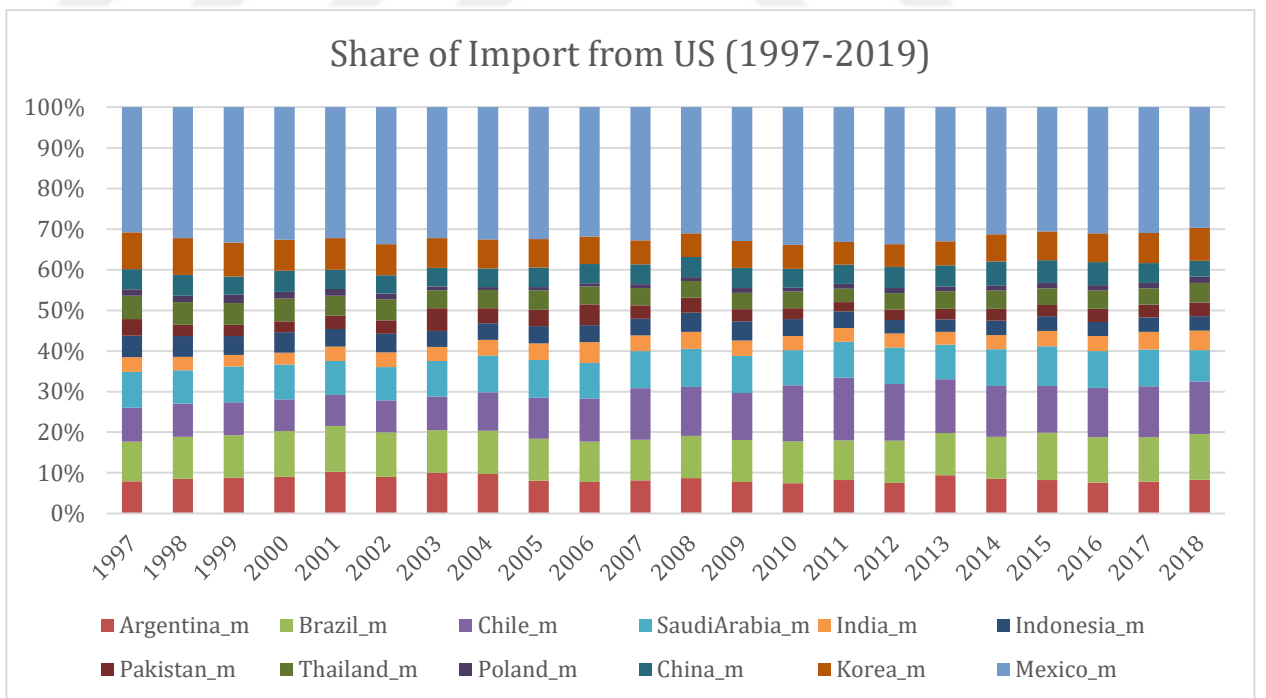


Figure 11: Share of Imports from the US.

Measures of pseudo R²:

$$R_{\text{McFadden}}^2 = 1 - \frac{LL_1}{LL_0}$$

$$\text{Adjusted } R_{\text{McFadden}}^2 = 1 - \frac{LL_1 - k_1}{LL_0 - k_0}$$

where k_0 and k_1 are the number of parameters to be estimated in the models

Log-Likelihood Ratio Statistic

$$LR = -2 \times (LL_0 - LL_1)$$

Where LL_0 is the log-likelihood from the maximum likelihood estimation of equation 3 (model without monetary policy) and LL_1 is the log-likelihood from the maximum likelihood estimation of equation 4 (model with monetary policy).