

THE RELATION BETWEEN CRUDE OIL PRICES AND FINANCIAL MARKET
INDICATORS: A COPULA APPROACH

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ABSTRACT

THE RELATION BETWEEN CRUDE OIL PRICES AND FINANCIAL MARKET INDICATORS: A COPULA APPROACH

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Oil prices have far reaching effects on the economy and financial markets since oil market is one of the most important markets in the world due to its crucial role of oil within economic activity. Although most of the economies are expected to be affected by the changes of oil prices, the magnitude of the effects may change from country to country. Oil-export/import dependent countries are expected to be more open to impacts arising from changes in oil prices. Turkey, as a heavily oil importing country, is also expected to be affected by the changes in oil prices substantially. This study aims to explore the dependence structure between crude oil prices and exchange rates and stock market indices of several countries as well as Turkish financial market indicators in a

detailed context using Copula approach. By covering a broad time period, the study aims to investigate the effect of global financial crisis on the mentioned dependence structure. Also, the study includes 1 to 30 days analysis to capture the variation of dependence day by day. For serving these aims, the time series data methods are used to filter the data and several copula measures are used to illustrate the level of the association. Findings of the study are expected to have important implications for portfolio management and financial risk management as well as monetary and fiscal policies.

Keywords: Crude Oil, Copula, Dependence, Cross-Market Analysis, Financial Markets.

ÖZ

HAM PETROL FİYATLARI İLE FİNANSAL PİYASA İNDİKATÖRLERİ ARASINDAKİ İLİŞKİ: BİR “COPULA” YAKLAŞIMI

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Petrolün, ekonomik aktive için kritik önemi bulunmasına bağlı olarak dünyadaki en önemli piyasalardan biri olması sebebiyle, ekonomi ve finansal piyasalar üzerinde kapsamlı etkileri bulunmaktadır. Birçok ülke ekonomisinin petrol fiyatlarındaki değişimlerden etkilenmesi beklenmekte birlikte bu etkinin büyüklüğü ülkeden ülkeye değişim gösterebilmektedir. Petrol ihraç ve ithal bağımlılığı olan ekonomilerin petrol fiyatlarındaki değişimden kaynaklı etkilere daha açık olması beklenmektedir. Benzer şekilde, petrol ithal bağımlılığı yüksek olan Türkiye ekonomisinin de petrol fiyatı değişikliklerinden büyük ölçüde etkilenmesi beklenmektedir. Bu çalışma, ham petrol fiyatları ile birçok ülkenin döviz kurları, hisse piyasası endeksleri arasındaki etkileşim yapısını, Türkiye finansal piyasa göstergelerini de içerek şekilde, Copula yaklaşımı ile kapsamlı olarak araştırmayı amaçlamaktadır. Çalışma geniş bir zaman dilimini kapsayarak, global finansal krizin bahsi geçen etkileşime etkisinin araştırılmasını

amaçlamaktadır. Ayrıca, söz konusu etkileşimin günden güne değişiminin incelenebilmesi amacıyla, çalışma günlükten 30 günlüğe kadar analizleri içermektedir. Bu kapsamda, verilerin filtrelenmesi amacıyla çeşitli zaman serileri analiz yöntemleri kullanılmakta, sonrasında farklı Copula yöntemleri ile etkileşimin derecesi ölçülmektedir. Çalışmanın bulgularının portföy yönetimi, finansal risk yönetimi ile mali politika ve para politikası açısından önemli sonuçları olması beklenmektedir.

Anahtar Kelimeler: Ham Petrol, Copula, Etkileşim, Piyasalar Arası Analiz, Finansal Piyasalar.

To My Family

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LIST OF ABBREVIATIONS

Australia S&P/ASX 200 Index	AS51
Australian Dollar-US Dollar	USDAUD
Borsa Istanbul	BIST
BIST Chem.,Petrol.,Plastic	XKMYA
BIST Electricity	XELKT
BIST Industrials	XUSIN
BIST Telecommunication	XILTM
BIST Transportation	XULAS
BIST-100	XU100
Brazil Ibovespa Index	IBOV
Brazilian real	USDBRL
Canada S&P/TSX 60 Index	SPTSX
Canadian Dollar-US Dollar	USDCAD
China Shanghai Stock Exchange Composite Index	SHCOMP
Gross Domestic Product	GDP
India S&P BSE SENSEX Index	SENSEX
Indian rupee	USDINR
International Energy Agency	IEA
Japan NIKKEI 225	NKY
Japanese Yen-US Dollar	USDJPY

Norway OSE Benchmark Index	OSEBX
Norwegian Krone-US Dollar	USDNOK
Russia MICEX Index	INDEXCF
Russian Ruble -US Dollar	USDRUB
South Africa FTSE/JSE AFRICA TOP40	TOP40
South African Rand	USDZAR
TRY-EURO Exchange Rate	EUR
TRY-US Dollar Exchange Rate	USDTRY or USD
Turkey BIST-30 Index	XU030 or XU30
West Texas Intermediate Price	WTI
Yuan Renminbi	USDCNY

CHAPTER 1

INTRODUCTION

Oil market is one of the most important markets in the world economy due to the crucial role of oil within economic activity. Oil is used in various areas such as transportation, heating, electricity generation, and industry. Based upon its wide array of use, the crude oil market is significantly larger than that for any other commodity; accordingly, crude oil prices have far reaching effects on the economy and financial markets.

Crude oil prices may affect the economies basically through three channels: Firstly, changes in crude oil prices have drastic effect on inflation through changes in the production costs leading shifts in the supply curve. Secondly, especially for oil-importing countries, changes in oil prices have significant impact on balance of payments, thus on exchange rates. Thirdly, changes in oil prices affect the total consumption value of an household causing substitution effects, meaning a downward shift in demand in case of increasing oil prices and vice versa. Moreover, since inflation and trade balance are both important determinants of exchange rates in medium and long term, oil prices are expected to affect exchange rates in medium and long term. Short term effects of crude oil price changes usually originate from financial markets.

Crude oil is priced primarily in terms of US Dollars; accordingly a change in crude oil prices directly affects exchange rates in terms of US Dollars while changes in crude oil prices are believed to affect stock markets through expectations channel. The change in oil prices leads to changes in production costs in related sector, thus affect the prices of the related stocks. Also, consumption and investment levels in the economy changes

accordingly to changes in the crude oil prices, resulting in increase or decrease in overall stock prices through affecting expected earnings. Besides, the mentioned effects are expected to be intense on the stocks in sectors that have stronger relations with crude oil markets. Another relation between crude oil and financial markets is a must to mention: Volatility in financial markets is believed to create financial flows to commodity markets, thus leading to price changes of commodities.

The direction of the relation between exchange rates and stock indices with crude oil prices is a frequently discussed subject. Principally, a negative relation is expected between crude oil prices and exchange rates in terms of Dollars since crude oil is quoted in Dollars and changes in oil prices directly changes the price of crude oil in domestic currency. Also, it is believed that changes in oil prices originating from demand side, such as changes in economic growth, are positively related with stock prices while those arising due to supply side conditions, such as war in the oil exporting regions, are negatively related with stock prices.

Both developed and developing countries are expected to be affected by the changes in oil prices through channels explained above. On the other hand, the degree of the effects may change from country to country based on country specific differences among economies. But, oil-export and oil-import dependent countries are expected to be more open to impacts arising from changes in oil prices. Accordingly, Turkey, as a heavily oil importing country, is expected to be affected by the changes in oil prices substantially. Turkey is among the top ten countries in the world by its imports of oil, therefore this oil dependence in the economy creates a stronger relation between oil prices, inflation, balance of payments and exchange rates. As this strong relation is already known by economic agents, the expectations channel amongst crude oil prices and Turkish stock markets is anticipated to be powerful as well.

This study aims to explore the dependence structure between crude oil prices and exchange rates and stock market indices of several countries as well as Turkish financial market indicators in a detailed context using Copula approach. Countries selected for

this study includes both developed/developing and oil exporter/importer countries in order to investigate the variation in dependence structure among countries. Also, dependence between Turkish financial market indicators and crude oil prices are elaborated including Industrials, Chemistry and Petroleum, Electricity, Transportation and Telecommunication sector indices to quest how dependence values change among related sectors. Moreover, the analysis in this study is not limited to daily and monthly dependence but grasps dependence from 1 day period to 30 days period. The time-varying aspect of the study will enlighten how dependence differs day by day from daily to monthly time period. Lastly, the pre-crisis and post-crisis periods are explored separately in order to capture the effect of financial crisis on the dependence structure investigated in this study.

To the extent of the literature survey done throughout this study, this is the first study to analyze dependence between crude oil prices and exchange rates/ stock market indices by Copula analysis for such a broad range of countries including both developed/developing and oil exporter/importer ones. Furthermore, the literature is mainly on daily analysis. This study will also be first to investigate dependence between crude oil prices and exchange rates/ stock market indices for daily to monthly period. Moreover, the study will contribute to Turkish energy and financial market literature since analysis of the financial market indicators in Turkey with Copula models and evaluation of the relation between crude oil prices and exchange rates of Turkish Lira along with the Turkish stock market indicators are introduced. To conduct the proposed study, the times series data between January 2005 and November 2013 of ten countries and Turkey are firstly filtered by ARMA and GARCH processes and then five different copula models as well as several dependence measures are applied.

Findings of the study are expected to have important implications for portfolio management and financial risk management as well as monetary and fiscal policies. The role of crude oil as a financial instrument in asset allocation and risk management will be lightened for several financial markets, while the findings will also clarify the

pressures on exchange rate and inflation originating from oil prices, stressing the difference for pre and post global crisis.

The thesis consists of six chapters. Chapter 2 gives brief information on world oil market dynamics and economies of selected countries. Chapter 3 includes the literature on the subject while Chapter 4 introduces the concept of Copula and dependence measures. Chapter 5 includes results and evaluation of the findings of applications and finally Chapter 6 concludes the whole study.

CHAPTER 2

OIL DYNAMICS and ECONOMIES OF SELECTED COUNTRIES

This chapter will give brief information on world oil market dynamics, pricing of oil and summarizes the important characteristics of the countries which are taken into account in the content of this study as well as Turkey for a comparative analysis.

2.1 World Oil Market Dynamics

Oil market is one of the most important markets in the world economy due to its crucial role within economic activity. Oil is used in various areas such as transportation (fuels as gasoline, diesel, jet fuel), heating, electricity generation, and production of asphalt, fertilizer, feedstock, petrochemicals, plastics, polyurethanes and solvents. Based upon its wide array of use, the crude oil market is significantly larger than that for any other commodity, both in terms of physical production and financial market activity. The value of crude oil production is more than twice that of coal and natural gas, 10 times that of iron ore and almost 20 times that of copper [12]. Accordingly, the price of crude oil has far-reaching effects over the global economy.

The Table 2.1 below shows the world energy consumption by fuel type according the regions. As seen below, it is the most widely used source of fuel, supplying around one-third of the world's energy needs except Europe and Eurasia, including Turkey, where natural gas is the most widely used type of energy source.

Table 2.1: World Energy Consumption by Fuel (Millions tones oil equivalent) [6]

	Oil	Natural Gas	Coal	Nuclear Energy	Hydro electric	Re-newables	Total
North America	1.016,8	820,0	468,5	206,9	156,3	57,0	2.725,4
North America (%)	37,31%	30,09%	17,19%	7,59%	5,74%	2,09%	
S. & Cent. America	302,2	148,6	28,2	5,0	165,7	15,6	665,3
S. & Cent. America (%)	45,42%	22,33%	4,24%	0,76%	24,91%	2,35%	
Turkey	31,5	41,7	31,3	-	13,1	1,6	119,2
Turkey (%)	26,41%	34,97%	26,27%	0,00%	10,99%	1,36%	
Europe & Eurasia	879,8	975,0	516,9	266,9	190,8	99,1	2.928,5
Europe & Eurasia (%)	30,04%	33,29%	17,65%	9,11%	6,52%	3,38%	
Middle East	375,8	370,6	9,9	0,3	5,1	0,1	761,9
Middle East (%)	49,33%	48,64%	1,29%	0,04%	0,67%	0,02%	
Africa	166,5	110,5	97,5	3,2	24,1	1,4	403,3
Africa (%)	41,29%	27,41%	24,18%	0,80%	5,98%	0,35%	
Asia Pacific	1.389,4	562,5	2.609,1	78,1	289,0	64,1	4.992,2
Asia Pacific (%)	27,83%	11,27%	52,26%	1,56%	5,79%	1,28%	
Total World	4.130,53	2.987,06	3.730,09	560,39	831,14	237,42	12.476,63
Total World (%)	33,11%	23,94%	29,90%	4,49%	6,66%	1,90%	

As oil is a naturally occurring, yellow-to-black liquid found in geologic formations beneath the Earth's surface, there are specific regions that are rich in oil and also, drilling oil is economically efficient. Table 2.2 shows the top ten oil producer countries along with the regions. Based on 2012 production values, 13% of the global oil production is supplied by Saudi Arabia, followed by 12% supplied by Russian Federation. USA is the third supplier country by 10%, the rest of the countries production is below 5%.

Table 2.2: Oil Production by Region & Top Ten Producer Countries (Thousands of Barrels Daily) [6]

Country/Year	2010	2011	2012	(%)
Saudi Arabia	10.075	11.144	11.530	13,38%
Russian Federation	10.365	10.510	10.643	12,35%
USA	7.552	7.868	8.905	10,34%
China	4.077	4.074	4.155	4,82%
Canada	3.332	3.526	3.741	4,34%
Iran	4.356	4.358	3.680	4,27%
United Arab Emirates	2.895	3.319	3.380	3,92%
Kuwait	2.536	2.880	3.127	3,63%
Iraq	2.490	2.801	3.115	3,62%
Mexico	2.959	2.940	2.911	3,38%
Total Middle East	25.763	27.988	28.270	32,81%
Total Europe & Eurasia	17.755	17.451	17.211	19,98%
Total North America	13.843	14.335	15.557	18,06%
Total Africa	10.123	8.742	9.442	10,96%
Total Asia Pacific	8.420	8.246	8.313	9,65%
Total S. & Cent. America	7.367	7.449	7.359	8,54%
Total World	83.272	84.210	86.152	

Oil consumption is closely related with economic activity due to its wide array of use in industry, transportation and energy production. Table 2.3 shows oil consumption by top

ten consumer countries along with all regions. Based on 2012 values, the number one consumer is USA with 21%, followed by China with 12% and Japan by 5%. Any of the other countries consume less than 5% of the total oil consumption of the world.

Table 2.3: Oil Consumption by Region & Top Ten Consumer Countries (Thousand barrels daily) [6]

Country/Year	2010	2011	2012	(%)
US	19.134	18.949	18.555	20,67%
China	9.272	9.750	10.221	11,39%
Japan	4.473	4.465	4.714	5,25%
India	3.319	3.488	3.652	4,07%
Russian Federation	2.892	3.089	3.174	3,54%
Saudi Arabia	2.790	2.835	2.935	3,27%
Brazil	2.676	2.740	2.805	3,12%
South Korea	2.370	2.394	2.458	2,74%
Canada	2.316	2.404	2.412	2,69%
Germany	2.445	2.369	2.358	2,63%
Turkey	694	673	685	0,76%
Total Asia Pacific	27.766	28.754	29.781	33,17%
Total North America	23.464	23.397	23.040	25,66%
Total Europe & Eurasia	19.057	18.974	18.543	20,66%
Total Middle East	7.861	7.992	8.354	9,31%
Total S. & Cent. America	6.222	6.405	6.533	7,28%
Total Africa	3.463	3.359	3.523	3,92%
Total World	87.833	88.879	89.774	

Table 2.4 shows the import and export values of oil and oil products for 2012. The significant values for crude imports belong to USA, China, India, Japan and Europe as a region, while crude exports are high for Canada, South and Central America, Former Soviet Union, Middle East and West Africa. In the below table, it is noted that the bunkers are not included as exports and intra-area movements (for example, between countries in Europe) are excluded.

Table 2.4: Oil Export-Import by Countries (Thousand barrels daily) [6]

Country	Crude Imports	Product Imports	Crude Exports	Product Exports
US	8.491	2.096	23	2.657
Canada	514	211	2.437	619
Mexico	<0,5	581	1.290	76
S. & Cent. America	392	1.411	3.143	691
Europe	9.512	2.976	383	1.791
Former Soviet Union	<0,5	114	6.049	2.548
Middle East	222	559	17.646	2.053
North Africa	186	312	2.139	465
West Africa	<0,5	238	4.328	235
East & Southern Africa	285	260	86	15
Australasia	575	379	272	164
China	5.433	1.729	26	538
India	3.547	323	<0,5	1.349
Japan	3.739	1.004	<0,5	221
Singapore	948	2.016	12	1.479
Other Asia Pacific	4.755	2.505	767	1.813
Total World	38.599	16.715	38.599	16.715

Oil market agents can be grouped into producers, consumers, traders and policy-makers. Private international oil companies as well as government-controlled national oil

companies play a major role in production of oil, while consumers are households, industrial companies, power generators and transportation companies. State-owned national oil companies dominate the reserves and production in the oil market although international oil companies are commonly viewed as the dominant players in the oil market. National oil companies control around 60 per cent of oil production and more than 80 per cent of the world's proven oil reserves. Moreover, the two largest oil-producing companies in the world are Saudi Aramco and the National Iranian Oil Company, controlling 12 per cent and 5 per cent of global oil production, respectively [12].

2.2 Pricing of Oil

Oil is both physically and financially traded commodity where physical trades are facilitated by merchants while participants of oil financial markets are hedgers and speculators, involving pensions, endowments which are usually index investors, hedge funds, and swap dealers.

Oil demand is affected by current conditions and future expectations for energy prices, OPEC supply capacity, usable spare capacity, non-OPEC capacity, geopolitics, weather, exploration and production costs, investments, and innovations while supply is affected by current conditions and future expectations for energy prices, economic growth, industrial production, transport, weather, and innovation in energy using equipment [26].

The WTI prices since 1986 and important/critical events that have impact on oil prices are represented in Figure 2.1. It is seen that until 2000s, oil prices were about \$20. The Asian crisis led to a decrease from that long-term level in the late 1990s until the decrease of OPEC quotas. Between 2000 and 2008, there was strong rise in the oil prices because of restricted supply and high global growth. The global financial crisis brought about significant decrease in the crude oil prices. In 2009, the prices recovered with the demand increase coming from mostly emerging economies.

Crude oil is traded both in OTC and organized markets but due to heterogeneous nature of crude oil, majority of the transactions take place in OTC markets where contracts can be tailored to specific needs. Crude oil markets are heavily shaped by medium and long term contracts where spot contracts (of which delivery process may differ from 10 days to 60 days) is a balancing mechanism for buyers who have underestimated its requirements covered by long-term contracts or for sellers who have surplus beyond the deal of long term contracts [12].

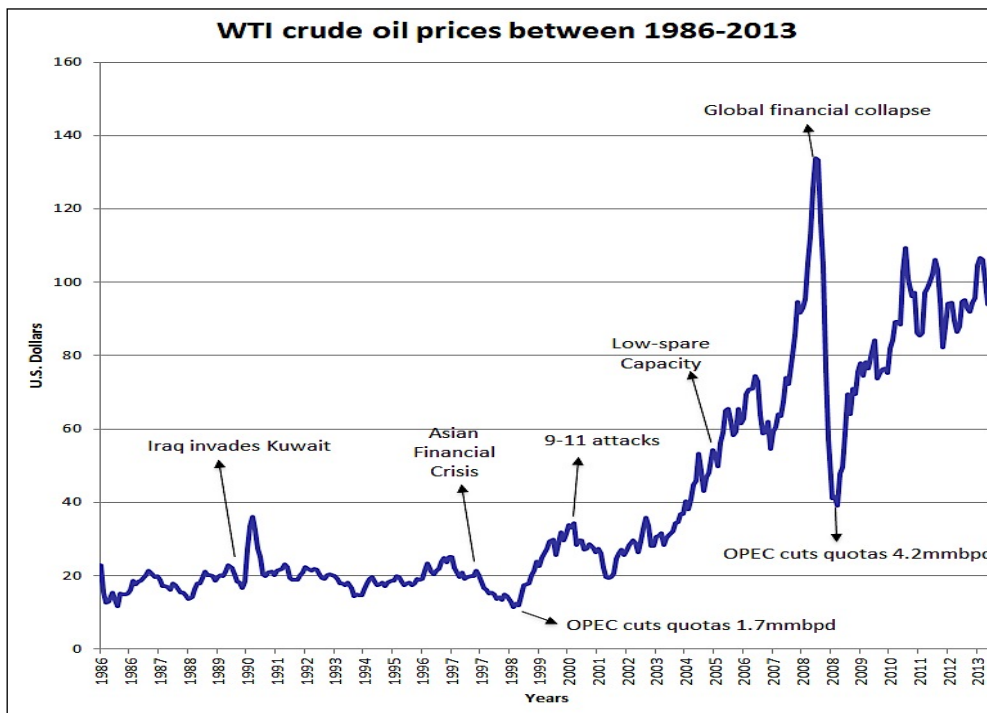


Figure 2.1: The Effects of Critical Events on WTI Crude Oil Prices between 1986-2013 [36]

Beyond physical market, there is an active financial trade in crude oil market and because of its global importance. Crude oil is frequently used as a benchmark for the energy market. There are several futures contracts traded in organized exchanges. Usually, these contracts are physically settled but only around 1 per cent of these contracts are settled in terms of the physical commodity. In recent years, as the liquidity

of the derivatives markets on energy instruments increased, the price of derivatives became the main reference for the cash market deals.

There are different varieties of crude oil but two of them serve as a reference point for the other types. These two primary benchmarks are WTI (West Texas Intermediate) which is a common benchmark for crude oil produced in U.S.A and Brent which is a common European benchmark. Both WTI and Brent crude are sweet crude oils with low sulphur contents which are the most valuable types of crude oil. The NYMEX WTI futures contract prices are followed as the indicator price of crude oil. The mentioned contract is based on 1.000 barrels of WTI, priced in US Dollars and physically settled.

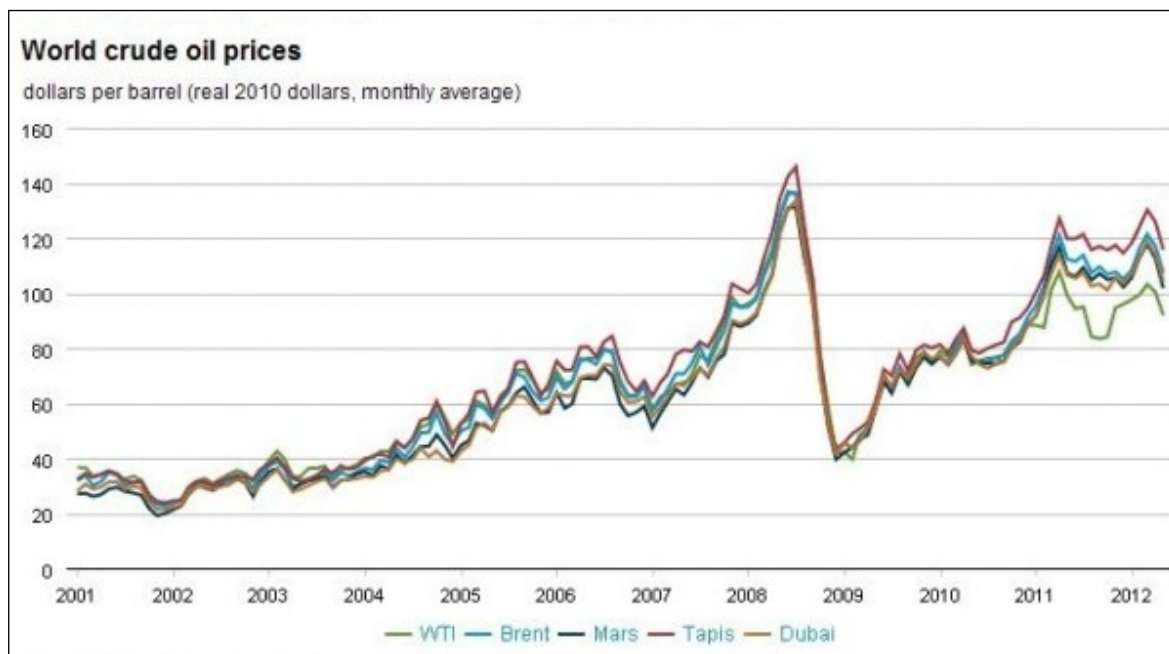


Figure 2.2: World Crude Oil Prices between 2001-2012 [36]

The underlying of the first energy derivative which was launched by NYMEX in 1970s was heating oil. And as of this date; arising from the volatility of oil prices, improvement of energy derivatives proceeded. Following the success of heating oil contract crude oil WTI and Brent futures contracts were launched in 1983 by NYMEX and IPE respectively. Currently, these two futures contracts are the most traded energy contracts worldwide. Crude oil derivatives stand at a specific place among energy derivatives market with its liquidity and its role as major economic indicator. Figure 2.2 shows the crude oil prices defined as benchmark prices in the world. As seen from the figure, the prices moved very close to each other between 2001 and 2012.

2.3 Economies and Energy Markets of Selected Countries

For this cross-country study, 10 countries are selected from different development and oil dependence levels to compare their currency and stock market dependence with the crude oil prices. Table 2.5 groups the countries based on their development and oil dependence level.

Table 2.5: Countries Selected based on their status in oil market

COUNTRIES	Developed	Developing
Oil Exporter	<ul style="list-style-type: none"> • Canada • Norway 	<ul style="list-style-type: none"> • Russia • Brazil
Oil Importer	<ul style="list-style-type: none"> • Australia (net importer of oil but generally energy exporter) • Japan 	<ul style="list-style-type: none"> • China • India • Turkey • South Africa

In this subsection, basic information is given on the economies and oil markets of the countries included in this study. Information on this subsection is compiled from, World Fact Book of CIA, Country Profiles of Economy Watch and Countries section of U.S. Energy Information Administration.

2.3.1 Canada

Canada is the 11th largest economy in the world based on GDP ranking with current prices in US dollars and the 13th largest economy based on GDP with Purchasing Power Parity in 2013 [36]. Canada resembles the USA in its market-oriented economic system, pattern of production, and high living standards. Prior to World War II, agriculture was the primary driver of the Canadian economy with over 60 percent of the population living in rural towns or farms. Since World War II, the impressive growth of the manufacturing, mining, and service sectors has transformed the nation from a largely rural economy into one primarily industrial and urban. The 1989 US-Canada Free Trade

Agreement (FTA) and the 1994 North American Free Trade Agreement (NAFTA) (which includes Mexico) touched off a dramatic increase in trade and economic integration with the US, its principal trading partner.

Canada's GDP is heavily dependent on services sector which comprises 69,9% of its GDP, followed by industry (28,4%) and agriculture sector (1,7%). Main industries of Canada are transportation equipment, chemicals, processed and unprocessed minerals, food products, wood and paper products, fish products, petroleum and natural gas. Its current account balance is equal to -\$59,5 billion based on 2013 estimates. Its major exports are with USA (74,5%), China (4,3%) and UK (4,1% while its major import partners are USA (50,6%), China (11%) and Mexico 5,5%. Canada is the US's largest foreign supplier of energy, including oil, gas, uranium, and electric power.

With close economic connections to USA, Canada's economic progress is also closely tied to that of the USA. The USA is Canada's largest foreign investor with heavy investments in mining, smelting, petroleum, chemicals and machinery. Often, Canadian economic policies have been adjusted in order to adapt to changes in the US economy. Historically, even a minor change in the US interest rates has had economic repercussions in Canada.

Despite being among the advanced economies, Canada distinguishes itself with its primary sector, namely the logging and oil industries. The country's large territory is endowed with an exceptionally rich and varied set of natural resources making Canada is one of the world's five largest energy producers, it is the third country in the world considering proven oil reserves and ranks third in dry natural gas production despite holding a relatively small share of the world's proven natural gas reserves. The country is a net exporter of most energy commodities and plays the principal source of U.S. energy imports. Virtually all of Canada's crude oil exports are directed to U.S. refineries, also all of Canada's current natural gas exports are sent to U.S. markets via pipeline. Moreover, Canada is a net exporter of electricity to the United States, and most of its power needs are met by hydroelectricity. This trade pattern not only makes the

United States dependent on Canada for much of its energy needs, but also makes Canada profoundly dependent on the United States as an export market. Thus, Canada is considering ways to diversify its trading partners, especially by expanding ties with emerging markets in Asia.

2.3.2 Norway

The Norwegian economy is a prosperous mixed economy, with a large state sector, an expansive private sector, and an extensive social safety system. Norway has 24th largest economy based on GDP with current prices in US Dollars and 46th largest economy based on GDP with Purchasing Power Parity with regard to 2013 estimates. Although the ranking of Norway is not up in the list of GDP ranking, it is 10th economy with its GDP per capita equaling \$55,400 in 2013. Norway is a member of the European Economic Area; it contributes sizably to the EU budget although it is not in the Euro area. GDP of Norway economy is comprised of services by 56,5%, industry by 42,3% and agriculture with 1,2% while main industries in the country are petroleum and gas, food processing, shipbuilding, pulp and paper products, metals, chemicals, timber, mining, textiles, fishing. The large magnitude of the petroleum and gas sector in the economy is due to the county's rich natural resources of petroleum where this rich endowment is not limited to petroleum and includes and hydropower, fish, forests and minerals.

Norwegian economy have current account surplus by \$67,4 billion based on 2013 estimations, this surplus is mainly due to high exports based on petroleum and petroleum products, machinery and equipment, metals, chemicals, ships, fish with its main partners UK (25,6%), Germany (12,6%), and Netherlands (12%).

Norwegian economy is highly dependent on the petroleum sector, which accounts for the largest portion of export revenue and about 30% of government revenue, making it the seventh largest oil exporter in the world and largest oil producer in Europe. Also, natural gas sector is vital for the Norwegian economy too as it is the world's third-largest

exporter of natural gas after Russia and Qatar. The government controls key areas of the vital petroleum and gas sector, through extensive regulation and large-scale state-majority-owned enterprises.

2.3.3 Japan

Japan is the 3rd largest economy in the world by GDP (current prices, US dollars) and the 4th largest by GDP (Purchasing Power Parity) based on 2013 estimates. The services sector forms 73,2% of this advanced economy's GDP, followed by industry (25,6%). Agriculture constitutes only 1,1% of the GDP. The Japanese were one of the earliest nations in Asia to industrialize. In the years following World War II, with the help of government-industry cooperation, a strong work ethic, mastery of high technology, and a comparatively small defense allocation (1% of GDP), Japan developed a technologically advanced economy. For three decades, overall real economic growth had been spectacular - a 10% average in the 1960s, a 5% average in the 1970s, and a 4% average in the 1980s. The after effects of inefficient investment and an asset price bubble in the late 1980s slowed the real growth rate to 1.7%. Modest economic growth continued after 2000, but the economy has fallen into recession three times since 2008. In late 2009 and 2010 government stimulus spending helped the economy to recover until the contraction of the economy in 2011 due to the massive 9,0 magnitude earthquake and the ensuing tsunami in March disrupted manufacturing.

Japanese economy gives \$56.6 billion surplus in its current account balance based on 2013 estimates. Its main exports consists of motor vehicles (13,6%), semiconductors (6,2%) and iron/steel products (5,5%), with its main export partners China (18,1%), US (17,8%), South Korea (7,7%), Thailand (5,5%), and Hong Kong (5,1%). Japan's industrial sector is heavily dependent on imported raw materials and fuels, where petroleum forms 15,5% and liquid natural gas forms 5,7% of its imports. Its' main import partners are China (21,3%), US (8,8%), Australia (6,4%), Saudi Arabia (6,2%) and United Arab Emirates (5%).

Japan has been fighting with deflation for a long period of time and expects that a weaker yen and higher energy costs help with this combat against deflation. Also, Japanese economy suffers from dependence on exports to drive growth and an aging, which may create major long-term challenges for the economy.

Japanese economy is highly dependent on energy import. It is the world's largest liquefied natural gas importer, second largest coal importer, and third largest net oil importer. Moreover, Japanese economy is highly dependent on the Middle East for the majority of its supply; for that reason Japan is seeking to diversify its supply sources in Russia, Southeast Asia, and West Africa. Limited hydrocarbon reserves of Japan leads to significant need to secure its energy imports, accordingly the government applies incentives to support upstream Japanese companies in their quest to purchase overseas oil and natural gas equity.

Japan was the world's third largest producer of nuclear power after the United States and France before the Fukushima Daiichi nuclear power plant accident in March 2011. The composition of fuel used for power generation shifted to fossil fuels, particularly LNG after this disaster. As of late 2013, all of Japan's nuclear power generation capacity was removed from service.

2.3.4 Australia

The Australian economy is the 12rd largest economy in the world by GDP (current prices, US dollars) and the 17th largest by GDP (Purchasing Power Parity) based on 2013 estimates. The economy has experienced continuous growth (averaging 3,5% growth rate for more than 20 years) and features low unemployment, contained inflation, very low public debt, and a strong and stable financial system. Prior to the 1970s, Australia was considered as a relatively closed and protectionist economy of which most of its trade was held with the European and North American markets. But later, Australian economy turned its attention from the Western markets to the Asia Pacific region where demand for resources and energy was growing rapidly, creating a channel

for resources investments and growth in commodity exports for Australia. This shift has turned Australia into one of the fastest growing advanced economies in the world.

The services sector forms 68,7% of GDP of the Australian economy, followed by industry (27,4%) and agriculture (3,8%). The main industries are defined as mining, industrial and transportation equipment, food processing, chemicals, and steel. The Eastern and western parts of Australia differs quite a lot in the characterization of the economy in those parts. The eastern part of Australia, containing Australia's capital city Canberra, is home to the majority of Australia's service and financial industries where Western Australia, on the other hand, controls the majority of Australia's natural resources, including iron ore, gold, oil and natural gas.

Australian economy gives \$44,9 billion deficit in its current account balance based on 2013 estimates. It is a significant exporter of natural resources, energy (Hydrocarbon exports accounted for 23 percent of total commodity export revenues in 2011), and food, while China (29,5%), Japan (19,3%), South Korea (8%) and India (4,9%) are the main export partners of it. Main import goods are machinery and transport equipment, computers and office machines, telecommunication equipment, crude oil and petroleum products.

Australia was comparatively unaffected by the global financial crisis as the banking system has remained strong and inflation is under control. Australia has benefited from a dramatic surge in its terms of trade in recent years, stemming from rising global commodity prices.

Australia is one of the few countries belonging to the Organization for Economic Cooperation and Development (OECD) that is a significant net hydrocarbon exporter. The country is rich in commodities, including fossil fuel and uranium reserves, exporting over 70 percent of its total energy production. Australia was the world's second largest coal exporter based on weight in 2011 and the third largest exporter of liquefied natural gas (LNG) in 2012. Australia holds 1,4 billion barrels of proven oil

reserves as of January 1, 2013 of which most of them are light, sweet grade, typically low in sulfur crude oil and therefore higher in value than the heavier crudes.

However, as the country's gap between domestic consumption and production of oil has been rising, Australia turns into a net importer of crude oil and refined petroleum products, although the country exports substantial amounts of petroleum liquids. 60% of Australia's oil imports are supplied by Singapore and rest of it comes from Malaysia, Nigeria, United Arab Emirates, and Indonesia. Because of the lack of sufficient regional refining capacity, the country's north and northwest regions rely on oil product imports, while the eastern side imports crude oil for its refineries and major domestic markets.

2.3.5 Brazil

Brazil has been expanding its visibility among economies of the world thanks to its large and well-developed agricultural, mining, manufacturing, and service sectors. The Brazilian economy is the 7th largest economy based on GDP with current prices in US Dollars and based on GDP with Purchasing Power Parity with regard to 2013 estimates. Also, Brazil's economy outweighs that of all other South American countries as the largest in South America.

The services sector forms 68,1% of this developing economy's GDP, followed by industry (26,4%) and agriculture (5,5%). The main industries of this economy are textiles, shoes, chemicals, cement, lumber, iron ore, tin, and steel. Since 2003, Brazil accumulated foreign reserves and reduced its debt profile by shifting its debt burden toward real denominated and domestically held instruments to improve its macroeconomic stability. Brazil realized strong growth in 2007 and 2008 but the global financial crisis hit Brazil in 2008 leading two quarters of recession as global demand for Brazil's commodity-based exports decreased substantially. However, Brazil was one of the first emerging markets to begin a recovery, while recovery was accompanied with rising inflation and historically low unemployment levels. Thus, authorities had to take measures to cool the economy. On the other hand, Brazil's historically high interest rates

have made it an attractive destination for foreign investors leading large capital inflows that have contributed to the appreciation of the currency, hurting the competitiveness of Brazilian manufacturing. As a result, the government intervened in foreign exchange markets and raised taxes on some foreign capital inflows.

The Brazilian currency, Real, from the time of its inception until January 1999, operated using an exchange rate anchor which was tied to the USD. It operated using a band which allowed for a 0,6% per month depreciation of the Real. However, as a result of extreme pressure on its foreign currency reserves, the Central Bank of Brazil allowed the Real to float freely in January 1999. Since 1999, the currency regime for Brazilian regime is free floating exchange rate (Central Bank of Brazil).

Brazilian economy carries \$77,63 billion deficit in its current account balance regarding 2013 estimates. Exports sector in the country has importance in the economy, its main exports are mainly transport equipment, iron ore, soybeans, footwear, coffee, autos and its main trade partners are China, USA and Argentina.

Due to the high demand in the economy, Brazil is the 8th largest total energy consumer in the world and as it is rich in natural resources, it is the 10th largest energy producer in the world. Also, Brazil's known reserves are increasing as the world's largest oil discoveries in recent years have come from Brazil's offshore, pre-salt basins. Along with the potential to significantly increase oil production in the country, the pre-salt areas are estimated to contain sizable natural gas reserves as well. Currently, more than 90% of Brazil's oil production is offshore in very deep water and consists of mostly heavy grades. The United States has been Brazil's largest crude oil export destination for the past decade. As the country is rich in oil, natural gas constitutes only a small portion of Brazil's total energy consumption. Brazil has the third-largest electricity sector in the Americas, behind the United States and Canada.

2.3.6 Russia

Russia, also known as the Russian Federation, is the largest country in the world in terms of area. It also has relatively grand economy as it is the 9th largest economy in the world by GDP (current prices, US dollars) and the 6th largest by GDP (Purchasing Power Parity) based on 2013 estimates. Russian economy shifted from a globally-isolated, centrally-planned, statist economy towards a more market-based and globally-integrated economy parallel to the significant changes since the collapse of the Soviet Union. Economic reforms in the 1990s privatized most industry, with notable exceptions in the energy and defense-related sectors.

GDP of Russia is comprised of services (58,3%), industry (37,5%) and of agriculture (4,2%). As seen from the percentages of GDP composition, industry in Russian economy has relatively more weight as compared to other countries' economies. The industry of Russia has mostly developed in the areas - complete range of mining and extractive industries producing coal, oil, gas, chemicals, and metals, all forms of machine building from rolling mills to high-performance aircraft and space vehicles and defense industries.

Russian economy has \$74,8 billion surplus in its current account balance regarding 2012 estimates. Country exports mostly petroleum and petroleum products, natural gas, metals, wood and wood products, chemicals, and a wide variety of civilian and military manufactures to its main export partners - Netherlands (14,6%), China (6,8%), Germany (6,8%), Turkey 5,2%, and Ukraine (5,2%). Russia is one of the world's leading producers of oil and natural gas and is also a top exporter of metals such as steel and primary aluminum.

Since 1999, the Russian Ruble is operated by policy of managed floating exchange rate in order to smooth the influence of changes in external conditions' on Russian financial markets and the Russian economy as a whole. Between 1995 and 2005, exchange rate corridor was applied based on the value of Ruble against US Dollar. In 2005, the Bank of Russia introduced a dual-currency basket (that consisted of the US Dollar 55% and

the Euro 45%) as the operational indicator of its exchange rate policy. In February 2009, the width of the band was fixed to 2 Ruble and automatic shift of the operational band related to the accumulated amount of the Bank of Russia's FX interventions was applied. Since then the width of the floating operational band was gradually increased. In October 2010, fixed band based on dual-currency basket was abandoned and the fixed upper and lower boundaries were set at the levels of 41 and 26 Ruble respectively (The Bank of Russia).

Russia's economy is vulnerable to boom and bust cycles that follow the swings in global prices due to its reliance on commodity exports. The economy realized 7% growth on average during 1998-2008 as oil prices rose rapidly, however it was hit harshly by the 2008-09 global economic crisis as oil prices decreased significantly and the foreign credits that Russian banks and firms relied on dried up because of tough liquidity conditions. By late 2009, the Russian economy had begun a modest recovery, with the help of government's anti-crisis policies, the global recovery, and strong rise in oil prices over the course of the year.

Oil and gas revenues of Russia account for more than 50% of the federal budget revenues; accordingly, Russia's economy is highly dependent on its hydrocarbons. Russia holds the largest natural gas reserves in the world; it is the second-largest producer of dry natural gas and third-largest liquid fuels producer in the world. Russia was the third-largest producer of liquid fuels in 2012, following the United States and Saudi Arabia. Despite its significant reserves of coal, it produces only modest amount of coal. Also, Russia is one of the top producers and consumers of electric power in the world, with more than 220 gigawatts of installed generation capacity.

2.3.7 India

India has the second largest population in the world, the 10th largest economy in the world by GDP (current prices, US dollars) and the 3rd largest by GDP (Purchasing Power Parity) based on 2013 estimates. India is developing into an open-market

economy since the early 1990s by applying economic liberalization measures, including industrial deregulation, privatization of state-owned enterprises, and reduced controls on foreign trade and investment. These measures accelerated the country's growth, at about 7% per year from 1997 to 2011.

The services sector forms 66,1% of this developing economy's GDP, followed by industry (17%) and agriculture (16,9%). Agriculture is a major component of the Indian economy, since half of the work force earns its livelihood from this area. Also, the economy of India is diverse with a number of major sectors including manufacturing industries, agriculture, textiles and handicrafts, and services. The country is a preferred destination for information technology products as well as business process outsourcing as it has an English speaking population, moreover the Indian economy is one of the fastest growing economies in the world with the services sector as the major source of economic growth. However, India's economic growth slowed in 2011 because of declining investment levels due to high interest rates, rising inflation, and investor pessimism about further economic reforms and the global situation. In 2013, growth decreased to low levels of a decade leading economic leaders to struggle with high budget and current account deficits. Moreover, shift of foreign investment to Western countries as their economies recover, resulted in a severe depreciation in the rupee.

During the period 1950-1951 until mid-December 1973, India followed an exchange rate regime with Rupee linked to the Pound Sterling. On September 1975, the Rupee's ties to the Pound Sterling were broken. India conducted a managed float exchange regime with the Rupee's effective rate placed on a controlled, floating basis and linked to a "basket of currencies" of India's major trading partners. In early 1990s, the managed float exchange rate regime came under severe pressures because of trade deficit, leading the introduction of the market determined exchange rate. However, despite the market-determined exchange rate, Reserve Bank of India trades actively in the USD/INR currency market. As a result, the currency regime for the Indian rupee with respect to the US dollar may be called controlled exchange rate or managed float.

Indian economy carries \$74,79 billion deficit in its current account balance regarding 2013 estimates. The main exports of the economy are petroleum products, precious stones, machinery, iron, steel and chemicals; while its imports include basically crude oil, precious stones, machinery and fertilizer. India's trade partners are UAE, USA, China and Saudi Arabia.

India is the fourth largest energy consumer in the world after the United States, China, and Russia with its high demand parallel to its large economy. It was the fourth largest consumer of oil and petroleum products in the world in 2011, after the United States, China, and Japan. The country's economy is heavily dependent on imported crude oil, mostly from the Middle East. But also, country had 5,5 billion barrels of proved oil reserves at the end of 2012. India's government promotes the country's refining sector, and India became a net exporter of petroleum products in 2001. The country has the world's fifth largest coal reserves, and coal is India's primary source of energy, mostly for the power sector. Also, natural gas is an important energy source for India as it serves as a substitute for coal for electricity generation in India. India had 43,8 trillion cubic feet of natural gas reserves at the end of 2012, mostly located offshore. The two biggest state-owned oil companies, ONGC and Oil India, dominate the country's upstream gas sector. India's imports are not limited to oil considering energy market; it also became the world's sixth largest liquefied natural gas importer in 2011. To meet rising demand, Indian companies have begun investing in new regasification facilities.

2.3.8 China

China is the world's most populous country with a fast-growing economy which is the second largest economy in the world by GDP (current prices, US dollars) and the GDP (Purchasing Power Parity) based on 2013 estimates. Since the late 1970s, China has moved from a closed, centrally planned system to a more market-oriented economy, this shift has changed the global economy balance and China became the world's largest exporter in 2010. Chinese economy has experienced a wide range of reforms including

phasing out of collectivized agriculture, gradual liberalization of prices, fiscal decentralization, increased autonomy for state enterprises, growth of the private sector, development of stock markets and a modern banking system, and opening to foreign trade and investment.

GDP of China has increased ten folds on a purchasing power parity basis since 1978 thanks to the restructuring of the economy. Moreover, except 2008 and 2009 for the years of economic downturn globally, China has managed to have two-digit growth rates. However, per capita income is still below the world average.

Industry and services sectors have equal weight in GDP of China with 45%, while agriculture sector covers 10% of the economy. China is called 'The World's Factory' as it has one of the most diverse spread of industrial production in the world. Despite the gradual decrease from 77% to about 50% in 35 years, Chinese economy is still dominated by State Owned Enterprises (SOE). 65 of the Chinese SOEs ranked in the 2012 Fortune Global 500 list, including the country's power grid operation company State Grid Corporation of China, and oil companies China National Petroleum Corporation and Sinopec.

Chinese economy has \$176,6 billion surplus in its current account balance based on 2013 estimates. The main partners for China to export its products and services are Hong Kong (17,4%), US (16,7%), Japan (6,8%) and South Korea (4,1%). China is the world's second largest trading nation behind the US – leading the world in exports and coming in second for imports. China is rapidly becoming their most important bilateral trade partner for many countries around the world. However, there have been concerns over large trade imbalances between China and the rest of the world.

Chinese currency, Renminbi, has its role in the global place of China in trade as the currency rates define the relative competitiveness of prices for tradable goods. Until July 2005, Chinese currency was tightly linked to the US dollar; then, China moved to an exchange rate system that references a basket of currencies. The appreciation of Renminbi against the US dollar has exceeded 20% between 2005 and 2008 but the

exchange rate remained virtually pegged to the dollar until June 2010 when the daily trading band which the RMB is permitted to fluctuate was expanded. The daily trading price of the U.S. dollar against the RMB in the inter-bank foreign exchange market was allowed to float within 0,3% band around the central parity until 2007 when the band was extended to 0,5%. On April 14, 2012, the band was extended to 1,0% and finally on March 17, 2014, the band was extended to 2%.

China is the world's largest energy consumer and producer in the world due to its high energy demand as it is the world's most populous country with a fast-growing economy. It is the world's second-largest consumer of oil and projected to move from second-largest net importer of oil to the largest in 2014. Although, China has large oil fields, there is an increased pressure on China to import greater volumes of oil from a wide range of sources because of substantial oil demand growth and geopolitical uncertainties. Chinese oil and gas upstream and downstream sectors are dominated by China's national oil companies although the government has granted international oil companies more access to technically challenging onshore and deep water offshore fields. As the oil import volume of China has been increasing, China's national oil companies have shifted their purchase method to direct acquisitions of equity and financial loans in exchange for oil supplies in order to secure long-term oil and gas supply security. Moreover, China is making investments to integrate its oil supply and demand centers and to diversify its oil import sources through pipeline links with Kazakhstan, Russia, and Myanmar.

The importance of natural gas is also increasing for Chinese economy, the country contains several natural gas producing regions, including the western and central parts of the country as well as offshore basins and continues to invest in natural gas pipeline infrastructure to link production areas with demand centers. Similarly, Chinese demand is increasing for LNG too as robust growth particularly in the urban coastal areas continues making way for China becoming the third largest LNG importer in the world. Another energy source that China is the leader of world consumption is coal as it is the

leading source of power generation in China. China is also the largest producer of coal in the world.

2.3.9 South Africa

South Africa is a middle-income country with a developing economy which is the 32nd largest economy in the world by GDP (current prices, US dollars) and the 25th largest by GDP (Purchasing Power Parity) based on 2013 estimates. South Africa is one of the most stable economies in the African continent with well-developed financial, legal, communications, energy, and transport sectors and a stock exchange that is the 16th largest in the world. The country also has abundant supply of natural resources.

Services sector (68,4%) has high weight in South African economy, followed by industry (29%) and agriculture (2,6%) based on 2013 estimates. Mining, automobile assembly, metalworking, machinery, textiles, iron and steel, and chemicals industries are large contributors to the country's GDP. Especially mining industry has a significant importance for the economy as South Africa is the world's largest producer of platinum, gold, chromium.

South African currency, Rand, was operated by fixed exchange rates in the 1960s and 1970s, then several forms of floating rate regimes was experienced in the 1980s and 1990s with accompanied with exchange control regulations and regular market interventions by the South African Reserve Bank. In 2000, the country changed the monetary policy regime to inflation targeting. With this regime, Rand was let to freely float.

South African economy has \$23.78 billion deficit in its current account balance based on 2013 estimates. The country mainly exports gold, diamonds, platinum, other metals and minerals, machinery and equipment to its export partners China (11,8%), US (8,3%), Japan (6%) and Germany (5,7%). On the other hand, the country also high import bill on importing machinery and equipment, chemicals, petroleum products, scientific

instruments, and foodstuffs from its import partner countries namely China (14,4%), Germany (10,1%), Saudi Arabia (7,7%), US (7,4%) (2012 estimates).

Even though the country is in the developing countries league, it has still unstable electricity supplies that retard growth. As a commodity exporter country, South Africa was also hit hard by the global financial crisis, growth rate fell nearly 2% in 2009, as the prices of and demand for commodity prices reduced. Unemployment, poverty, and inequality - among the highest in the world - remain a challenge for South African economy as well as high inflation and high budget deficits.

South Africa meets most of its energy needs, particularly in the electricity sector, from coal deposits as the country has limited proved reserves of oil and natural gas. It holds 95% of Africa's total coal reserves and the world's ninth-largest amount of recoverable coal reserves and it exports roughly 25% of its coal production. The country's crude oil production is very limited thus synthetic fuels, derived from coal and natural gas, account for almost 90% of the country's domestic petroleum production making South Africa the second-largest consumer of petroleum in Africa, behind Egypt. The country imports crude oil mostly from OPEC countries in the Middle East and West Africa, with roughly half of the imports were supplied by Saudi Arabia in 2013. South Africa is considered to be rich for the rising source of energy of today, namely shale gas. However international companies are still waiting to be issued permit licenses for shale exploration as the government has released proposed new regulations to govern the exploration of shale resources.

2.4 Energy and Oil Market in Turkish Economy

As a fastest growing country, demand for energy of Turkey is increasing day by day. Over the past three years, Turkey has experienced some of the fastest growth in energy demand of countries in the Organization for Economic Cooperation and Development (OECD). Moreover, the energy use is still relatively low, making room for increasing demand at a fast pace (EIA, Turkey Analysis). According to the International Energy

Agency (IEA), energy use will approximately double over the next decade by growing at an annual growth rate of around 4,5% from 2015 to 2030. However, as energy resources of the country are limited, the expected energy demand growth emphasizes the problems already existing because of import dependence in energy.

Turkey’s energy consumption is heavily based on oil and natural gas. Oil has the largest share among primary sources of energy until 2007 when natural gas has exceeded the share of oil and became the mostly consumed energy source. In 2012, natural gas had 32% and oil had 27% share among the primary energy sources of Turkey (Ministry of Energy and Natural Resources, 2012).

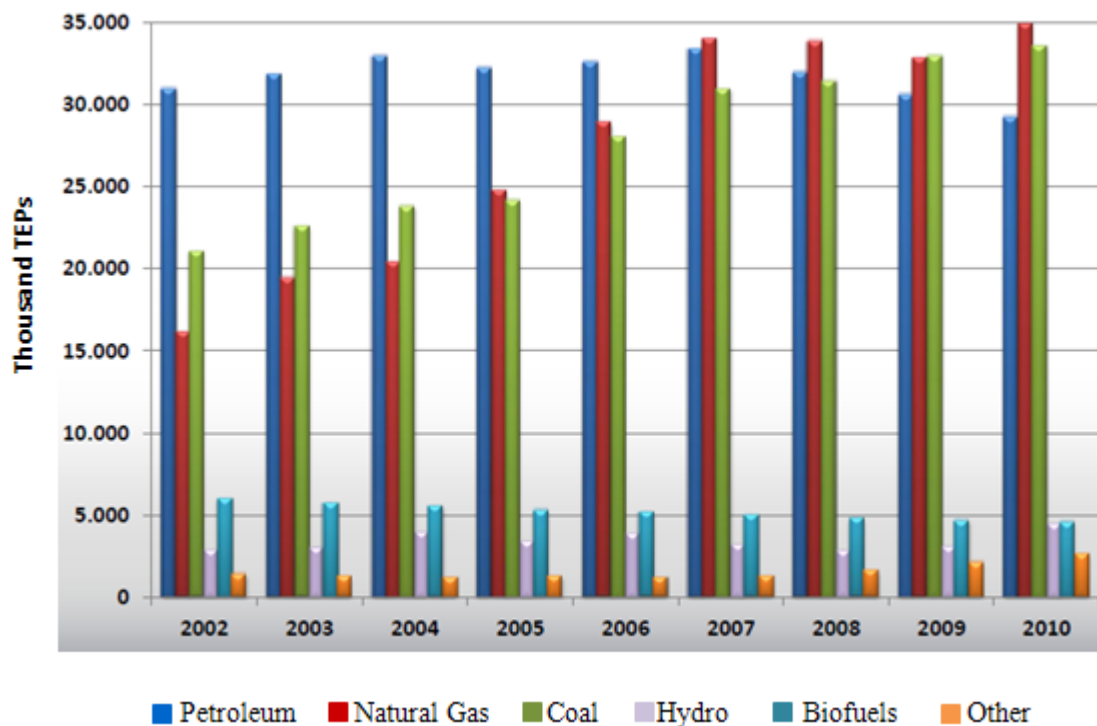


Figure 2.3: Primary Energy Sources of Turkey between 2002-2010 [25]

As Turkey’s resources are limited for petroleum and natural gas, most of the consumption of these resources is imported. In 2012, 71% percent of energy consumption was based on imported energy while 29% was based on domestic production [38].

Table 2.6: Energy Import Value of Turkey Between 2002-2011 [25]

Years	Total Export (Billion \$)	Energy Export (Billion \$)	Transportation (Billion \$)	The Share of Transportation Sector in Energy Export (%)	Energy (Billion \$)	The Share of Energy Sector in Energy Export (Billion \$)
2002	51,5	9,20	5,41	58,80	3,79	41,20
2003	69,3	11,58	6,58	56,82	5,00	43,18
2004	97,5	14,41	8,64	59,96	5,77	40,04
2005	116,7	21,26	12,41	58,37	8,85	41,63
2006	139,5	28,86	16,61	57,55	12,25	42,45
2007	170,1	33,88	19,34	57,08	14,54	42,92
2008	201,9	48,28	27,03	55,99	21,25	44,01
2009	140,9	29,91	15,17	50,72	14,74	49,28
2010	185,5	38,49	21,03	54,64	17,46	45,36
2011	240,8	54,10	33,60	62,11	20,50	37,89

In 2012, imports value reached \$236,5 billion where \$60,1 billion of this amount was solely for energy import. Accordingly, energy import had a substantial role in the current account deficit which has been \$46,9 billion. That is, it can be said that excluding energy import, Turkey had more than \$12 billion surplus in the current account balance in 2012. Moreover, the share of energy import is increasing for years in Turkish economy. It has been more than 20% between 2008-2013, reaching 25% in 2012 from 22,5% in 2011 [11].

Among imported energy sources, crude oil and natural gas has very high import dependence ratios (over 90%), making these two sources important not only for

economy but also for energy supply security and international politics. Table 2.8 given below show demand, production, net imports and import dependence values for oil and natural gas between 1995 and 2012. As seen from the tables, import dependence for oil increased from 88,7% in 1985 to 93,3% in 2012. On the other hand, natural gas import dependence has been over 90% since 2012, maximizing in 98,6% at 2012.

Table 2.7: Key Oil and Natural Gas Data between 1985-2012 [19]

Key Oil Data

	1985	1990	1995	2000	2005	2010	2011	2012
Production (kb/d)	40.6	72.5	67.7	52.8	43.5	48.3	45.6	44.9
Demand (kb/d)	359.5	477.0	608.3	662.8	647.5	649.8	655.9	670.3
<i>Motor gasoline</i>	44.4	74.0	100.2	83.6	61.9	47.3	44.7	41.2
<i>Gas/diesel oil</i>	114.2	153.7	180.0	184.8	216.8	300.1	310.6	327.6
<i>Residual fuel oil</i>	121.3	119.8	144.4	141.5	117.8	20.2	18.7	19.8
<i>Others</i>	79.7	129.6	183.7	252.9	251.1	282.3	281.9	281.7
Net imports (kb/d)	318.9	404.5	540.6	610.0	604.0	601.5	610.3	625.4
Import dependency	88.7%	84.8%	88.9%	92.0%	93.3%	92.6%	93.0%	93.3%
Refining capacity (kb/d)	460	725	713	691	714	630	630	630
Oil in TPES	46.0%	44.3%	46.1%	40.0%	34.0%	28.6%	27.7%	-

Key Natural Gas Data

	1985	1990	1995	2000	2005	2010	2011	2012 *
Production (mcm/y)	67	212	182	639	897	682	761	632
Demand (mcm/y)	67	3 468	7 029	14 835	27 375	38 127	44 686	45 254
<i>Transformation</i>	18	2 585	3 600	8 845	15 157	20 708	21 570	-
<i>Industry</i>	49	814	1 984	2 098	3 839	7 901	9 878	-
<i>Residential</i>	-	49	1 364	3 218	5 747	5 888	8 779	-
<i>Others</i>	-	20	81	674	2 632	3 630	4 459	-
Net imports (mcm/y)	-	3 256	6 847	14 196	26 478	37 445	43 925	44 622
Import dependency	0.0%	93.9%	97.4%	95.7%	96.7%	98.2%	98.3%	98.6%
Natural Gas in TPES	0.1%	5.4%	9.4%	16.6%	27.0%	29.8%	32.3%	-

* based on monthly data submissions to the IEA.

The single largest share of oil consumption in Turkey belongs to the transport sector as in other IEA countries. In 2010, the transport sector represented 50% of total oil use in the country which is lower than the International Energy Agency (IEA) average of 60%. The industry sector, having the second largest share, represented 24% of total oil demand. The share of industry sector is slightly higher than the IEA average of 21% due to high demand coming from construction sector (around 33% of total industry share) and chemical sector (31%). The remainder of oil consumed in Turkey in 2010 was in the

commercial/agriculture/other sector (14%) and the transformation/energy sector (7%).

Figure 2.4 below shows oil consumption by sector for the years 1973-2009.

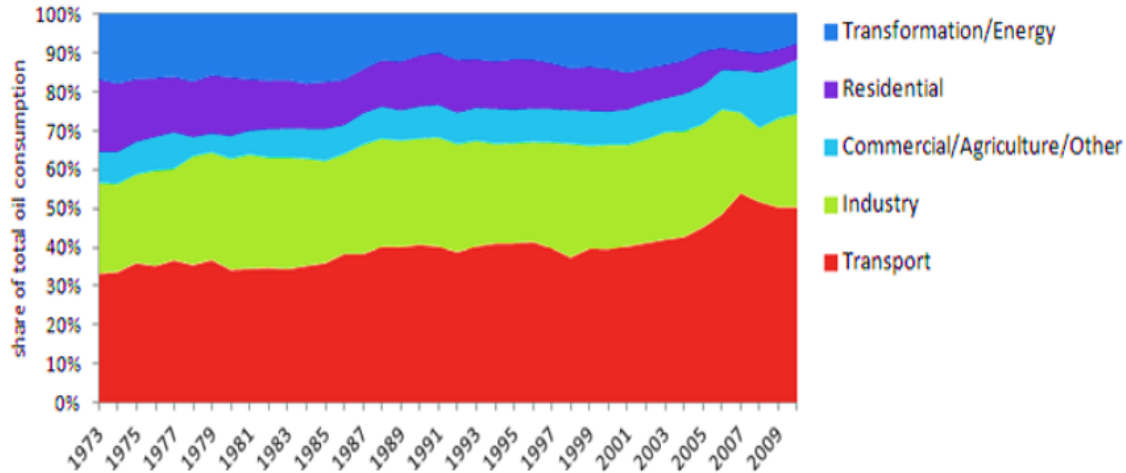


Figure 2.4: Oil Consumption by Sector [19]

The importance of energy for Turkish economy is increasing day by day since it has very limited energy sources. As a country already heavily import dependent considering energy sources is face to face more challenging problems, especially considering the tradeoff between growth and current account balance. Oil and natural gas import is crucial to the growth for the economy; on the other hand, these two resources have significant effect on the current account deficit. Accordingly, issues related to energy sources are expected to have significant impact on Turkish economy, especially prices and exchange rates which defines the relative prices. Thus, price of crude oil which is an important source of energy in Turkey, is expected to have effect on financial indicators, especially exchange rate and stock indices, of the country.

CHAPTER 3

LITERATURE REVIEW

As the importance of crude oil as a financial indicator and asset increases, its co-movement or dependency with other financial assets and/or indicators arouse interest. There are several studies questioning the dependence relation between crude oil and exchange rates as well as its relation with stock indices. Majority of the studies on the relation between oil price and exchange rate movements study the causal dynamics with VAR and Granger causality models. There are some important empirical results reached in this area. For example, Adiguzel et al. [1] indicated that different causalities may occur on different time periods. Turhan et al. [34] found that importance of oil price movements on exchange rates of emerging countries has increased after the financial crisis. To answer the time specific interrelation structure, Benhmad [5] and Reboredo et al. [29] made use of Wavelet Decomposition techniques and both found bidirectional relationship between oil and US Dollar, additionally Reboredo et al. [28] stressed oil price changes had no effect on US Dollar in the pre-crisis period. Copula models are also newly introduced in the mentioned area of research. Modelling the dependence structure between oil prices and exchange rates, Reboredo [30] and Aloui et al. [3] found an increase in the extreme dependence between oil and US Dollar while Wu et. al [39] suggested that the dependence between oil and US Dollar returns decreased since 2003. Table 2.1 summarizes the literature on the relation and dependence between the crude oil and exchange rate prices.

Table 3.1: Research on Crude Oil and Exchange Rate Interdependence

Paper	Topic	Data	Methodology	Findings
Fratzscher et al. [17]	The relationship between oil prices, the US dollar and asset prices	Daily data from January 1, 2001 to October 19, 2012	Structural VAR	Oil prices in general immediately react to changes in other financial assets. The causality between oil prices and exchange rates runs negative in both directions. Equity market shocks and risk shocks have been important drivers of oil prices and of the US Dollar exchange rate since 2001.
Turhan et al. [34]	The role of oil prices in explaining the dynamics of selected emerging countries exchange rates	Daily data from March 1, 2003 to February 6, 2010	VAR and generalized impulse response analyses	Increased importance of oil price movements after the financial crisis. As oil prices rise, appreciation of the local currency against the US dollar and the co-movement has increased in the post crisis period.
Adiguzel et al. [1]	Causal dynamics between crude oil prices and exchange rates in Brazil, India and Turkey	Monthly data from 1999 to 2011	Linear and Non Linear Granger Causality, time domain, frequency domain analysis	There is a causal relationship running from real exchange rate to real oil price on the short run for all countries. There might be different causalities on different time periods.
Benhmad [5]	The linear and nonlinear Granger causality between the real oil price and the real effective U.S. Dollar exchange rate	Monthly data from February 1970 to February 2010	Wavelet decomposition and Granger Linear causality, Non Linear Causality tests (Taylor Expansion and Neural Networks)	In short term (3 months period), the causality runs from the real oil prices returns to real effective US dollar exchange rate returns, in the long term (16 months) strong bidirectional causal relationship between the real oil and the real effective exchange rate US Dollar returns.

Reboredo et al. [29]	The dependence between oil prices and US dollar exchange rates	Daily data from January 4, 2000 to October 7, 2011	Wavelet multi-resolution analysis	Oil price changes had no effect on exchange rates or vice versa in the pre-crisis period. There was evidence of contagion and interdependence between oil prices and exchange rates from the onset of the global financial crisis. Oil prices led exchange rates and vice versa with the onset of the financial crisis, but before there was no lead and lag relation in between.
Reboredo [30]	Oil prices and exchange rates comovement using two measures of dependence	Daily data from January 4, 2000 to June 15, 2010	TGARCH and Copula	An increase in oil prices is weakly associated with USD depreciation and vice versa, but the intensity of this comovement differs across currencies, dependency increased noticeably with the onset of the financial crisis.
Wu et al. [39]	The authors examine the economic value of comovement between WTI oil price and U.S. dollar index futures	Weekly data from January 2, 1990 to December 28, 2009	Copula-GARCH Models	The dependence structure between oil and exchange-rate returns becomes negative and decreases continuously after 2003.
Aloui et al. [3]	Conditional dependence structure between crude oil prices and US Dollar exchange rate	Daily data January 4, 2000 to February 17, 2011	Copula-GARCH Models	Increase in the extreme dependence for several oil-exchange rate market pairs in times of crisis.

The relation between crude oil and stock index values has been an interesting topic since it has important implications for financial market participants, policy makers and risk managers. For that reason the literature on the subject is rich. Researches came up with

significant results by benefiting from GARCH models, Wavelet analysis and Copula models and etc. Chang, C. et al. [7], by using VARMA-GARCH and VARMA-AGARCH models, concluded that there is little evidence on the dependence between crude oil and financial markets. Similarly, Reboredo [30] found that there was no effect of oil prices changes on stock market returns in the pre-crisis period. On the other hand, he stressed that the interdependence between oil and stock prices has been evident since the onset of the global financial crisis. Aloui et al. [2] applied copula models for crude oil and the stock indexes of Central Eastern European countries and found evidence of positive dependence between the oil and the stock markets of the six CEE countries, and contagion between those markets during severe financial stress. Zhu et al. [41] analyzed the dynamic dependence structure between crude oil prices and stock markets across the Asia-Pacific region by making use of GARCH and Copula models, and concluded that the dependence between crude oil prices and Asia-Pacific stock market returns is generally weak but it has increased after the global financial crisis. Selected studies are summarized in Table 3.2.

As explained above, Copula models are newly introduced to model or analyze the dependence structure between crude oil and other assets but have been used to answer the needs of several areas in finance literature for several years. In the book called “Copula Models in Finance”, Cherubini et al. [9] states the power of Copula methods in finance as “*copula functions enable us to tackle the problem of specification of marginal univariate distributions separately from the specification of market comovement and dependence copula functions is much more general than the standard linear correlation concept, and it is able to capture non-linear relationships among the markets*”, similarly Patton [27] explains the primary motivation for the use of copulas in finance as the non-normal dependence between assets and groups the main application areas of copulas as risk management, derivatives pricing, credit risk calculation, optimal portfolio construction and financial contagion. To detect the best copula model that fits the financial market data is another concern one must think of. Kole et al. [21] showed to extend the standard tests for the fit of a distribution to apply for copulas, and concluded

that the Student's t copula as the best compared to the correlation-based Gaussian copula and the extreme value-based Gumbel copula.

Table 3.2: Research on Crude Oil - Stock Market Interdependence

Paper	Topic	Data	Methodology	Findings
Chang, C. et al. [7]	The conditional correlations and volatility spillovers between the crude oil and financial markets	Daily data from January 2, 1998 to November 4, 2009	DCC, VARMA-GARCH, VARMA-AGARCH	The estimated conditional correlations for returns across markets were very low, and some were not statistically significant. The empirical results provided little evidence of dependence between the crude oil and financial markets.
Miller [24]	The long-run relationship between the world price of crude oil and international stock markets	Monthly data from 1971 January to March 2008	Cointegrated vector error correction model	There is clear long-run relationship between real stock prices and world real oil price for 1971-1980 and 1988-1999, between 1980-1988, the relationship is no longer significant.
Zhu et al. [41]	The relationship between crude oil shocks and stock markets for the OECD and non-OECD countries	Monthly data from January 1995 to December 2009	Panel based cointegration tests	There exists a bidirectional long run Granger-causal relation between crude oil and stock markets, increased crude oil prices have a positive impact on stock prices and that increased stock prices influence crude oil prices positively in the long run.
Aloui et al. [3]	The conditional dependence between the Brent crude oil price and stock markets in the Central and Eastern European (CEE) transition economies	Daily data from December 1, 2005 to August 20, 2012.	ARMA, GARCH and Copula models	There is a positive dependence between the oil and the stock markets of the six CEE countries, there is a contagion between those markets during severe financial stress, regardless of the changes in the Brent oil price or the CEE stock index.

Aloui et al. [4]	The effects of oil price shocks on stock market returns in emerging countries	Daily data from September 29, 1997 to November 2, 2007	Conditional and unconditional regression models	Oil price risk is more conditionally relevant for pricing of emerging market stocks. The oil sensitivity of stock returns is asymmetric and particularly significant during rising oil markets, especially for emerging markets positively correlated with oil price movements.
Chang, K. et al. [8]	The impact of crude oil price shock on stock return dynamics	Daily data from January 2, 2001 to April 17, 2012	GJR-GARCH (MS-ARJI-GJR-GARCH-X) model	Conditional return and variance will respond instantly to a current oil price shock. However, when oil price shock occurs, the smoothed probabilities will with a one-period lag.
Filis et al. [16]	The time-varying correlation between stock market prices and oil prices for oil importing and oil-exporting countries	Monthly data from January 1987 to September 2009	DCC-GARCH-GJR model	Time-varying correlation of oil and stock prices do not differ for oil-importing and oil-exporting economies, demand side shocks tend to be influencing the correlation between oil and stock market prices more than supply-side shocks.
Zhu et al. [41]	The dynamic dependence between crude oil prices and stock markets across the Asia-Pacific region	Daily data from January 4, 2000 to March 30, 2012	GARCH and copula models	The dependence between crude oil prices and Asia-Pacific stock market returns is generally weak, it was positive before the global financial crisis, and that it increased significantly in the aftermath of the crisis.

Reboredo [30]	The relationship between oil and stock markets in Europe and the USA at the aggregate and sectoral levels	Daily data from June 1, 2000 to July 29, 2011	Wavelet multi resolution analysis	Oil prices changes had no effect on stock market returns, either at the aggregate level or sectoral level, in the pre-crisis period. Contagion and positive interdependence between oil and stock prices has been evident in Europe and the USA since the onset of the global financial crisis.
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Reviewing the literature related crude oil dependence with financial assets and exchange rates, it is seen Wu et al. [39] used time varying copula models such as Gaussian, Student t, Clayton, survival Clayton and mixture Clayton copula and found that the Gaussian dependence structure exhibits better explanatory ability than other dependence structures in terms of the values of Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The authors stress that the Clayton and survival Clayton copulas have worse explanatory ability implying that introducing the tail dependence between oil and exchange-rate returns does not add much to the explanatory ability of the models. Reboredo [30] made use of Gaussian, Student t, Plackett, Frank, Clayton, Gumbel, TVP Gaussian and TVP Student t copula models to analyze the dependence between oil price and several exchange rates and applied pseudo-likelihood ratio test of Joe and Xu [20] as goodness-of-fit test of copulas, by comparing each model with the Gaussian copula as benchmark. He found that there was no clear superiority of the Gaussian over the Student-t for both of the periods that symmetrical tail dependence exists and does not exist. Aloui et al. [2] benefited from Normal, Student-t, Frank, Plackett, Gumbel and Clayton copula models while studying the conditional dependence structure between crude oil prices and U.S. dollar exchange rates and concludes that the Student-t copula is the best one due to the results of the goodness-of-fit test.

CHAPTER 4

COPULAS AND DEPENDENCE

4.1 Copula

In this section, firstly basis of the copula theory is introduced. Then, copula theory is explained in the formal context. Lastly, dependence concept and measures of dependence are detailed. The texts in this section are mainly from Meucci [23], Schmidt [32], Embrechts [13], Trivedi and Zimmer [33].

The basis of copula theory will be discussed before going deeper in the Copula theory. This subsection is mainly based on the texts from Meucci [23].

Consider an arbitrary random variable X , with a fully arbitrary distribution. For any set of potential values for the variable X , the following identity for probability density function (pdf) f_x , holds:

$$P\{X \in \mathcal{X}\} \equiv \int_{\mathcal{X}} f_x(x) dx \quad (4.1)$$

The cumulative distribution function (cdf) of X is defined as follows:

$$F_x(x) \equiv \int_{-\infty}^x f_x(z) dz \quad (4.2)$$

If we feed the random variable X into a generic function g , we obtain another random variable $Y = g(X)$. A special situation arises when we transform X with its own cdf — i.e., $g = F_x$.

Definition: If we feed the arbitrary variable X through its own cdf, we obtain a very special transformed random variable, which is called the grade of X ;

$$U \equiv F_X(X) \quad (4.3)$$

The distribution of the grade is uniform on the unit interval, regardless of the original distribution f_x :

$$U \sim U_{[0,1]} \quad (4.4)$$

The simple proof of the result is as following:

$$\begin{aligned} F_U(u) &\equiv P\{U \leq u\} = P\{F_X(X) \leq u\} \\ &= P\{X \leq F_X^{-1}(u)\} = F_X(F_X^{-1}(u)) = u \end{aligned} \quad (4.5)$$

Therefore, $F_U(u) = u$, which is the cdf of a uniform distribution.

Also, if we feed a uniform random variable U into the inverse cdf F_X^{-1} , we obtain a random variable $X = F_X^{-1}(U)$ with distribution f_x , as follows:

$$U \sim U_{[0,1]} \rightarrow X \equiv F_X^{-1}(U) \sim f_x \quad (4.6)$$

The theory given above explains the basis of copula theory for the univariate case above. The similar context is discussed for multivariate case in the following:

Consider a N-dimensional vector of random variables $X = (X_1, \dots, X_N)$ with a multivariate distribution represented by its pdf $X \sim f_x$. In the multivariate case, the pdf f_x is defined in such a way that, for any set of potential joint values $X = (X_1, \dots, X_N)$ the following identity holds:

$$P\{(X_1, \dots, X_N) \in \mathcal{X}\} \equiv \int_{\mathcal{X}} f_x(x_1, \dots, x_N) dx_1 \dots dx_N \quad (4.7)$$

From the joint distribution f_x , all the N marginal distributions $X_n \sim f_{x_n}$, where $n=1, \dots, N$ is extracted by computing the marginal pdfs, as follows:

$$f_{X_n}(x_n) = \int_{\mathfrak{R}^{N-1}} f_X(x_1, \dots, x_N) dx_1 \dots dx_{n-1} dx_{n+1} \dots dx_N \quad (4.8)$$

Also, marginal cdf 's F_{X_n} can be computed by using f_{x_n} . Finally, each cdf F_{X_n} , is feed with the respective entry of the vector X — namely, the random variable X_n . The outcome of this operation is the grades which have a uniform distribution on the unit interval.

$$U_n \equiv F_{X_n}(X_n) \sim U_{[0,1]} \quad (4.9)$$

However, the entries of $U = (U_1, \dots, U_N)$ are not independent. Therefore, the joint distribution f_U of the grades is not uniform on its domain, which is the unit cube $[0,1] \times \dots \times [0,1]$.

The **copula** of an arbitrary distribution f_{X_n} is the joint distribution f_U of its grades, as following:

$$\left(\begin{array}{c} U_1 \equiv F_{X_1}(X_1) \\ \vdots \\ U_N \equiv F_{X_N}(X_N) \end{array} \right) \sim f_U \quad (4.10)$$

The information contained in each marginal distribution f_{X_n} is swept away by feeding each random variable X_n into its own cdf. Then, the remaining is the pure joint information amongst the X_n 's — i.e., the copula f_U . This statement is summarized intuitive definition of the copula: “*The copula is the information missing from the individual marginals to complete the joint distribution*” [23].

The intuitive definition is made rigorous from the definition of copula as following:

$$\begin{aligned}
F_U(u) &\equiv P\{U_1 \leq u_1, \dots, U_N \leq u_N\} \\
&= P\{F_{X_1}(X_1) \leq u_1, \dots, F_{X_N}(X_N) \leq u_N\} \\
&= P\{X_1 \leq F_{X_1}^{-1}(u_1), \dots, X_N \leq F_{X_N}^{-1}(u_N)\} \\
&= F_X(F_{X_1}^{-1}(u_1), \dots, F_{X_N}^{-1}(u_N))
\end{aligned} \tag{4.11}$$

Differentiating this expression, we obtain Sklar's theorem (for two variables):

$$\begin{aligned}
f_U(u_1, u_2) &= \partial_{u_1 u_2}^2 F_U(u_1, u_2) = \partial_{u_1 u_2}^2 F_X(F_{X_1}^{-1}(u_1), F_{X_2}^{-1}(u_2)) \\
&= \partial_{u_1 u_2}^2 F_X(F_{X_1}^{-1}(u_1), F_{X_2}^{-1}(u_2)) d_{u_1} F_{X_1}^{-1}(u_1) d_{u_2} F_{X_2}^{-1}(u_2) \\
&= \frac{\partial_{u_1 u_2}^2 F_X(F_{X_1}^{-1}(u_1), F_{X_2}^{-1}(u_2))}{d_{u_1} F_{X_1}(F_{X_1}^{-1}(u_1)) d_{u_2} F_{X_2}(F_{X_2}^{-1}(u_2))} \\
&= \frac{f_X(F_{X_1}^{-1}(u_1), F_{X_2}^{-1}(u_2))}{f_{X_1}(F_{X_1}^{-1}(u_1)) f_{X_2}(F_{X_2}^{-1}(u_2))}
\end{aligned} \tag{4.12}$$

Sklar's theorem links the original joint distribution f_x , the copula f_U and the marginals f_{X_n} — or, equivalently, F_{X_n} , as follows:

$$\underbrace{f_X(F_{X_1}^{-1}(u_1), \dots, F_{X_N}^{-1}(u_N))}_{\text{joint}} = \underbrace{f_U(u_1, \dots, u_N)}_{\text{pure joint}} \times \underbrace{f_{X_1}(F_{X_1}^{-1}(u_1)) \times \dots \times f_{X_N}(F_{X_N}^{-1}(u_N))}_{\text{pure marginal}} \tag{4.13}$$

Sklar's theorem, by providing the pdf of the copula from the joint pdf and the marginal pdfs, allows the use of maximum likelihood to fit copulas to empirical data.

4.1.1 Copula Theory

Definition: A d-dimensional copula $C : [0; 1]^d \rightarrow [0; 1]$ is a function which is a cumulative distribution function with uniform marginals satisfying following three properties:

- (1) $C(1, \dots, 1, a_n, 1, \dots, 1) = a_n$ for every $n \leq m$ and all a_n in $[0, 1]$;

(2) $C(a_1, \dots, a_m) = 0$ if $a_n = 0$ for any $n \leq m$;

(3) C is d -increasing.

Theorem; Sklar (1959): Consider a d -dimensional cdf F with marginals F_1, \dots, F_d . There exists a copula C , such that;

$$F(x_1, \dots, x_d) = C(F_1(x_1), \dots, F_d(x_d)) \quad (4.14)$$

for all x_i in $[-\infty, \infty]$, $i = 1, \dots, d$. If F_i is continuous for all $i=1, \dots, d$ then C is unique; otherwise C is uniquely determined only on $\text{Ran } F_1 \times \dots \times \text{Ran } F_d$, where $\text{Ran } F_i$ denotes the range of the cdf F_i . On the other hand, consider a copula C and univariate cdfs F_1, \dots, F_d . Then F as defined in (3.14) is a multivariate cdf with marginals F_1, \dots, F_d .

4.1.2.1 Conditional Distributions

Let two uniform rvs U_1 and U_2 with known copula C and U_1 is observed then the conditional distribution to estimate U_2 is obtained by;

$$\begin{aligned} P(U_2 \leq u_2 | U_1 = u_1) &= \lim_{\delta \rightarrow 0} \frac{P(U_2 \leq u_2, U_1 \in (u_1 - \delta, u_1 + \delta])}{P(U_1 \in (u_1 - \delta, u_1 + \delta])} \\ &= \lim_{\delta \rightarrow 0} \frac{C(u_1 + \delta, u_2) - C(u_1 - \delta, u_2)}{2\delta} \\ &= \frac{\partial}{\partial u_1} C(u_1, u_2) \end{aligned} \quad (4.15)$$

4.1.2.2 Invariance Property of Copula

Proposition: If $(X_1, \dots, X_N)^t$ has a copula C and T_1, \dots, T_N are increasing continuous functions, then $(T_1(X_1), \dots, T_N(X_N))^t$ also has a copula C .

Proof. Let $(U_1, \dots, U_n)^t$ have distribution function C (in the case of continuous marginal F_x , take $U_i = F_{X_i}(X_i)$), [13].

$$\begin{aligned}
& C(F_{T_1(X_1)}(x_1), \dots, F_{T_n(X_n)}(x_n)) \\
&= P[U_1 \leq F_{T_1(X_1)}(x_1), \dots, U_n \leq F_{T_n(X_n)}(x_n)] \\
&= P[F_{T_1(X_1)}^{-1}(U_1) \leq x_1, \dots, F_{T_n(X_n)}^{-1}(U_n) \leq x_n] \\
&= P[T_1 \circ F_{X_1}^{-1}(U_1) \leq x_1, \dots, T_n \circ F_{X_n}^{-1}(U_n) \leq x_n] \\
&= P[T_1(X_1) \leq x_1, \dots, T_n(X_n) \leq x_n]
\end{aligned} \tag{4.16}$$

4.1.2.4 Bounds of Copulas

Fréchet–Hoeffding bounds apply to copulas since copulas are multivariate distribution functions; that is,

$$W = \max \left[\sum_{j=1}^m F_j - m + 1, 0 \right] \leq C(y_1, \dots, y_m) \leq \min[F_1, \dots, F_m] = M \tag{4.17}$$

The upper bound is itself a distribution function and hence a copula, thus denoted as C_U . If the lower bound is also a copula, then it is denoted as C_L . This leads to the Fréchet–Hoeffding bounds for copulas:

$$C_L(y_1, \dots, y_m) \leq C(y_1, \dots, y_m) \leq C_U(y_1, \dots, y_m) \tag{4.18}$$

4.1.3 Main Families of Copulas

4.1.3.1 Product Copulas (Independence Copula)

Random variables are independent if and only if their copula is the independence copula where it is defined as following:

$$\Pi(u) = \prod_{i=1}^d u_i \tag{4.19}$$

4.1.3.2 Implicit Copulas

Two copulas, namely Gaussian Copula and Student's t-copula, are derived using distribution functions. These two copulas will be introduced in this subsection.

Gaussian (Normal) Copula

The two-dimensional Gaussian copula takes the following form:

$$\begin{aligned} C(u_1, u_2; \theta) &= \Phi_G(\Phi^{-1}(u_1), \Phi^{-1}(u_2); \theta) \\ &= \int_{-\infty}^{\Phi^{-1}(u_1)} \int_{-\infty}^{\Phi^{-1}(u_2)} \frac{1}{2\pi(1-\theta^2)^{1/2}} \times \left\{ \frac{-(s^2 - 2\theta st + t^2)}{2(1-\theta^2)} \right\} ds dt \end{aligned} \quad (4.20)$$

where Φ is the cdf of the standard normal distribution, and $\Phi_G(u_1, u_2)$ is the standard bivariate normal distribution with correlation parameter θ restricted to the interval $(-1, 1)$. The normal copula attains the Fréchet lower and upper bound, respectively as the dependence parameter approaches -1 and 1 , The normal copula is flexible since it allows for equal degrees of positive and negative dependence and includes both Fréchet bounds in its permissible range.

Student's t-Copula

A bivariate t-distribution copula with two dependence parameters takes the following form:

$$C^t(u_1, u_2; \theta_1, \theta_2) = \int_{-\infty}^{t_{\theta_1}^{-1}(u_1)} \int_{-\infty}^{t_{\theta_2}^{-1}(u_2)} \frac{1}{2\pi(1-\theta_2^2)^{1/2}} \times \left\{ 1 + \frac{(s^2 - 2\theta st + t^2)}{(1-\theta_2^2)} \right\}^{-(\theta_1+2)/2} ds dt \quad (4.21)$$

Where $t_{\theta_1}^{-1}(u_1)$ denotes the inverse of the cdf of the standard univariate t distribution with ν the degrees of freedom. The two dependence parameters are θ_1 and θ_2 . The parameter θ_1 controls the heaviness of the tails.

4.1.3.3 Explicit Copulas

In contrast to the copulas derived from multivariate distributions, there are a number of copulas which can be stated directly and have a quite simple form. They typically fall in the class of Archimedean copulas, Archimedean copulas (Clayton, Frank and Gumbel) in the bivariate case will be introduced in this subsection.

Clayton Copula

The Clayton Copula takes the following form:

$$C(u_1, u_2; \theta) = (u_1^{-\theta} + u_2^{-\theta} - 1)^{-1/\theta} \quad (4.22)$$

with the dependence parameter θ restricted on the region $(0, \infty)$. As θ approaches zero, the marginals become independent. As θ approaches infinity, the copula attains the Fréchet upper bound, but lower bound is not in its permissible range. The Clayton copula cannot account for negative dependence. It exhibits strong left tail dependence and relatively weak right tail dependence making it a preferable tool to study correlated risks.

Frank Copula

The Frank Copula takes the following form:

$$C(u_1, u_2; \theta) = -\theta^{-1} \log \left\{ 1 + \frac{(e^{-\theta u_1} - 1)(e^{-\theta u_2} - 1)}{e^{-\theta} - 1} \right\} \quad (4.23)$$

The dependence parameter may take any real value $(-\infty, \infty)$. Values of $-\infty$, 0 , and ∞ correspond to the Fréchet lower bound, independence, and Fréchet upper bound, respectively. The Frank copula, unlike some other copulas, permits negative dependence between the marginals. Also, dependence is symmetric in both tails, similar to the Gaussian and Student-t copulas. Moreover, Fréchet bounds are included in the range of permissible dependence. Consequently, the Frank copula can, in theory, be used to

model outcomes with strong positive or negative dependence. However, since dependence in the tails of the Frank copula tends to be relatively weak compared to the Gaussian copula, and the strongest dependence is centered in the middle of the distribution, the Frank copula is most appropriate for data that exhibit weak tail dependence.

Gumbel Copula

The Gumbel Copula takes the following form:

$$C(u_1, u_2; \theta) = \exp\left(-\left(\tilde{u}_1^\theta + \tilde{u}_2^\theta\right)^{1/\theta}\right) \quad (4.24)$$

where;

$$\tilde{u}_j = -\log u_j \quad (4.25)$$

The dependence parameter is restricted to the interval $[1, \infty)$. Values of 1 and ∞ correspond to independence and the Fréchet upper bound, Fréchet lower bound is not permissible in the range if this copula. Similar to the Clayton copula, Gumbel does not allow negative dependence. Contrary to Clayton, Gumbel exhibits strong right tail dependence and relatively weak left tail dependence. Gumbel copula is an appropriate choice if outcomes are known to be strongly correlated at high values but less correlated at low values.

4.1.4 Estimation of Copulas

This subsection is mainly based on the texts from Cherubini, Luciano and Vecchiato [9].

As for most multivariate statistical models, much of the classical statistical inference theory is not applicable for a copula function. The only theory that can be applied is the asymptotic maximum likelihood estimation (MLE). In addition, there are other possible

ad hoc estimation methods that were proposed to get exact MLEs. These methods share, and also mix, concepts from non-parametric statistical inference and simulation techniques.

4.1.4.1 Maximum Likelihood Estimation

Recall the following representation:

$$f(x_1, x_2, \dots, x_n) = c(F_1(x_1), F_2(x_2), \dots, F_n(x_n)) \cdot \prod_{j=1}^n f_j(x_j) \quad (4.26)$$

where;

$$c(F_1(x_1), F_2(x_2), \dots, F_n(x_n)) = \frac{\partial^n (C(F_1(x_1), F_2(x_2), \dots, F_n(x_n)))}{\partial F_1(x_1) \partial F_2(x_2) \dots \partial F_n(x_n)} \quad (4.27)$$

is the n th mixed partial derivative of the copula C , c is the copula density and f is the standard univariate probability density function.

This representation for the multivariate density function permits to decompose the statistical modeling problem for copulas into two steps:

- 1) identification of the marginal distributions;
- 2) definition of the appropriate copula function.

Let $\mathfrak{X} = \{x_{1t}, x_{2t}, \dots, x_{nt}\}_{t=1}^T$ be the sample data matrix. Thus, the expression for the log-likelihood function is

$$l(\theta) = \sum_{t=1}^T \ln c(F_1(x_{1t}), F_2(x_{2t}), \dots, F_n(x_{nt})) + \sum_{t=1}^T \sum_{j=1}^n \ln f_j(x_{jt}) \quad (4.28)$$

where θ_0 is the set of all parameters of both the marginals and the copula. Hence, given a set of marginal pdfs and a copula the previous log-likelihood may be written, and by maximization we obtain the maximum likelihood estimator:

$$\hat{\theta}_{MLE} = \max_{\theta \in \Theta} l(\theta) \quad (4.29)$$

The maximum likelihood estimator is asymptotically Normal with the distribution:

$$\sqrt{T}(\hat{\theta}_{MLE} - \theta_0) \rightarrow N(0, \mathfrak{S}^{-1}(\theta_0)) \quad (4.30)$$

with $\mathfrak{S}^{-1}(\theta_0)$ the usual Fisher's information matrix and θ_0 the usual true value.

4.1.4.2 Inference of the Margins Method

Joe and Xu [20] proposed that these set of parameters should be estimated in two steps, this may be advantageous from the computationally intensive maximum likelihood method:

As a first step, margins' parameters θ_1 are extracted by performing the estimation of the univariate marginal distributions:

$$\hat{\theta}_1 = \text{ArgMax}_{\theta_1} \sum_{t=1}^T \sum_{j=1}^n \ln f_j(x_{jt}; \theta_1) \quad (4.31)$$

As a second step, given $\hat{\theta}_1$, the estimation of the copula parameter θ_2 is performed:

$$\hat{\theta}_2 = \text{ArgMax}_{\theta_2} \sum_{t=1}^T \ln c(F_1(x_{1t}), F_2(x_{2t}), \dots, F_n(x_{nt}); \theta_2, \hat{\theta}_1) \quad (4.32)$$

The IFM estimator is defined as the vector:

$$\hat{\theta}_{IFM} = (\hat{\theta}_1, \hat{\theta}_2)' \quad (4.33)$$

4.2 Concept of Dependence

There are several methods to measure dependence between random variables. In this part, three basic dependence measures, namely linear correlation and copula related dependence measures (rank correlation and tail dependence measure) will be introduced.

A measure of dependence summarizes the dependency structure of two random variables in a single number. Let $\delta(\cdot, \cdot)$ be a dependency measure which assigns a real number to any pair of real-valued random variables X and Y . Ideally, the following properties are desired for a measure of dependence:

- (1) $\delta(X,Y) = \delta(Y,X)$ (symmetry)
- (2) $-1 \leq \delta(X,Y) \leq 1$ (normalization)
- (3) $\delta(X,Y) = 1 \iff X, Y$ comonotonic;
 $\delta(X,Y) = -1 \iff X, Y$ countermonotonic.
- (4) For $T: \mathbb{R} \rightarrow \mathbb{R}$ strictly monotonic on the range of X :
 $\delta(T(X), Y) = \begin{cases} \delta(X, Y) & T \text{ increasing,} \\ -\delta(X, Y) & T \text{ decreasing.} \end{cases}$
- (5) $\delta(X,Y) = 0 \iff X, Y$ are independent.

Proposition: There is no dependency measure satisfying (4) and (5).

4.2.1 Measures of Dependence

4.2.2.1 Linear Correlation

The most common dependence measure is the *Pearson correlation coefficient* which is sensitive only to a linear relationship between two variables.

Given two rvs X_1 and X_2 , the linear correlation coefficient is defined as:

$$\rho(X_1, X_2) = \frac{\text{Cov}(X_1, X_2)}{\sqrt{\text{Var}(X_1)\text{Var}(X_2)}} \quad (4.34)$$

where Cov denotes covariance and Var denotes the variance.

Some remarks about *Pearson correlation coefficient* are listed below:

- It is defined only if both variances are nonzero and finite. Finite variance restriction may cause problems with heavy-tailed distributions.
- If X_1 and X_2 are independent, then $\rho(X_1, X_2) = 0$, but the converse is not true.
- The correlation coefficient takes values between -1 and 1.
- If $\rho(X_1, X_2) = 1$, then X_1 and X_2 have perfect positive dependence.
- If $\rho(X_1, X_2) = -1$, then X_1 and X_2 have perfect negative dependence.

Linear correlation fulfills properties of dependence measures numbered (1) and (2) only.

4.2.2.2 Rank Correlation

Consider two random variables X and Y with continuous distribution functions F_1 and F_2 respectively, and joint distribution function F . Two well-established measures of correlation are Spearman's rank correlation ("Spearman's rho"), defined as

$$\rho_s(X, Y) = \rho(F_1(X), F_2(Y)) \quad (4.35)$$

and Kendall's rank correlation ("Kendall's tau") defined as:

$$\rho_\tau(X, Y) = P((X_1 - X_2)(Y_1 - Y_2) > 0) - P((X_1 - X_2)(Y_1 - Y_2) < 0) \quad (4.36)$$

where (X_1, Y_1) and (X_2, Y_2) are two independent pairs of random variables from F . The first term on the right, $P((X_1 - X_2)(Y_1 - Y_2) > 0)$, is referred to as P (concordance), the second as P (discordance), and hence Kendall's tau is a measure of the relative difference between the two.

$$\rho_\tau(X, Y) = P(\text{concordance}) - P(\text{discordance}) \quad (4.37)$$

Spearman's rho is the linear correlation between $F_1(X)$ and $F_2(Y)$, which are integral transforms of X and Y . In this sense it is a measure of rank correlation. Both $\rho_s(X, Y)$ and $\rho_\tau(X, Y)$ are measures of monotonic dependence between (X, Y) . Both measures are based on the concept of concordance, which refers to the property that large values of one random variable are associated with large values of another, whereas discordance refers to large values of one being associated with small values of the other.

Theorem: Let X and Y be random variables with continuous distributions F_1 and F_2 , joint distribution F and copula C . The following are true:

$$\rho_s(X, Y) = \rho_s(Y, X), \rho_\tau(X, Y) = \rho_\tau(Y, X)$$

If X and Y are independent then,

$$\rho_s(X, Y) = \rho_\tau(X, Y) = 0$$

$$-1 \leq \rho_s(X, Y), \rho_\tau(X, Y) \leq +1$$

For $T : \mathfrak{R} \rightarrow \mathfrak{R}$ strictly monotonic on the range of X , both ρ_s and ρ_τ satisfy:

$$\rho_s(X, Y) = \rho_\tau(X, Y) = 1 \Leftrightarrow C = C_U \Leftrightarrow Y = T(X) \text{ a.s. with } T \text{ increasing.}$$

$$\rho_s(X, Y) = \rho_\tau(X, Y) = -1 \Leftrightarrow C = C_L \Leftrightarrow Y = T(X) \text{ a.s. with } T \text{ decreasing.}$$

4.2.2.3 Rank Correlation and Copulas

Both Spearman's rho and Kendall's tau can be expressed in terms of copulas as follows:

$$\begin{aligned} p_s(X,Y) &= 12 \int_0^1 \int_0^1 \{C(u_1, u_2) - u_1 u_2\} du_1 du_2 \\ p_\tau(X,Y) &= 4 \int_0^1 \int_0^1 C(u_1, u_2) dC(u_1, u_2) - 1 \end{aligned} \quad (4.38)$$

4.2.2.4 Tail Dependence

Definition: Let X_1 and X_2 be random variables with distribution functions F_1 and F_2 .

The coefficient of (upper) tail dependence of X_1 and X_2 is

$$\lambda_U = \lim_{\alpha \rightarrow 1^-} P(X_2 > F_2^{-1}(\alpha) | X_1 > F_1^{-1}(\alpha)) \quad (4.39)$$

provided a limit $\lambda \in [0,1]$ exists.

Analogously, the coefficient of lower tail dependence is:

$$\lambda_L = \lim_{\alpha \rightarrow 0^+} P(X_2 > F_2^{-1}(\alpha) | X_1 < F_1^{-1}(\alpha)) \quad (4.40)$$

If F_1 and F_2 are continuous dfs, then simple expressions for λ_L and λ_U in terms of the unique copula C of the bivariate distribution may be extracted. Then, the lower tail dependence is:

$$\lambda_L = \lim_{\alpha \rightarrow 0^+} \frac{P(X_2 > F_2^{-1}(\alpha) | X_1 < F_1^{-1}(\alpha))}{P(X_1 < F_1^{-1}(\alpha))} = \lim_{\alpha \rightarrow 0^+} \frac{C(\alpha, \alpha)}{\alpha} \quad (4.41)$$

The upper tail dependence is obtained as;

$$\lambda_U = \lim_{\alpha \rightarrow 1^-} \frac{\hat{C}(1-\alpha, 1-\alpha)}{1-\alpha} = \lim_{\alpha \rightarrow 0^+} \frac{\hat{C}(\alpha, \alpha)}{\alpha} \quad (4.42)$$

Where \hat{C} is the survival copula of C and defined as;

$$\bar{C}(u_1, u_2) = u_1 + u_2 - 1 + C(1 - u_1, 1 - u_2) = P(U_1 > u_1, U_1 > u_2) \quad (4.42)$$

For radially symmetric copulas $\lambda_L = \lambda_U$, since $C = \hat{C}$ for such copulas.

CHAPTER 5

ANALYSES

5.1 Data and Descriptive Statistics

The applications of this study have two main parts. First part examines the dependence between WTI prices and exchange rates and stock indices of 10 selected countries whereas the second part analyzes the dependence between WTI prices and Turkish market indicators, namely, TRY-US Dollar and TRY-Euro exchange rates as well as BIST-30, BIST-100 and selected sector indices. 10 countries are selected based on their economic development and export/import of oil.

Last settlement prices of NYMEX WTI futures, which are extracted from Bloomberg terminals, are used as the benchmark oil prices in this study. The reason behind this can be explained as following: NYMEX WTI futures contracts are actively traded, its prices are considered as the benchmark prices globally and quoted in US Dollars. Exchange rates and stock index values of the selected countries used in the cross-country analysis are also extracted from Bloomberg. For the second part of the study which is solely on Turkish financial market, daily indicative TRY-US Dollar and TRY-Euro exchange rates announced by the Central Bank of Turkey (CBRT) are used. Borsa Istanbul index values, which are daily last values, are acquired from Borsa Istanbul (BIST). All exchange rates in this study show price of the related currency in terms of US Dollars.

The missing days due to the official holidays of the markets are filled by taking the average of the nearest former and latter values. All series related to Turkish market data

include the period between January 5, 2005 and November 7, 2013 while series related to cross-country data include the period between January 10, 2005 and November 7, 2013.

For monthly analysis, monthly averages of the daily values are used for all of the data series. All analysis are based on the returns of the series, for this reason log returns are calculated for all daily and monthly values based on the former value.

5.1.1 Descriptive Statistics of the Cross-Country Data

Exchange rates in terms of US Dollars and the most indicative stock indices of 10 selected countries are used in this study. WTI returns, shown in Figure 5.1 and 5.2, give an idea of price movements in crude oil. As seen below, daily WTI prices are volatile in short terms periods compared to the monthly prices which are smoothed by taking average. Also, WTI prices have an upward movement, which is steeper between January 2007 and June 2008, and then it starts to decrease strongly related to the effect of the global financial turbulence.

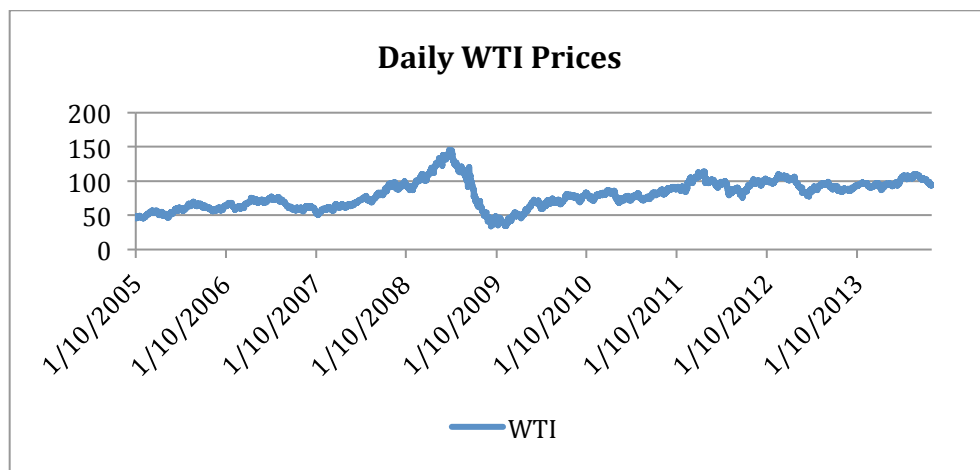


Figure 5.1: Daily WTI Prices

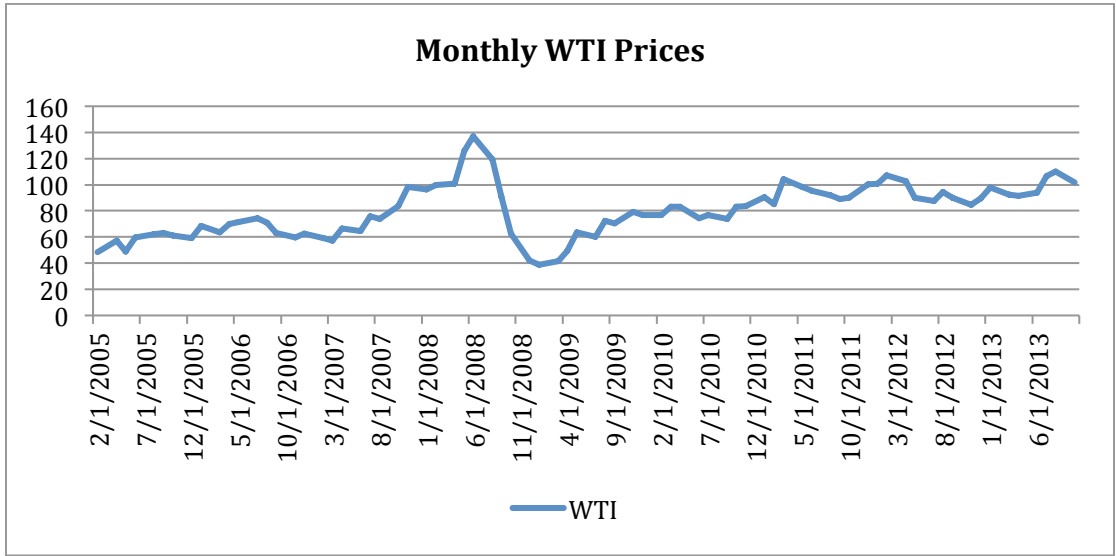


Figure 5.2: Daily WTI Prices

Time plots of the daily and monthly return series used in this study are given in Figures 5.3-5.10 below. Graphs of daily and monthly returns of exchange rate data given are followed by the graphs of daily and monthly returns of stock indices data.

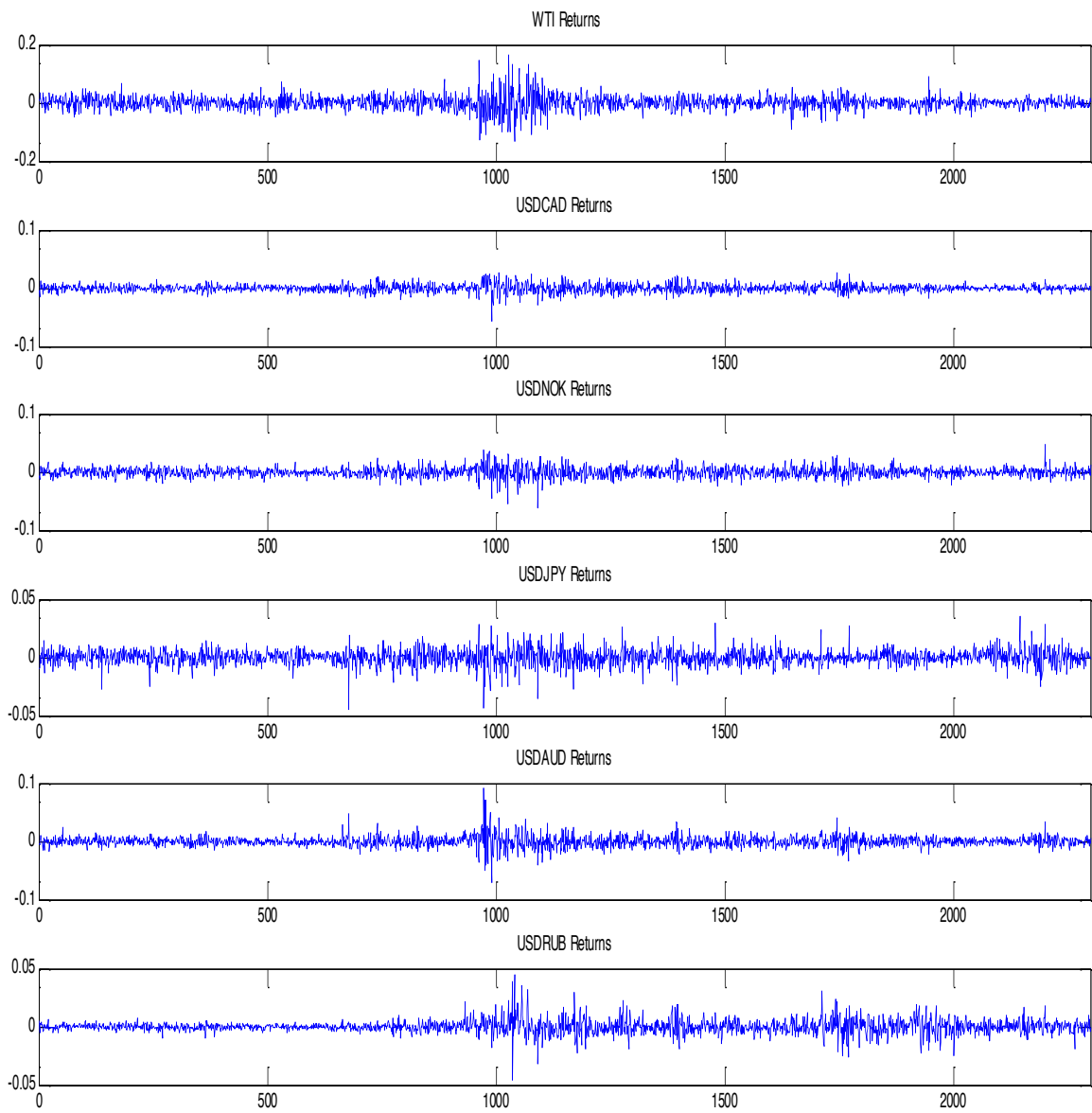


Figure 5.3: Daily Returns for Exchange Rates (1)

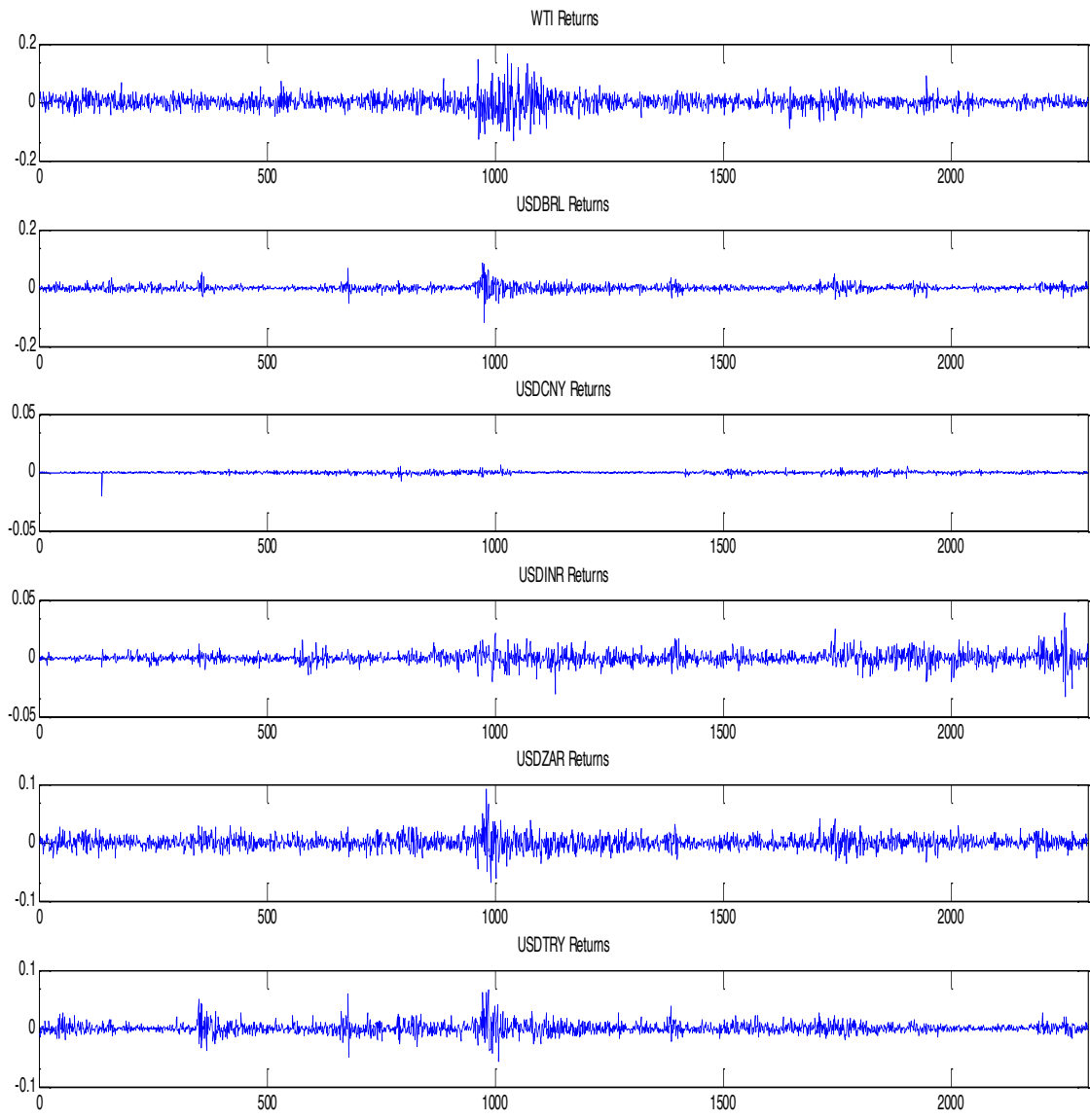


Figure 5.4: Daily Returns for Exchange Rates (2)

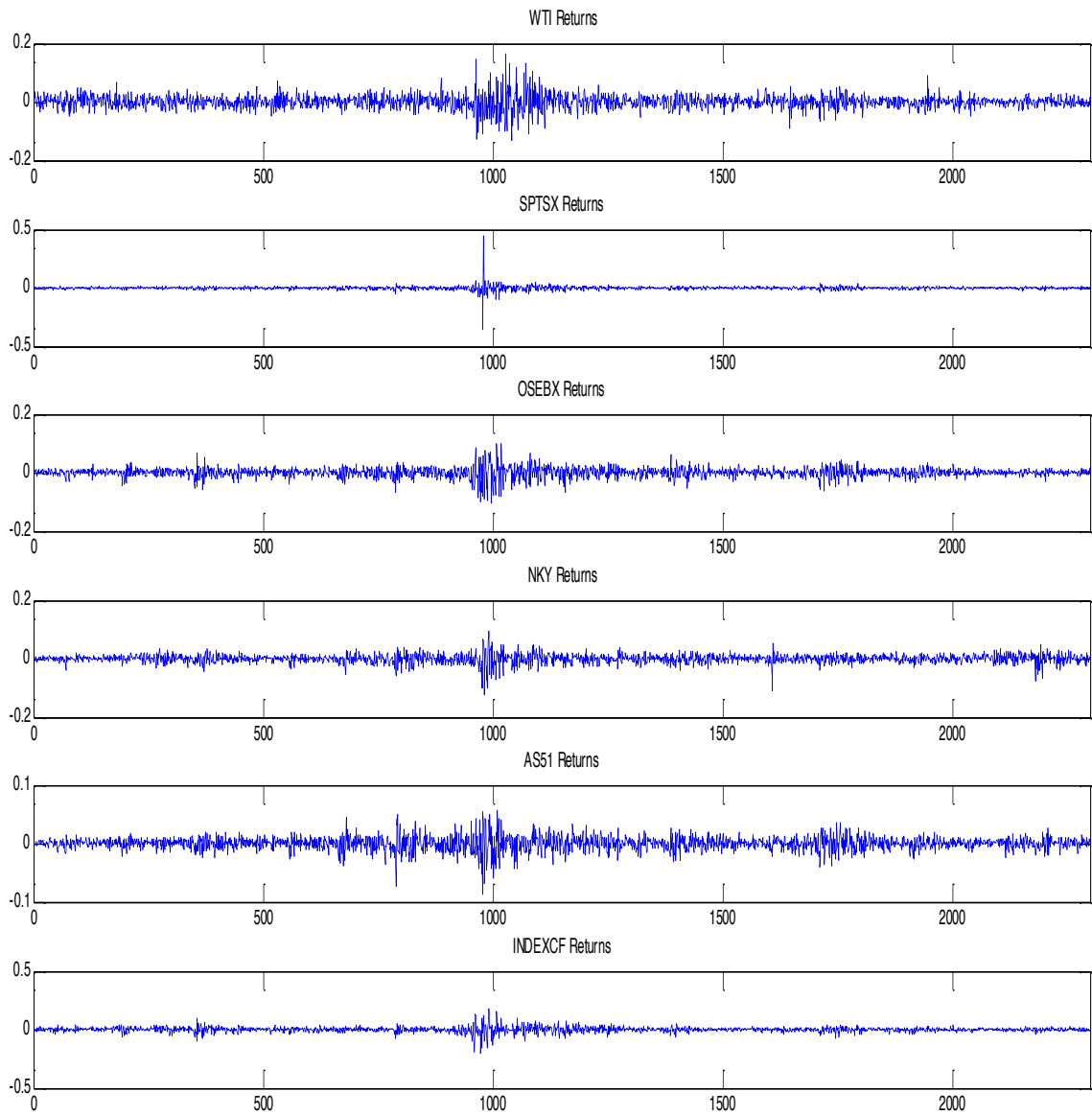


Figure 5.5: Daily Returns for Stock Market Indices (1)

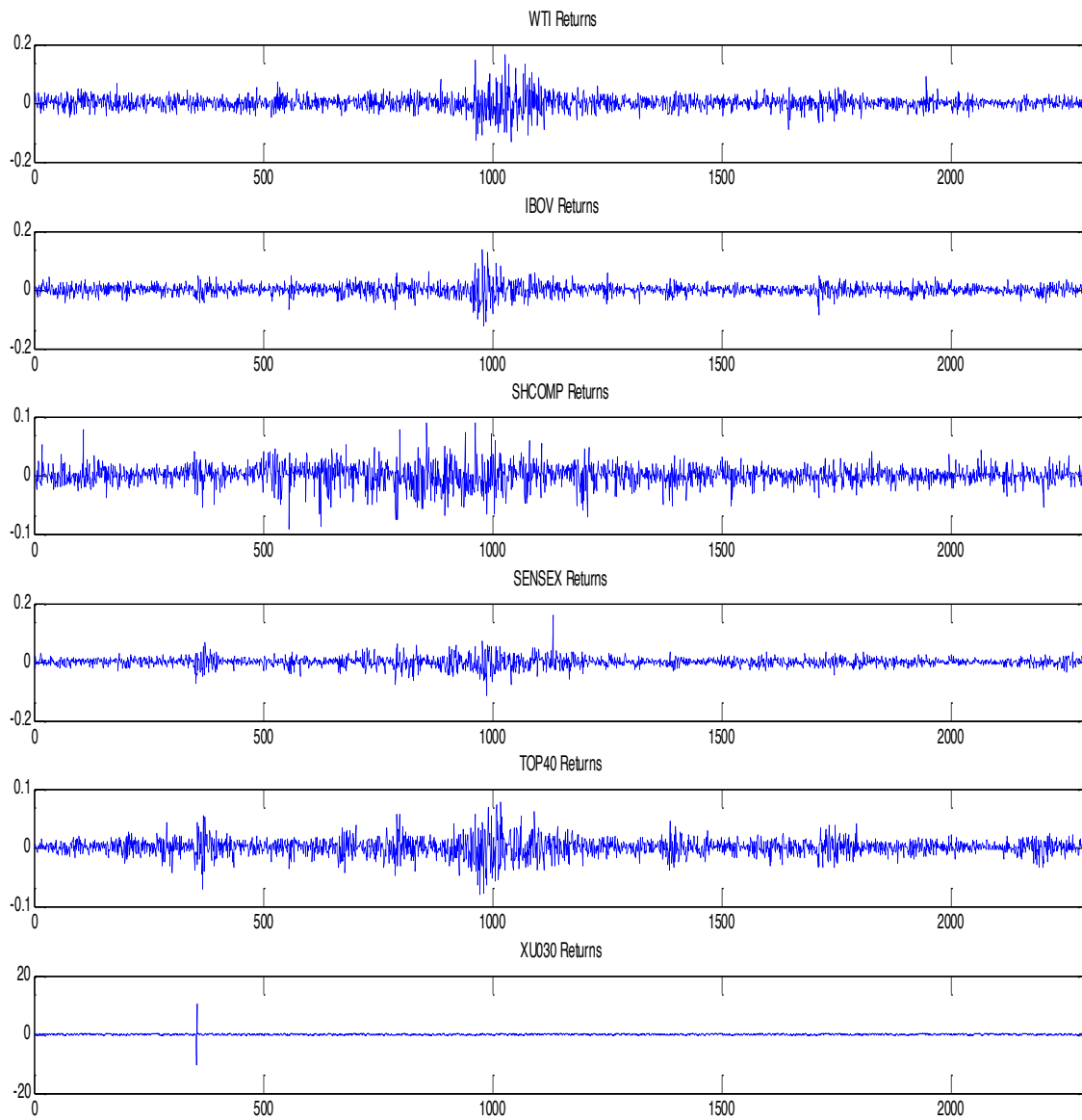


Figure 5.6: Daily Returns for Stock Market Indices (2)

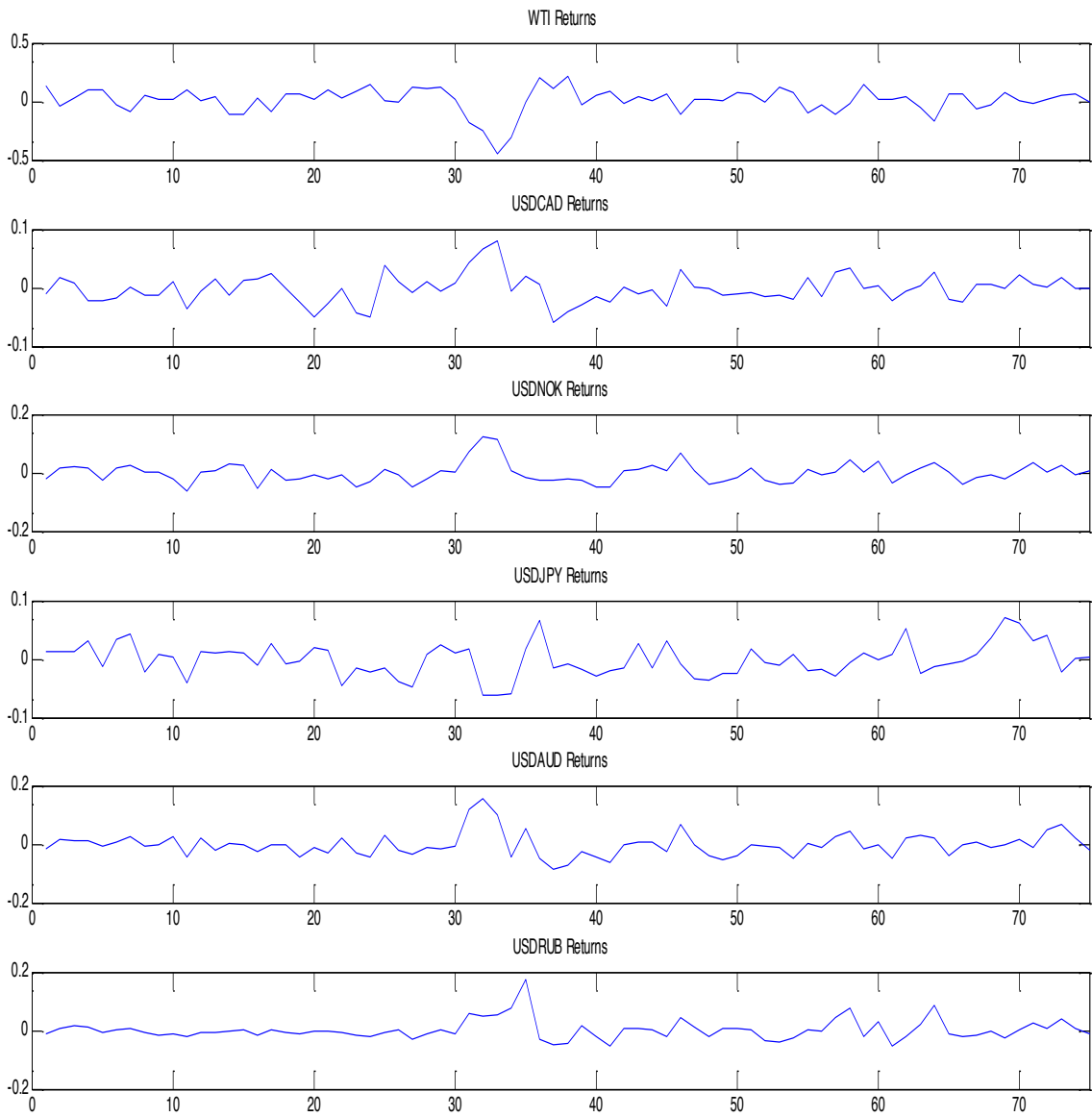


Figure 5.7: Monthly Returns for Exchange Rates (1)

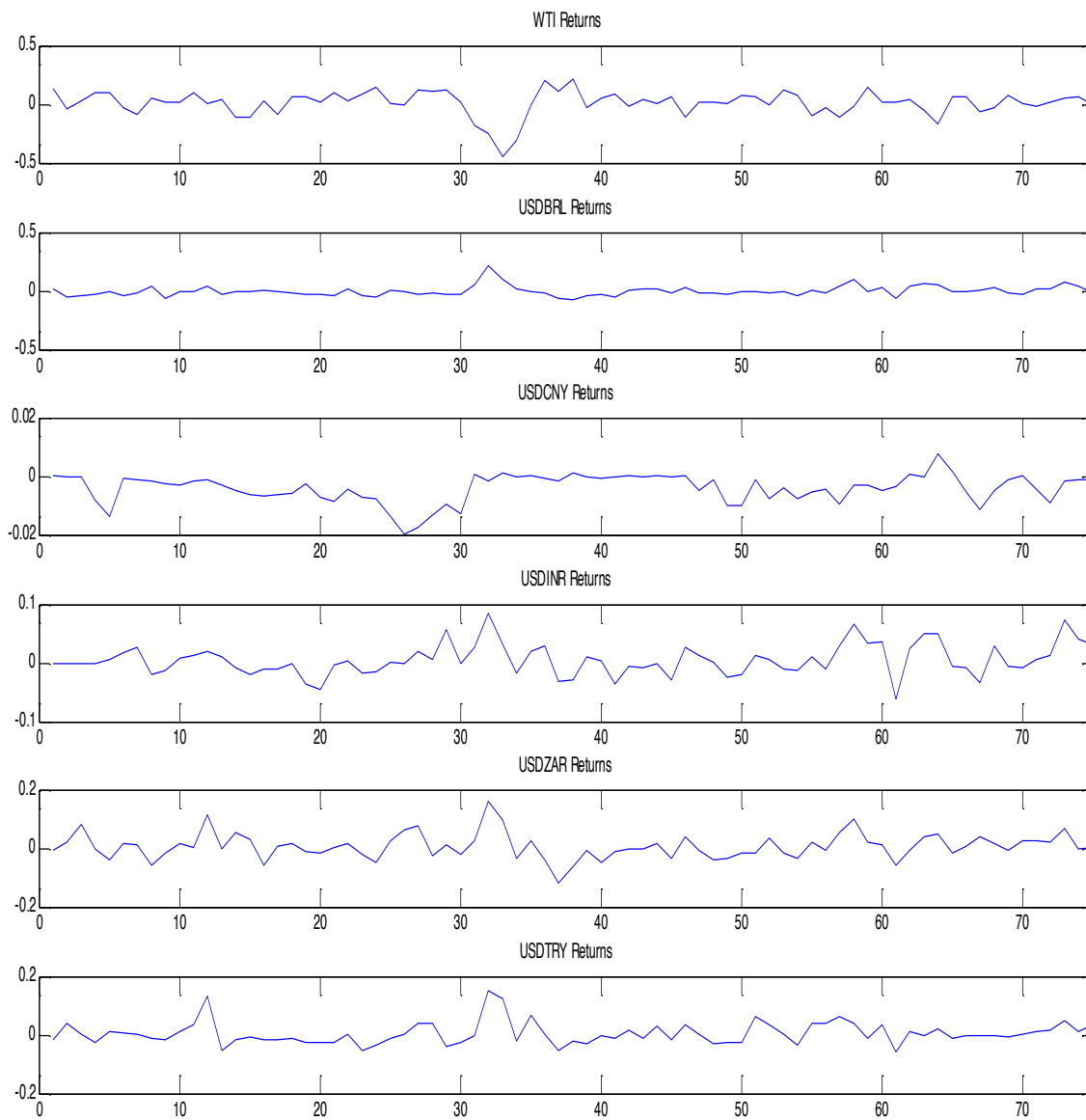


Figure 5.8: Monthly Returns for Exchange Rates (2)

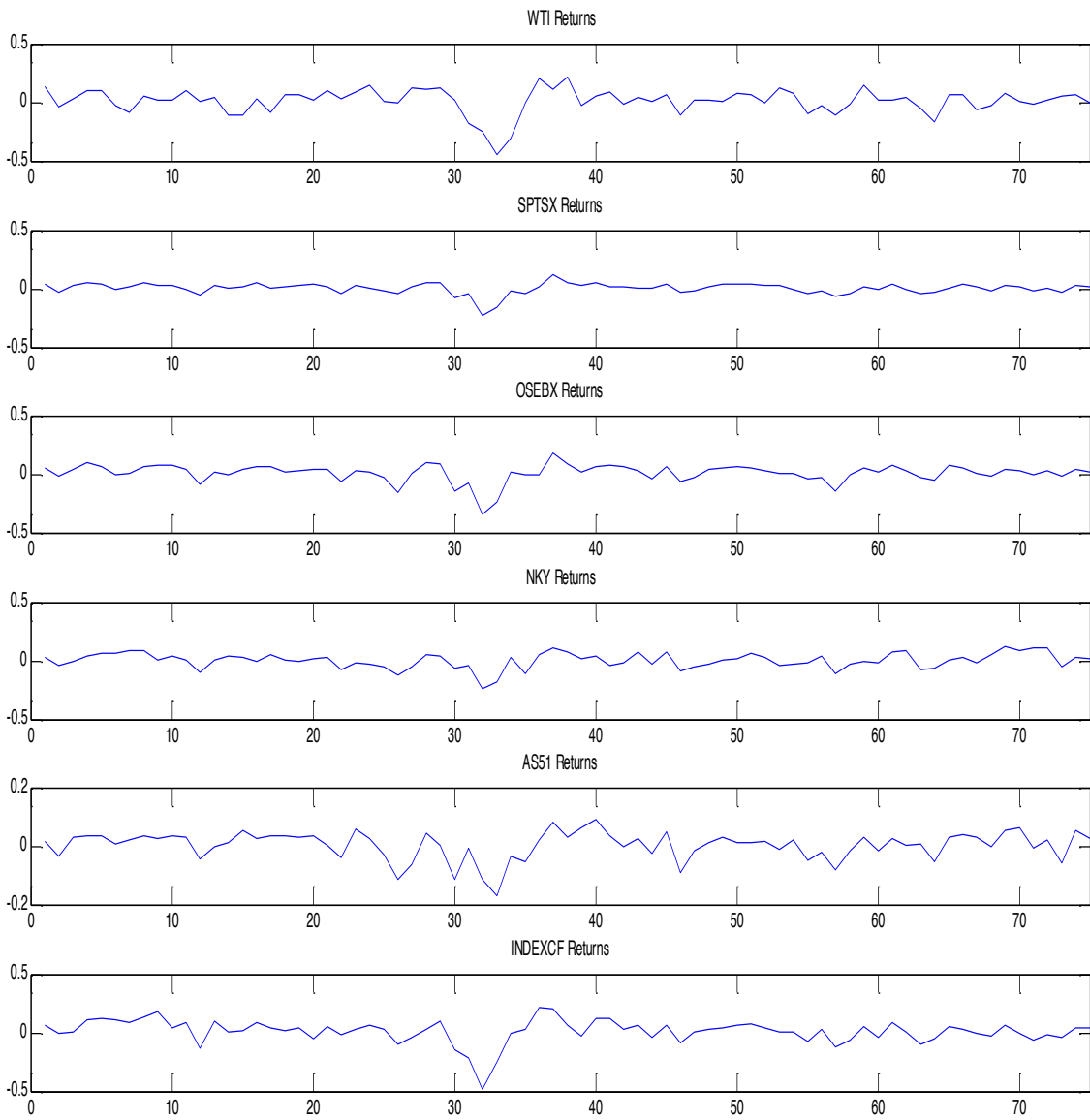


Figure 5.9: Monthly Returns for Stock Market Indices (1)

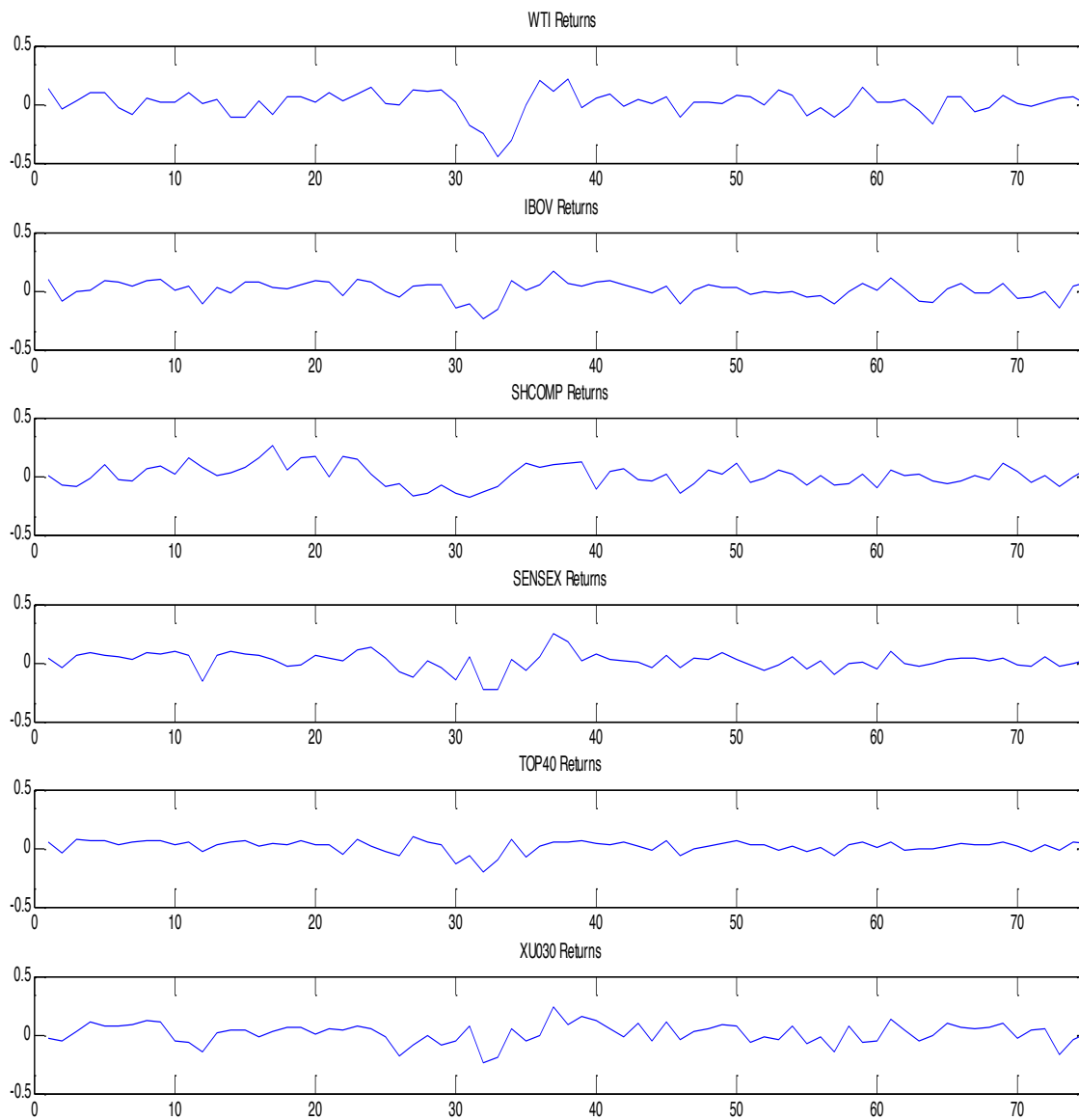


Figure 5.10: Monthly Returns for Stock Market Indices (2)

Table 5.2 shows the descriptive statistics of the return series belonging daily and monthly exchange rate data. The average returns are 0 for all of the daily series whereas means of monthly series are similar across markets. Corresponding standard deviations are larger for monthly series and also relatively high for WTI, Brazilian Real and South African Rand. Also, the standard deviations for Chinese Yuan and Indian Rupee are

small since the currency regime for the mentioned currencies are not free float. Negative values for skewness are not common to all exchange rates, and are less for monthly data. All returns showed extreme kurtosis, ranging from 3,05 to 10,2 for the monthly data where kurtosis of the daily returns are very close to 0. The null hypothesis of the Jarque Bera test, expressing the sample comes from a normal distribution, is rejected for all daily series and most of the monthly series.

Table 5.1: Descriptive Statistics of Daily&Monthly Exchange Rate Data

	DAILY										
	WTI	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
Min	-0,131	-0,058	-0,061	-0,045	-0,071	-0,046	-0,119	-0,020	-0,033	-0,069	-0,057
Max	0,164	0,028	0,047	0,035	0,091	0,044	0,085	0,006	0,039	0,092	0,065
Mean	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Median	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Std Dev	0,023	0,006	0,008	0,007	0,009	0,006	0,011	0,001	0,005	0,011	0,009
Skewness	0,108	-0,171	-0,094	-0,265	0,789	0,454	0,072	-3,386	0,260	0,321	0,756
Kurtosis	8,803	7,802	7,014	6,961	15,124	11,422	17,521	67,112	9,414	8,011	10,413
JB Test	1	1	1	1	1	1	1	1	1	1	1
	MONTHLY										
	WTI	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
Min	-0,452	-0,060	-0,063	-0,062	-0,086	-0,055	-0,079	-0,020	-0,061	-0,119	-0,058
Max	0,213	0,080	0,125	0,070	0,158	0,175	0,218	0,008	0,084	0,162	0,152
Mean	0,011	-0,002	-0,001	-0,001	-0,002	0,002	-0,002	-0,004	0,005	0,007	0,005
Median	0,021	-0,002	0,002	-0,003	-0,004	-0,003	-0,008	-0,003	0,000	0,001	-0,001
Std Dev	0,106	0,024	0,033	0,028	0,040	0,035	0,045	0,005	0,027	0,044	0,039
Skewness	-1,577	0,513	1,164	0,177	1,247	2,055	1,880	-0,917	0,498	0,606	1,447
Kurtosis	7,481	4,455	5,784	3,057	6,168	10,276	9,541	4,008	3,668	4,731	6,097
JB Test	1	1	1	0	1	1	1	1	0	1	1

Table 5.3 shows the descriptive statistics of the return series belonging daily and monthly stock indices data. The average returns are 0 for all of the daily series while they vary between 0,003 and 0,16 for monthly series. Standard deviations are relatively high for WTI and Russia and larger for monthly series compared to daily values. For monthly return series, left sided skewness is indicated for all of the series except Chinese Index and also it is valid for most of the daily series. The daily and monthly returns show extreme kurtosis, especially for Canadian and Turkish index. The kurtosis values are also higher for daily return series. The null hypothesis of the Jarque Bera test is rejected for all of the series except monthly Chinese and Turkish indices.

Table 5.2: Descriptive Statistics of Daily & Monthly Stock Indices Data

	DAILY										
	WTI	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
Min	-0,131	-0,358	-0,105	-0,121	-0,087	-0,207	-0,121	-0,093	-0,116	-0,080	-10,426
Max	0,164	0,451	0,101	0,095	0,056	0,178	0,137	0,090	0,160	0,077	10,340
Mean	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,001	0,000
Median	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
Std Dev	0,023	0,017	0,017	0,015	0,012	0,022	0,018	0,017	0,016	0,014	0,307
Skewness	0,108	3,771	-0,647	-0,894	-0,458	-0,619	-0,061	-0,295	0,073	-0,146	-0,420
Kurtosis	8,803	307,870	9,158	10,905	7,938	17,635	9,558	6,825	11,213	6,821	1141,535
JB Test	1	1	1	1	1	1	1	1	1	1	1
	MONTHLY										
	WTI	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
Min	-0,452	-0,224	-0,339	-0,235	-0,168	-0,481	-0,243	-0,179	-0,226	-0,201	-0,241
Max	0,213	0,124	0,176	0,125	0,091	0,216	0,166	0,259	0,248	0,099	0,242
Mean	0,011	0,004	0,010	0,003	0,003	0,012	0,010	0,007	0,015	0,016	0,013
Median	0,021	0,013	0,026	0,011	0,018	0,030	0,019	0,009	0,028	0,031	0,030
Std Dev	0,106	0,047	0,076	0,067	0,048	0,101	0,074	0,090	0,077	0,052	0,087
Skewness	-1,577	-1,898	-1,967	-0,830	-1,203	-1,789	-0,930	0,203	-0,573	-1,630	-0,527
Kurtosis	7,481	10,256	9,083	4,301	4,612	9,779	3,930	2,794	5,104	6,420	3,549
JB Test	1	1	1	1	1	1	1	0	1	1	0

5.1.2 Descriptive Statistics of the Turkish Financial Market Data

In the second part of the applications of this study Turkish market indicators are used. The dependence with WTI prices are investigated for TRY-US Dollar and TRY-Euro exchange rate, BIST-30, BIST-100 and sector indices. For the study, the sector indices of the markets of which oil is an important input are selected. Time plots of the daily and monthly return series used in analysis related to Turkish market and WTI prices are given in Figures 5.11-5.14.

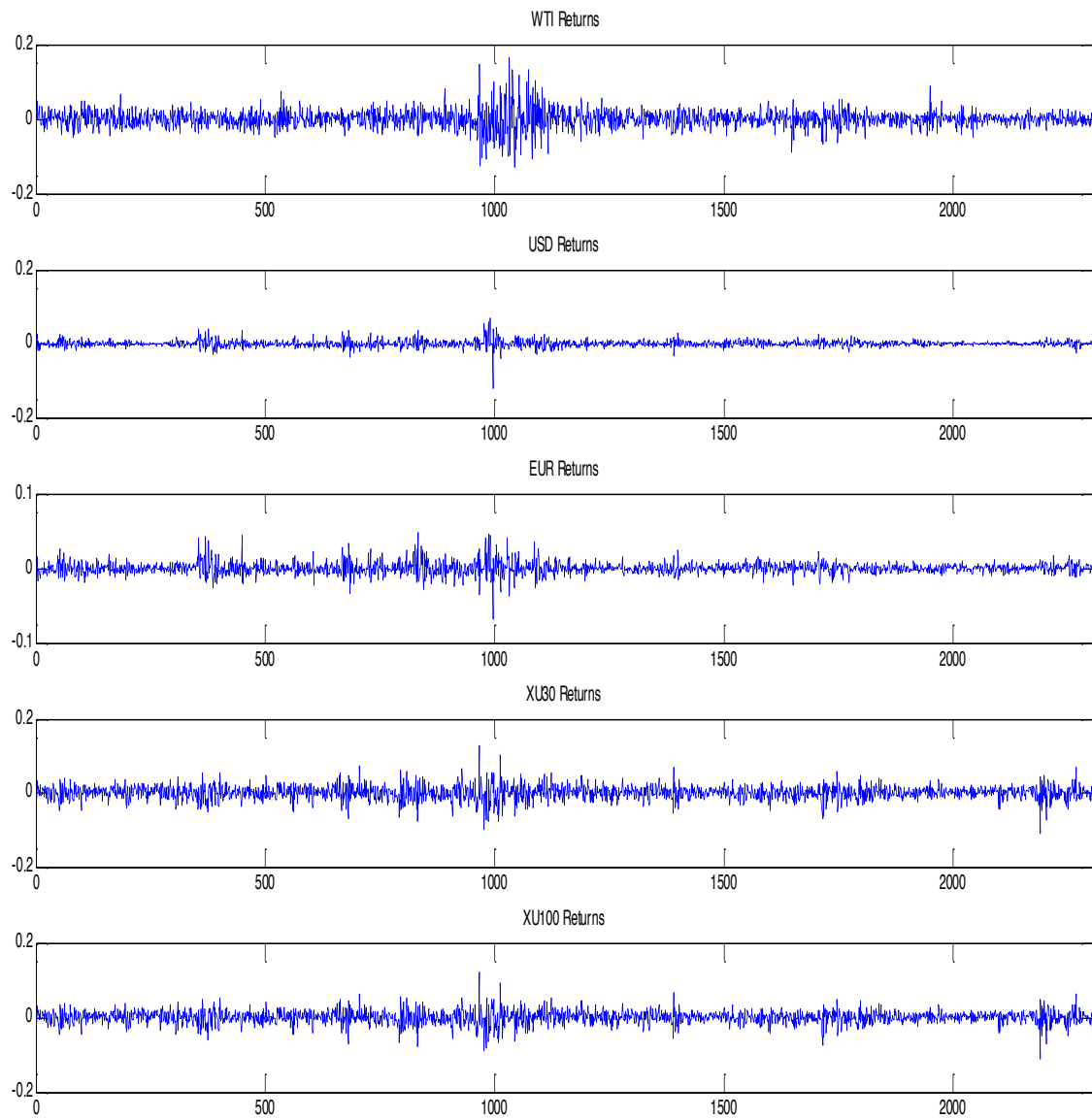


Figure 5.11: Daily Returns for Turkish Market Indicators (1)

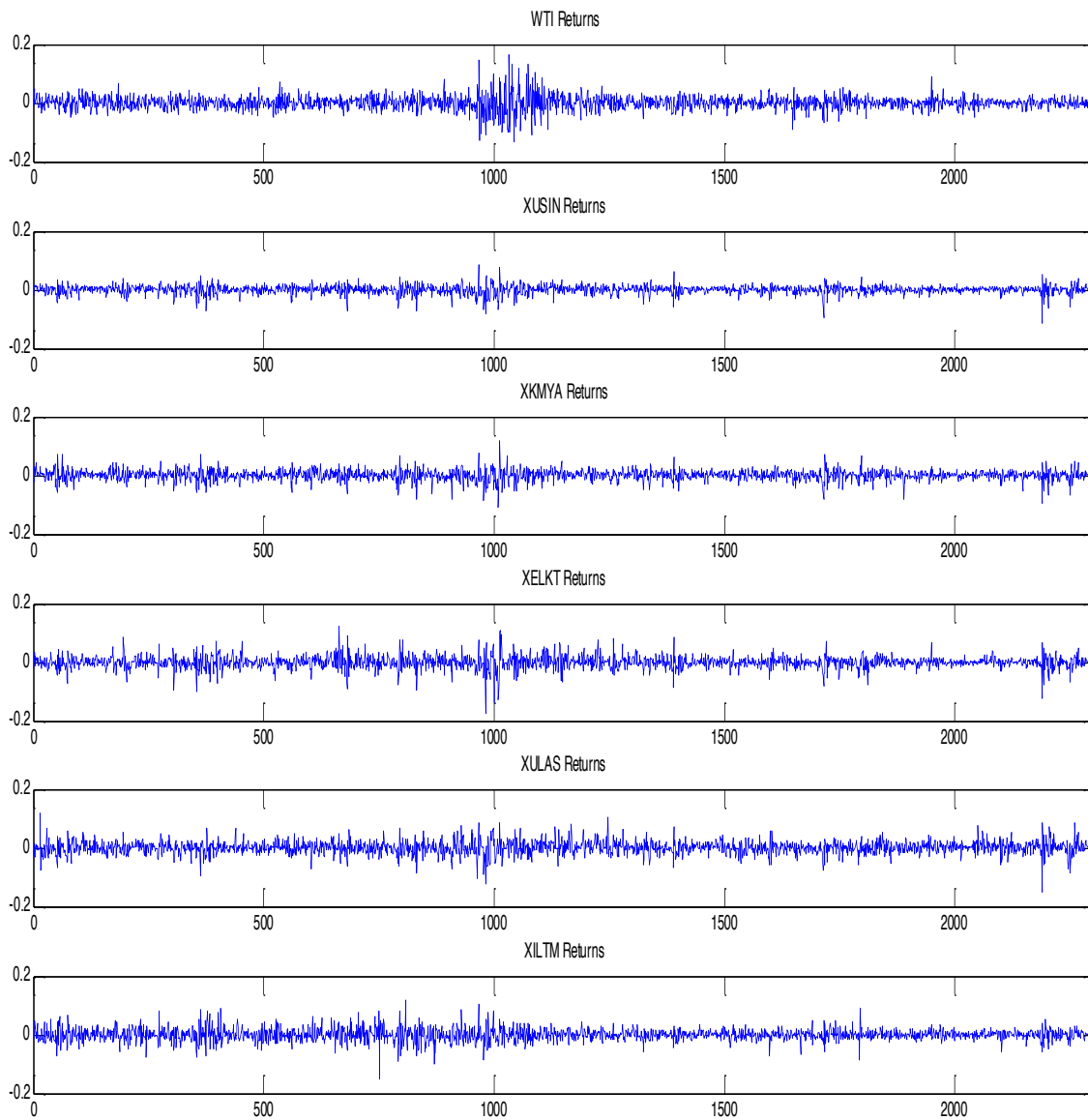


Figure 5.12: Daily Returns for Turkish Market Indicators (2)

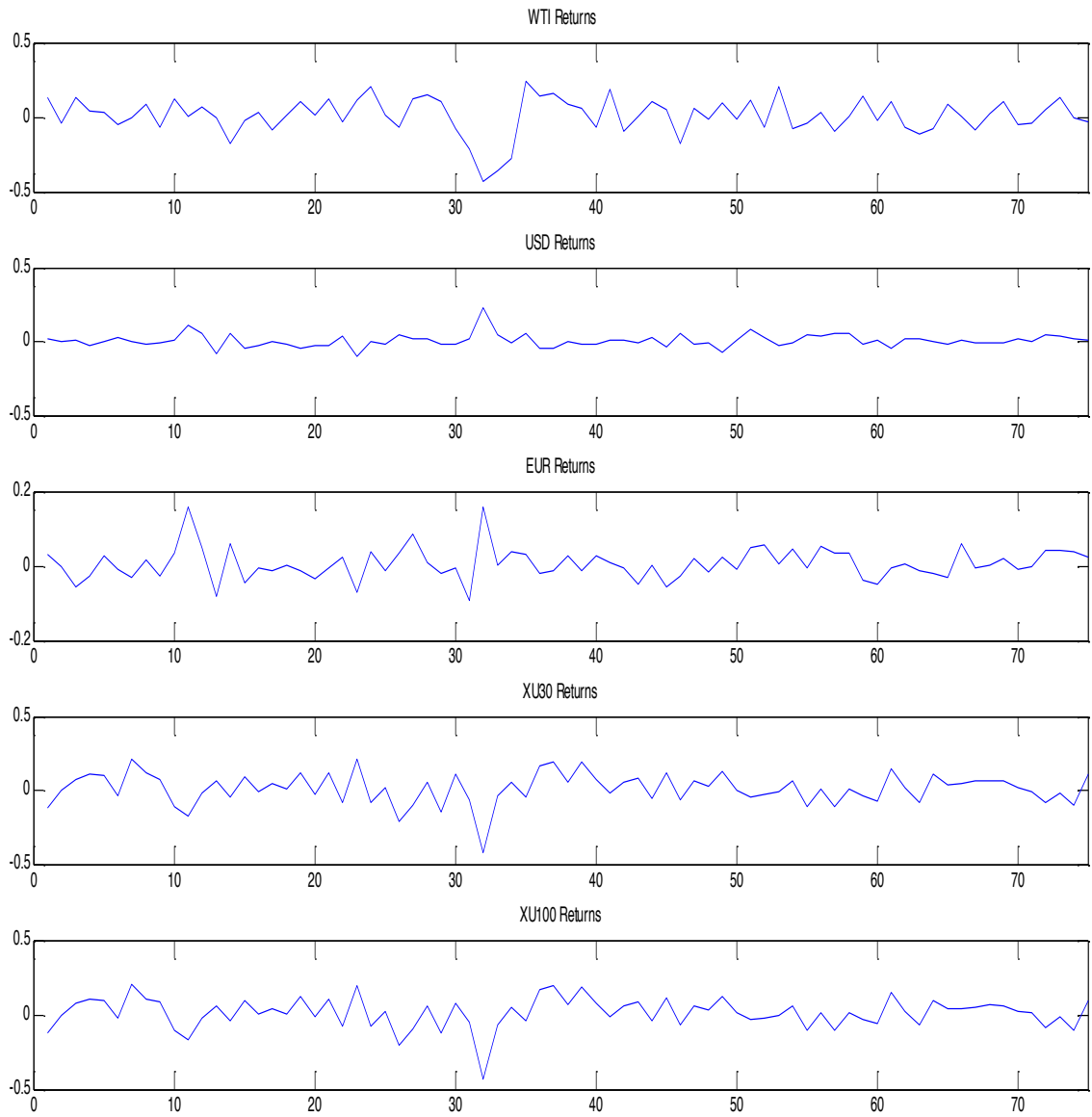


Figure 5.13: Monthly Returns for Turkish Market Indicators (1)

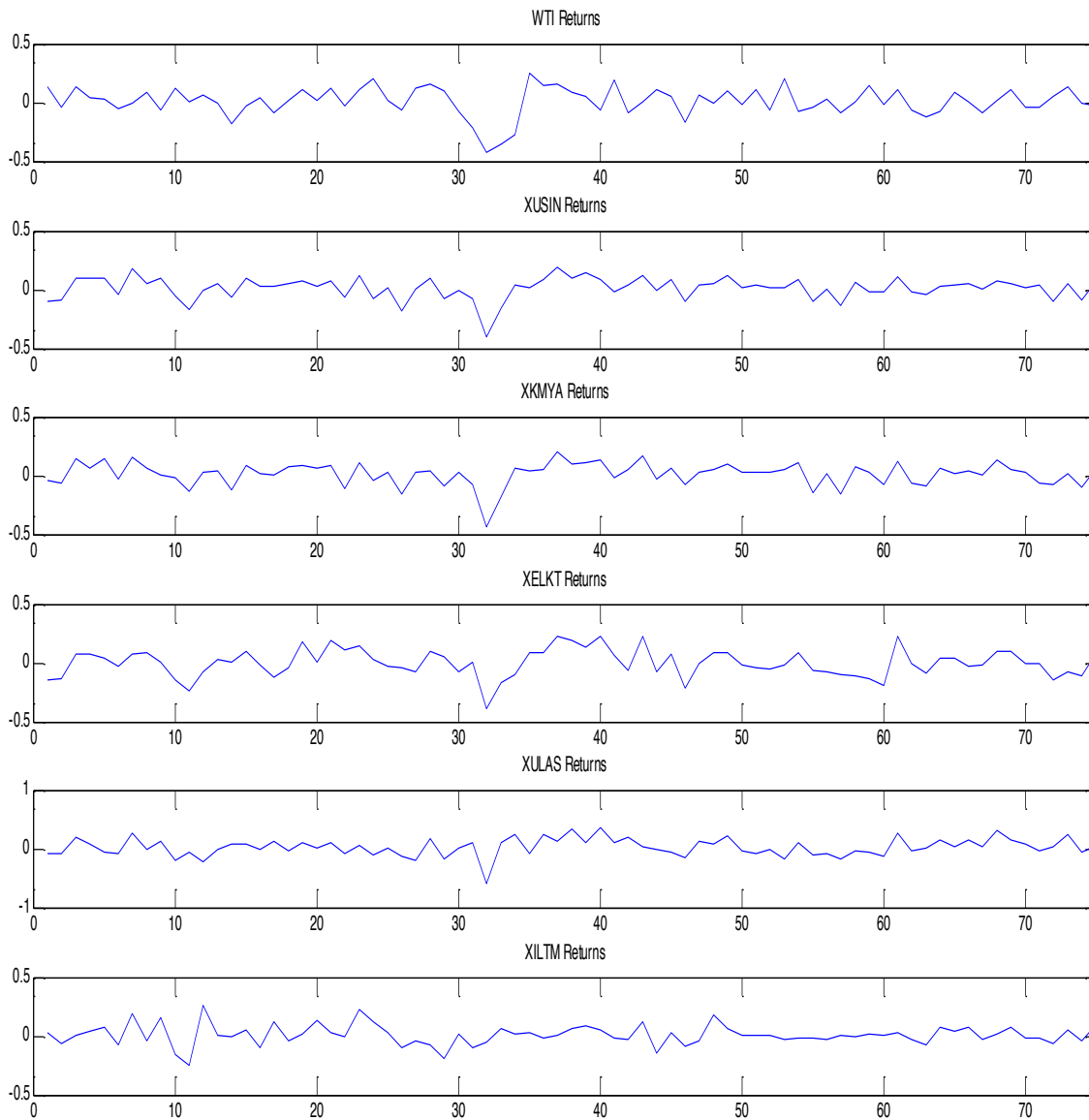


Figure 5.14: Monthly Returns for Turkish Market Indicators (2)

Table 5.5 shows the descriptive statistics of the return series belonging daily and monthly Turkish market data and WTI prices. The average returns are higher than daily returns which are almost 0 for all of the series. Monthly standard deviations are low and slightly higher than that of daily. The series are negatively skewed for all of the daily series except WTI prices and TRY-Euro exchange rate whereas there are some more

positively skewed monthly series. The kurtosis values of the daily series are between 6,2 and 24,3, being maximum for TRY-Euro exchange rate. The kurtosis values are slightly low for the monthly series. The null hypothesis of the Jarque Bera test is rejected for all of the series except monthly Electricity and Telecommunication indices.

Table 5.3: Descriptive Statistics of the Turkish Financial Market Data

	DAILY									
	WTI	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
Min	-0,131	-0,119	-0,068	-0,109	-0,111	-0,114	-0,107	-0,174	-0,152	-0,149
Max	0,164	0,070	0,048	0,127	0,121	0,084	0,120	0,123	0,119	0,119
Mean	0,000	0,000	0,000	0,000	0,000	0,001	0,001	0,000	0,001	0,000
Median	0,001	0,000	0,000	0,001	0,001	0,002	0,001	0,000	0,001	0,000
Std Dev	0,023	0,009	0,008	0,019	0,017	0,015	0,018	0,022	0,022	0,021
Skewness	0,114	-0,252	0,465	-0,180	-0,307	-0,947	-0,426	-0,420	-0,165	-0,006
Kurtosis	8,780	24,378	10,106	6,241	6,653	9,049	7,047	9,424	6,362	6,910
JB Test	1	1	1	1	1	1	1	1	1	1
	MONTHLY									
	WTI	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
Min	-0,430	-0,104	-0,092	-0,425	-0,428	-0,401	-0,434	-0,392	-0,602	-0,255
Max	0,245	0,225	0,160	0,213	0,206	0,189	0,201	0,229	0,354	0,265
Mean	0,010	0,006	0,006	0,013	0,013	0,014	0,014	0,000	0,027	0,010
Median	0,016	0,001	0,000	0,020	0,020	0,029	0,031	-0,004	0,018	0,005
Std Dev	0,121	0,045	0,043	0,105	0,102	0,093	0,099	0,118	0,155	0,088
Skewness	-1,003	1,489	0,870	-0,898	-1,027	-1,354	-1,386	-0,297	-0,574	0,130
Kurtosis	4,995	9,795	5,685	5,693	6,342	6,965	7,160	3,531	5,312	4,227
JB Test	1	1	1	1	1	1	1	0	1	0

5.2 Empirical Findings

This study aims to investigate the dependence structure between WTI prices and exchange rates/ stock indices for several countries as well as Turkey in a detailed context. Countries are selected based on the oil dependence of their economies. Also, both developed and developing countries are included in the study to grasp any difference on the mentioned dependence based on development of the countries. Oil dependence of the countries in this study captures both import and export dependence. Moreover, Turkish financial market indicators are analyzed demandingly regarding their

dependence with WTI prices by analyzing TRY-US Dollar and TRY-Euro exchange rates, BIST-30, BIST-100. Also, sector indices including Industrials, Chemistry and Petroleum, Electricity, Transportation and Telecommunication are included in the study to investigate how dependence values change among related sectors.

The study does not only analyze dependence on daily returns; in order to investigate how dependence differs from 1 day period to 30 days period, the study includes returns of 1 to 30 day averages. With the findings of this study, one can capture the movement of dependence of selected exchange rates and stock indices from 1 day to 30 days period day by day. Moreover, to capture how dependence differs, the study also investigates pre and post crisis periods separately. The pre and post crisis period are divided by the date on which the strict downside movement in the financial markets has started, namely, July 1, 2008. For this aim, the study includes modelling and filtering of 2700 series.

To measure dependence, several copula parameters and dependence measures are estimated based on the filtered return series. Firstly, the series, of which logarithmic returns are calculated using prices, are checked for the validity of white noise formation. The series that are not white noise are applied ARMA (AR, MA or ARMA) modelling by choosing the best lags for AR and MA parts. Then the series obtained after ARMA modeling are checked if their variances are white noise. The series that does not show white noise variance are then applied GARCH process by choosing the best ARCH and GARCH lags. Lastly, the filtered series are applied 5 different Copula analysis, namely Gaussian, Student's t, Clayton, Frank and Gumbel. Matlab R2012b code used in this study can be found in the Appendix section.

The findings of the analysis mentioned above will be given in two parts. First part will explain the cross-country findings whereas the findings related to Turkish market will be introduced in the second part.

5.2.1 Cross-Country Empirical Findings

This subsection includes empirical findings related to cross-country analysis. In the first part, findings related to exchange rates and in the second part, findings related to stock market indices are explained.

5.2.1.1 Exchange Rates

Dependence parameters of several copula models and correlation measures indicate that all of the currencies show dependence with WTI prices; moreover the direction of the dependence for exchange rates is negative given by all dependence parameters and correlation measures are all negative except for Japanese Yen. Also, the dependence increases in absolute terms from one day to 30 days for all of the currencies. Besides, the dependence parameters and correlation measures related the whole period are lower than the values of the post crisis period and higher than the values of pre-crisis period.

Gaussian Copula results related with the whole period are given in Appendix Table A.1.1. Results show that the selected currencies show dependence with WTI prices higher than %20 on the average. Except Japanese Yen, there exists negative dependence between currencies and WTI Prices. The highest dependence on average exists for Norwegian Krone (54%); it is followed by Canadian Dollar (50%). The third highest dependence is for Australian Dollar, followed by Russian Ruble, South African Rand and Brazilian Real. The lowest dependence is showed by Chinese Renminbi and Japanese Yen. The low dependence of Chinese Renminbi is considered as the result of the managed float regime of the currency. Looking at the 1 to 30 days of dependence results, it is seen that dependence of the currencies show positive change except Brazil. Also, percentage change is low for Brazil and Turkey, and takes very close numbers from 1 to 30 days. Percentage change from 1 day to 30 days is highest for China, from 5% to 12%. But in China case, this increase is seen from 1 day to 2 days and lasts similar to value for 2 days. It may be because the Chinese currency is operated by managed float and has daily trading limits. On the other hand, Chinese financial markets

operate in a complete different time zone from USA financial markets; this may also cause the high difference between values for 1 and 2 days.

Table A.1.2 shows the Student's-t Copula results for 2005-2013 period. Parallel to Gaussian Copula results, the direction of the dependence is negative excluding Japanese Yen. Also, t-Copula estimates higher dependence for all of the currencies except Japanese Yen, which stays same for both methods. The highest daily dependence belongs to Canadian Dollar whereas Norwegian Krone is found to have highest monthly dependence. Also, looking at the average values of 1-30 days, the highest dependence exists for Norwegian Krone (57%) and it is followed by Canadian Dollar (54%). The third highest dependence is for Russian Ruble, followed by Australian Dollar. This ranking does not show drastic change from Gaussian results. The results for Frank Copula, given in Table A.1.3, exhibits both negative and positive dependence. This comprehensive copula results are similar to Gaussian, not in values but in comparison of dependence values. Since Clayton and Gumbel Copula do not allow negative dependence, the results of these two copulas are 0 and 1, respectively except for Japanese Yen and the related tables for the results are not given for the exchange rates.

Table A.1.4, A.1.5, and A.1.6 shows the Pearson, Spearman and Kendall correlation measures for the selected exchange rates. It is seen that the Pearson correlation results are higher than Copula (both Gaussian Copula and t-Copula) results, especially for currencies showing less dependence with WTI prices while the Spearman correlation results are very close to Gaussian Copula results for most of the currencies. Kendall measure estimates significantly lower values than several Copula parameters and other correlation results for all of the currencies.

Dependence parameters of copula models and correlation measures included in this study indicate that most of the currencies show increase in the dependence with WTI prices from pre to post crisis period. Different from the 2005-2013 period, the direction of the dependence is all negative for all of the currencies including Japan in the pre-crisis period. Also, India does not show any dependence in the pre-crisis period.

The Gaussian Copula results for pre-crisis period, shown in the Table A.1.7, are significantly less than Copula results for 2005-2013 period, whereas moreover Gaussian Copula results for post-crisis period, given in the Table A.1.8, are significantly higher than Gaussian Copula results for pre-crisis period, these results are also higher than Gaussian Copula results and close to t-Copula results for 2005-2013 period. Japanese Yen shows negative dependence with WTI prices in the pre-crisis period while the dependence among Japanese Yen and WTI prices turns to positive and increases significantly in the post-crisis period. Comparing average of Gaussian copula dependence parameters for 1-30 days among pre-crisis and post-crisis period shows that dependence of selected currencies with WTI prices increased significantly in the post crisis period except Chinese Renminbi which has not changed at all.

Table A.1.9 represents The Student's t-Copula results for pre-crisis period. These results are found to be higher than Gaussian Copula results for the same period and lower than the Student's t- Copula results for 2005-2013 except for Norwegian Kroon and Japanese Yen. Student's t- Copula results for post-crisis period, which are given in the Table A.1.10, are higher than the Student's t- Copula results for 2005-2013 period except for Norwegian Krone, Australian Dollar and Chinese Rembinhi. Student's t- Copula dependence increases in the post-crisis period compared to pre-crisis period except for Norwegian Krone. The increase is mostly significant for India and Brazil. Also, Japanese Yen showing negative dependence in the pre-crisis period turns to have positive dependence in the post-crisis period.

The estimations of the correlation measures for exchange rates are given in the Table A.1.13-A.1.18. It is seen that Pearson correlation values are closer to Spearman correlation values and Kendall measures are lower for all of the periods. The summary of the results are given in the Table 5.6, which shows the 1-30 days average of dependence values. According the results, it can be said that for all of the methods, the dependence is highest in the post-crisis period followed by whole period and lastly pre-crisis period. Also, for 2005-2013 period and post-crisis period, the highest dependence is estimated by Pearson correlation followed by t-Copula which is the method that has

the highest values in the pre-crisis period by excluding Clayton, Frank and Gumbel from ranking.

Table 5.4: Summary of Estimations for Exchange Rates

ALL PERIOD										
	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
Gaussian	-0,50	-0,54	0,15	-0,47	-0,46	-0,32	-0,12	-0,20	-0,38	-0,29
Student's t	-0,54	-0,57	0,15	-0,51	-0,52	-0,36	-0,14	-0,24	-0,42	-0,32
Frank	-3,58	-3,88	0,74	-3,36	-3,57	-2,21	-0,65	-1,43	-2,58	-1,83
Pearson	-0,57	-0,60	0,23	-0,54	-0,49	-0,46	-0,16	-0,22	-0,43	-0,38
Spearman	-0,51	-0,52	0,11	-0,47	-0,52	-0,35	-0,13	-0,21	-0,38	-0,29
Kendall	-0,36	-0,37	0,08	-0,33	-0,37	-0,24	-0,09	-0,15	-0,27	-0,20
PRE CRISIS PERIOD										
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
Gaussian	-0,41	-0,54	-0,20	-0,38	-0,37	-0,12	-0,06	0,04	-0,32	-0,21
Student's t	-0,50	-0,61	-0,26	-0,47	-0,48	-0,16	-0,08	0,04	-0,40	-0,26
Frank	-3,04	-4,38	-1,42	-2,92	-3,29	-0,88	-0,48	0,25	-2,29	-1,44
Pearson	-0,42	-0,54	-0,17	-0,41	-0,37	-0,12	-0,15	0,05	-0,32	-0,18
Spearman	-0,43	-0,52	-0,19	-0,43	-0,40	-0,13	-0,16	0,04	-0,33	-0,22
Kendall	-0,29	-0,37	-0,13	-0,29	-0,29	-0,09	-0,11	0,02	-0,22	-0,15
POST CRISIS PERIOD										
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
Gaussian	-0,53	-0,47	0,31	-0,46	-0,45	-0,39	-0,11	-0,26	-0,42	-0,34
Student's t	-0,58	-0,51	0,35	-0,49	-0,53	-0,45	-0,11	-0,32	-0,46	-0,38
Frank	-4,07	-3,37	1,94	-3,30	-3,70	-2,83	-0,61	-1,96	-2,84	-2,18
Pearson	-0,62	-0,61	0,39	-0,57	-0,52	-0,53	-0,12	-0,28	-0,50	-0,45
Spearman	-0,56	-0,51	0,29	-0,49	-0,58	-0,46	-0,07	-0,31	-0,42	-0,33
Kendall	-0,41	-0,36	0,21	-0,35	-0,42	-0,32	-0,04	-0,22	-0,30	-0,23

Overall, the results show that the currencies show significant dependence with WTI prices. The currencies of oil exporter countries show the highest dependence followed by the countries of developing oil exporters. Also, the dependence of currencies of developing oil importer countries is seen to have the least dependence with WTI prices. Additionally, the increase from 1 day to 30 days in dependence is higher for countries with higher dependence. It is important to emphasize that the dependence values for China and India are restricted since these two countries apply managed floating exchange rate regime.

5.2.1.2 Stock Market Indices

All stock market indices are found to have significant positive dependence with WTI prices considering the dependence parameters and correlation measures. Furthermore, the direction of the dependence for all stock market indices is positive for all dependence parameters. Also, the dependence increases in absolute terms from one day to 30 days for most of the indices. By comparing whole period with pre-crisis and post-crisis periods, it is seen that the dependence is highest in the post-crisis period than whole period, followed by the pre-crisis period.

Gaussian Copula results related with the whole period are given in Table A.2.1 show that the selected indices show dependence with WTI prices higher varying between 14% and 50%. The highest dependence on average belongs to Norwegian index (50%) followed by Canadian (49%) and Russian index (47%). The lowest dependence is showed by Chinese index; Turkish Index has the second least dependence with 20% on the average. Additionally, the daily dependence of BIST-30 is 0,08, which is significantly lower than other values. Looking at the 1 to 30 days of dependence results, it is seen that dependence of indices increase day by day; this increase is very high especially for Australia, Turkey and Japan.

Table A.2.2 shows the Student's-t Copula results for 2005-2013 period. All results have positive values similar to Gaussian results; furthermore, the estimates are slightly higher than Gaussian results for all of the indices. The highest daily dependence is shown by Canadian index (47%) followed by Norwegian (40%). Also, looking at the average values of 1-30 days, the highest dependence is spotted for Canada and Norway (49%), followed by Russia (47%). The lowest dependence is seen for China and Turkey; thus, Gaussian and t-copula results show similar ranking among countries. Additionally, the results for Clayton, Frank and Gumbel Copula, shown in the Table A.2.3-A.2.5, exhibit similar ranking as Gaussian and t-copula.

The Pearson, Spearman and Kendall correlation measures for 2005-2013 period are shown in the Table A.2.6-A.2.8, respectively. It is seen that the Pearson correlation

results are higher than Copula (both Gaussian Copula and t-Copula) results for most of the series. Kendall measure estimates significantly lower values than several Copula parameters and other correlation results for all of the indices (parallel to results for exchange rates).

Analyzing parameters of pre and post-crisis periods show that dependence is higher in the post-crisis period than pre-crisis period. Also, pre-crisis results are lower than the parameters of 2005-2013 period. The direction of dependence is positive for all periods and all indices.

The Gaussian parameters estimated for pre and post crisis period are given in Table A.2.9 and Table A.2.10. Daily dependence in the post-crisis period is much higher than the Gaussian values of the pre-crisis period and the whole period. The increase is highest for Turkish index, which rises from 6% to 26% from pre to post crisis. The parameters of pre-crisis period, surprisingly, decrease from 1 day to 30 days for Japan, Australia, India and Turkey whereas in the post-crisis period, dependence values increase at minimum 23% (Turkey) and at maximum 51% (Russia). These values are gradually higher than the degree of increase in the 2005-2013 period.

Table A.2.11 and A.2.12 represent the pre and post crisis dependence parameters of t-Copula method. Based on t-copula results for selected periods, it can be said that the dependence increases from pre-crisis to post-crisis period significantly for all indices. Also, t-Copula parameters are higher than Gaussian Copula estimates of the related periods. The t-Copula results are also similar in terms of dependence ranking of the indices. In pre and post crisis period, the highest average dependence is for Norway with 46% and 56%, respectively; the lowest dependence belongs to China with 3% in the pre-crisis period, while in the post crisis period, the least dependence is shown by BIST-30. It is important to mention that based on t-Copula results Chinese stock market index shows no dependence with WTI prices in the pre-crisis period, but this dependence increases up to 32% after the crisis. Gaussian results are similar for China but the increase is less in the Gaussian case. Clayton, Frank and Gumbel Copula parameters,

shown in the Table A.2.13-A.2.18, also implies similar conclusions like Gaussian and t-Copula.

The estimations of the correlation measures for indices are given in the Table A.2.19-A.2.24. It is seen that Pearson correlation values are highest for most of the indices for all the periods and Kendall measures show the least dependence for all of the countries in these 3 periods. The summary of the results, showing the 1-30 days average of dependence values, are given in the Table 5.7. According to the results, the dependence is highest in the post-crisis period followed by whole period. Excluding Clayton, Frank and Gumbel from ranking, the Pearson gives the highest results in 2005-2013 period and post crisis period, it is followed by t-Copulas estimates in the in 2005-2013 period whereas Spearman values follow Pearson estimates in the post-crisis period.

Table 5.5: Summary of Estimations for Stock Market Indices

	ALL PERIOD									
	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
Gaussian	0,49	0,50	0,31	0,38	0,47	0,42	0,14	0,27	0,43	0,20
Student's t	0,54	0,54	0,34	0,40	0,52	0,47	0,18	0,29	0,46	0,22
Clayton	0,82	0,83	0,53	0,63	0,82	0,73	0,23	0,43	0,75	0,34
Frank	3,56	3,74	2,01	2,47	3,49	2,94	1,10	1,77	3,04	1,24
Gumbel	1,50	1,54	1,25	1,34	1,49	1,39	1,10	1,23	1,43	1,15
Pearson	0,57	0,58	0,39	0,46	0,55	0,48	0,18	0,36	0,44	0,25
Spearman	0,50	0,50	0,28	0,36	0,46	0,42	0,20	0,26	0,39	0,17
Kendall	0,35	0,36	0,19	0,25	0,32	0,30	0,14	0,18	0,28	0,11
	PRE CRISIS PERIOD									
	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
Gaussian	0,41	0,38	0,10	0,18	0,29	0,31	0,00	0,11	0,28	0,12
Student's t	0,50	0,46	0,13	0,24	0,38	0,40	0,03	0,14	0,36	0,16
Clayton	0,61	0,50	0,13	0,20	0,40	0,44	0,03	0,06	0,35	0,12
Frank	2,97	2,75	0,72	1,31	1,95	2,19	0,22	0,71	1,93	0,74
Gumbel	1,49	1,42	1,10	1,21	1,30	1,33	1,03	1,13	1,30	1,11
Pearson	0,41	0,37	0,10	0,18	0,27	0,33	-0,07	0,10	0,29	0,12
Spearman	0,41	0,38	0,10	0,20	0,26	0,32	-0,02	0,12	0,28	0,10
Kendall	0,28	0,26	0,08	0,14	0,17	0,21	-0,02	0,08	0,19	0,07
	POST CRISIS PERIOD									
	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
Gaussian	0,46	0,50	0,37	0,43	0,51	0,44	0,26	0,35	0,43	0,23
Student's t	0,51	0,56	0,41	0,45	0,57	0,49	0,32	0,39	0,48	0,26
Clayton	0,86	0,95	0,72	0,90	0,98	0,87	0,47	0,67	0,83	0,50
Frank	3,47	3,94	2,62	2,91	4,02	3,23	1,92	2,48	3,27	1,54
Gumbel	1,48	1,56	1,34	1,40	1,58	1,44	1,23	1,32	1,47	1,19
Pearson	0,61	0,65	0,48	0,57	0,62	0,53	0,34	0,48	0,50	0,33
Spearman	0,56	0,59	0,40	0,48	0,57	0,49	0,34	0,35	0,47	0,23
Kendall	0,41	0,44	0,28	0,34	0,42	0,35	0,24	0,26	0,35	0,16

In sum, it can be said that the stock indices of several countries show significant (positive) dependence with WTI prices. The relatively high dependence values belong to Canada, Norway, Australia, Brazil and Russia, showing that the indices of energy exporter countries have more dependence with WTI prices compared to energy importers. The dependence of indices of developing oil importer countries is seen to have the least dependence with WTI prices, especially it is very low for China.

Furthermore, as in the currency results, the increase from 1 day to 30 days in dependence is higher for countries with higher dependence. Additionally, the relative difference between dependence of developed exporter countries and developing exporter countries that is observed in the exchange rates seems to vanish for stock market indices.

5.2.2 Empirical Findings for Turkish Financial Market Indicators

The dependence parameters and correlation measures of Turkish financial market indicators included in this study are found to have dependence with WTI price except TRY/Euro exchange rate. All of the selected stock indices have positive dependence even if the some of the stock indices are indicators of sectors where prices of crude oil and oil products are an important cost factor. Both of the exchange rates included in the study are observed to have negative dependence with WTI prices. Furthermore, the dependence increases from one day to 30 days for most of the indices, this increase is significant especially for indicators that show high dependence with WTI prices. Analyzing the results related to 3 periods, it is seen that dependence increased from pre-crisis period to post-crisis period but does not change much from 200-2013 to post-crisis period for most of the series.

Gaussian Copula results for 2005-2013 period are represented in Table A.3.1. It is observed that the highest dependence on the average is shown by chemistry sector index (XKMYA) by 36%, followed by industrials index by 31% and electricity index by 27%. Also, close values among daily dependences draws interest as well as the low daily dependence shown by TRY-USD exchange rate (1%). (This dependence value is much lower than the value estimated in the cross-country analysis although there is a slight change of start date of the series. The cross-country analysis uses closing market values whereas the indicative CBRT rates are used in the Turkish market analysis. The difference is thought to be because of the use of different data and shows the poverty of indicative CBRT rates in daily analysis.)The monthly dependence of USD exchange rate reaches 31%, where Euro exchange rate stays as low as 4%. Similar to cross-country

results, it is seen that dependence of indices increase day by day; this increase is very high especially for USD, XKMYA and XELKT.

Student's-t Copula estimates for 2005-2013 are given in the Table A.3.2. All results are similar but slightly higher than Gaussian results for all of the series. The dependence of XKMYA is estimated as 40% representing the highest dependence. Euro exchange rate shows the least dependence by 2% based on average values. Estimates for XULAS turns to negative for some of the days and very close to 0, representing nearly no dependence. Additionally, the results for Clayton, Frank and Gumbel Copula, shown in the Table A.3.3-A.3.5, exhibit similar ranking as Gaussian and t-copula but one should keep in mind that Clayton and Gumbel does not allow negative dependence, thus, the estimates for exchange rates are not reliable.

Table A.3.6-A.3.8 shows the Pearson, Spearman and Kendall correlation measures for 2005-2013 period. It is seen that the Pearson correlation results are higher than estimates of other correlation measures where Kendall measures estimates are lower values than other measures including Gaussian and t-Copula. TRY-Euro exchange rate is estimated to have positive dependence based on correlation measures while Gaussian and t-copula shows negative dependence and Frank shows positive dependence for some of days and negative for others.

By analyzing parameters of pre and post-crisis periods, it is seen that dependence is lower in the pre-crisis period than post-crisis period for all of the series. Also, pre-crisis results are lower than the parameters of 2005-2013 period. The direction of dependence stays same in all periods for all of the series except Euro exchange rate which turns to positive in the pre-crisis period.

The Gaussian parameters estimated for pre and post crisis period are given in Table A.3.9 and A.3.10. Daily dependence increases from pre-crisis to post-crisis significantly for most of the series. The estimates related to post-crisis period are slightly higher than the results for 2005-2013 period. The dependence values estimated for XULAS and XITL are negative in the pre-crisis period with 9% and 11% respectively; but, the

dependence of these series turns to positive in the post-crisis period by 19% and 16% respectively. Also, the dependence of the series that show the highest dependence in 3 periods decrease from 36% to 34% after the crisis.

Table A.3.11 and A.3.12 represent the pre and post crisis dependence parameters of t-Copula method. Based on t-copula results for selected periods, it can be said that the dependence increases from pre-crisis to post-crisis period significantly for most of the series except Euro exchange rate and XMYA index. TRY-Euro exchange rate shows positive dependence by 10% in the pre-crisis period whereas it turns to negative and becomes 2% in the post-crisis period. Furthermore, the post-crisis values are slightly higher than the estimates for 2005-2013 period while the increase of the dependence is very high for XULAS and XILTM compared to the changes related to other series. Also, the t-copulas results are higher than Gaussian estimates excluding Euro series. By looking at Clayton, Frank and Gumbel Copula parameters shown in the Table A.3.13-A.3.18, it is seen that these models imply similar results but only Frank Copula is sufficient for both for positive and negative dependence.

The estimations of the correlation measures for indices are given in the Table A.3.19-A.3.24. It is seen that Kendall measures show the least dependence for all of the series in these 3 periods. And Pearson correlation values are strongly higher than other correlation measures for most of the indices for all the periods. The summary of the results, showing the 1-30 days average of dependence values, are given in the Table 5.8. According to the results, the dependence is highest in the post-crisis period followed by whole period. Excluding Clayton, Frank and Gumbel from ranking, the t-Copula estimates are the highest in the pre-crisis period. Pearson gives the highest results in 2005-2013 period and post crisis period.

To sum up, it can be said that the TRY-USD exchange rate and selected stock indices show significant dependence with WTI prices whereas the dependence is positive for indices and negative for exchange rates. The dependence is highest for Chemistry index, followed by Industrials index. The TRY-USD exchange rate has the third highest dependence while the transportation and telecommunication sector are observed to be

least dependent one among the series selected. BIST-30 and BIST-100 show about 20% dependence in 2005-2013 period; the dependence of BIST-30 and BIST-100 with WTI prices significantly increase from around 12% to 25%.

Table 5.6: Summary of Estimations for Turkish Market Indicators

	ALL PERIOD								
	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
Gaussian	-0,24	-0,01	0,21	0,22	0,31	0,36	0,27	0,08	0,03
Student's t	-0,27	0,02	0,23	0,25	0,35	0,40	0,30	0,07	0,04
Clayton	0,00	0,05	0,35	0,37	0,48	0,59	0,50	0,18	0,06
Frank	-1,55	0,13	1,28	1,40	2,06	2,43	1,70	0,35	0,20
Gumbel	1,00	1,01	1,16	1,17	1,27	1,32	1,19	1,06	1,03
Pearson	-0,34	-0,07	0,26	0,30	0,43	0,46	0,37	0,13	0,01
Spearman	-0,26	0,03	0,18	0,19	0,30	0,35	0,27	0,03	0,02
Kendall	-0,18	0,02	0,12	0,13	0,21	0,24	0,19	0,02	0,01
	PRE CRISIS PERIOD								
	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
Gaussian	-0,20	0,06	0,12	0,13	0,22	0,36	0,22	-0,09	-0,11
Student's t	-0,25	0,10	0,17	0,18	0,29	0,45	0,30	-0,12	-0,15
Clayton	0,00	0,09	0,12	0,12	0,28	0,56	0,33	0,01	0,01
Frank	-1,39	0,55	0,80	0,83	1,51	2,63	1,54	-0,74	-0,82
Gumbel	1,00	1,06	1,12	1,13	1,23	1,40	1,23	1,01	1,01
Pearson	-0,17	0,03	0,14	0,14	0,23	0,37	0,23	-0,09	-0,11
Spearman	-0,22	0,05	0,13	0,13	0,23	0,36	0,23	-0,09	-0,11
Kendall	-0,15	0,03	0,09	0,09	0,15	0,24	0,16	-0,06	-0,07
	POST CRISIS PERIOD								
	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
Gaussian	-0,29	-0,05	0,25	0,26	0,33	0,34	0,27	0,19	0,16
Student's t	-0,32	-0,02	0,27	0,29	0,37	0,38	0,31	0,20	0,19
Clayton	0,00	0,03	0,52	0,54	0,63	0,62	0,61	0,39	0,33
Frank	-1,80	-0,10	1,62	1,73	2,27	2,25	1,81	1,09	1,14
Gumbel	-1,80	-0,10	1,62	1,73	2,27	2,25	1,81	1,09	1,14
Pearson	-0,40	-0,13	0,34	0,38	0,53	0,50	0,42	0,26	0,11
Spearman	-0,28	0,01	0,23	0,26	0,37	0,36	0,31	0,15	0,14
Kendall	-0,20	0,01	0,16	0,18	0,26	0,25	0,21	0,10	0,10

5.2.3 Discussion

In order to investigate the dependence structure between WTI prices and exchange rates/ stock indices for several countries as well as Turkey in a detailed context, the dependence of several series are estimated by various methods including Gaussian Copula, t-Copula, Clayton, Frank and Gumbel Copula as well as Pearson, Spearman and Kendall correlation measures. For cross-country analysis, countries are selected based on the oil dependence of their economies and for Turkish market analysis, basic financial indicators were included as well as sector indices that is expected to have dependence with oil prices. The study examines not only daily and monthly dependences, but also the change of dependence from 1 day period to 30 days period. Moreover, captures how dependence differs from pre-crisis and post-crisis periods.

It is found that the currencies show significant dependence with WTI prices, this relation is also increasing strongly after the global crisis. The currencies of oil exporter countries show the highest dependence followed by the countries of developing oil exporters. Developing oil importer countries is seen to have the least dependence with WTI prices regarding their exchange rates against US Dollar. Also, the increase from 1 day to 30 days in dependence is higher for countries with higher dependence. Results in this study are parallel to the ones that Turhan et al. [34] found by VAR analysis that the selected emerging market countries (countries included in EMBI+) exchange rates were positively related with oil prices.

The analysis on stock indices of several countries shows significant (positive) dependence with WTI prices. The relatively high dependence values belong mostly to energy exporter countries such as Canada, Norway, Australia, Brazil and Russia. Developing oil importer countries is observed have the less dependence with WTI prices, especially it is very low for China. Like exchange rates, dependence of stock indices rises significantly after crisis. Findings of this study related to relation of crude oil prices with stock market indices are parallel to the findings of Zhu et al. [41] which states the dependence between crude oil prices and Asia-Pacific stock market returns

increased significantly after crisis. The findings of Reboredo [30] and Aloui [3] also support the findings related to cross-country stock market dependence analysis since they found that positive interdependence had been evident since global crisis. However, the results in this study contradicts with Chang's [7], Zhu et al. [41] and Reboredo [30] who found very low or no correlations between stock markets and crude oil prices. Furthermore, the findings of Filis et al. contradicts the result concluded in this study since Filis found that time-varying correlation does not differ for oil exporting and importing countries. Aloui et al. have concluded in their studies [3] and [4] that positive dependence exists between stock markets and oil prices especially for emerging markets. This finding supports the findings in this study.

Analyzing the dependence level difference between oil exporting and oil importing countries, one should consider the relatively high percentage of oil and energy industries in oil exporting countries. This high share in stock indices not only increases the dependence of the index with WTI prices, but also contributes to the dependence between crude oil prices and exchange rates by affecting capital flows from/to the stock markets.

In Turkish market, TRY-USD exchange rate and selected stock indices show significant dependence with WTI prices. The dependence is found to be positive for indices and negative for exchange rates. Also, it is observed that the dependence is highest for Chemistry index. It is followed by Industrials index in the second place and by TRY-USD exchange rate as the third one. The transportation and telecommunication sector are observed to be least dependent one among the series selected. Dependence of the most of the series is observed to increase in the post-crisis period. However, there is not detailed work on the dependence of Turkish market indicators with crude oil prices to compare findings.

By analyzing all the results, transportation sector is observed to be least dependent one among the series selected in Turkish market. This result is surprising since weight of the

transportation sector in oil import is high and crude oil prices are one of the important determinants of costs in transportation sector. Thus, the transportation sector is expected to have high negative dependence with WTI prices. It is also important to mention that transportation sector index is negatively dependent before the crisis while it turns to be positively dependent after the crisis. Hence, it can be said that the cost related effects of oil prices were taken into account for pricing the mentioned index in the pre-crisis period while in the post-crisis period, global demand and economic outlook had effect on pricing of transportation sector stocks.

For all of the markets and countries, there is increase in the dependence level from pre crisis to post crisis period. One should keep in mind that this structure is not unique to dependence with crude oil. There are several studies showing increase in dependence among financial instruments and financial markets. It is thought that in the crisis and post crisis period, the effect of market/instrument related conditions is decreasing while the effect of the overall expectation about economic and financial conditions is increasing.

Also, the increase from 1 day to 30 days is valid for most of the countries. The increase from 1 to 2 days in specific markets can be explained by the different time zones in financial markets but the increase in one month period reflects a delayed impact in the pricing mechanism.

5.2.4 Using Copulas in Value at Risk Assessments

Value-at-Risk (VaR), which can be defined as the change in value of a portfolio of financial assets as the minimum amount of money that one could expect to lose with a given probability over a specific time horizon, has become a key measure of market risk in the past decade. Moreover, it is one of the most widely used risk measures in the field of risk management. There are basically three methods to compute VaR, namely

historical simulation, the variance-covariance method and Monte Carlo (MC) simulation. While historical simulation is not based on particular assumptions as the behavior of the risk factors, the two other methods assume some kind of multivariate normal distribution of the risk factors. Therefore the dependence structure between different risk factors is described by the covariance or correlation between these factors meaning the multivariate normal assumption restricts the type of association between the (normal) margins to be linear. This restriction is not reasonable since linear association is not the only type of dependency which could be observed among financial series. Another pitfall is about the inadequacy of the VaR methodology to answer fat tail problem [22].

Copulas, as flexible tools to measure the dependence (linear and non-linear) between the multivariate random variables offer some solutions to the pitfalls mentioned above. As copulas measure not only linear but also non-linear dependence between variables, VaR estimates are expected to be improved by applying copulas. Also, copulas which are powerful tools to study tail dependence such as t-copula or Clayton, may offer improvements in VaR estimations by answering fat tail problem.

The high dependence parameters between crude oil prices and exchange rates and stock markets especially in oil-exporting countries found in this study suggests improvements in VaR estimations for portfolios including oil and currency or stocks. VaR calculations using copulas on portfolios including oil and currency or stocks for especially oil-importing countries can be suggested as the further study. Fitting copulas to daily returns and simulating from the fitted models may improve classic VaR estimations since the variables show high dependence and also high tail dependence. Comparing the effect of the choice of copula on risk measures can also be a good contribution to the literature.

CHAPTER 6

CONCLUSION

Oil prices have far reaching effects on the economy and financial markets since oil market is one of the most important markets in the world due to its crucial role of oil within economic activity. Oil prices may affect the price levels, current account balances, short, medium and long term equilibrium of exchange rates of an economy. Moreover, oil prices have impact on financial markets through expectations channel and capital flows.

Although most of the economies are expected to be affected by the changes of oil prices, the magnitude of the effects may change from country to country. Thus, oil-export and oil- import dependent countries are expected to be more open to impacts arising from changes in oil prices. Turkey, as a heavily oil importing country, is also expected to be affected by the changes in oil prices substantially.

This study aims to explore the dependence structure between crude oil prices and exchange rates and stock market indices of several countries as well as Turkish financial market indicators in a detailed context using Copula approach. Both developed/developing and oil exporter/importer countries are included in this in order to quest how dependence structure varies among countries. Moreover, dependence between Turkish financial market indicators and crude oil prices are examined including Industrials, Chemistry and Petroleum, Electricity, Transportation and Telecommunication sector indices to investigate how dependence values change among related sectors. The analysis in this study includes 1 to 30 day dependences for all of the

series taken into account in this study to capture the variation of dependence day by day. Last but not least, in order to grasp the effect of financial crisis on the dependence structure investigated in this study, the pre-crisis and post-crisis periods are investigated separately.

The methodology implemented in the study proposes the evaluation of the concerned variables in terms of their development in time by using time series methods and then, determine the dependency structure by using Copula approach. Different types of copula measures are taken into account to illustrate the level of the association, also compared with the Pearson correlation coefficient.

The study shows that currencies show significant dependence with WTI prices, this relation is also increasing strongly after the global crisis. The currencies of oil exporter countries are found to have the highest dependence followed by the countries of developing oil exporters where developing oil importer countries is found to have the least dependence. Also, there is a significant increase in dependence from 1 day to 30 days which is higher for countries with higher dependence.

It was contrived that stock market indices of several countries had significant (positive) dependence with WTI prices where higher dependence values belonged mostly to energy exporter countries. Parallel to findings related to exchange rates, developing oil importer countries that are observed, have the less dependence with WTI prices. The dependence of stock market indices, also rises significantly after crisis.

TRY-USD exchange rate and selected stock indices of Turkish financial market are observed to show significant dependence with WTI prices where the dependence is found to be positive for indices and negative for exchange rates. Moreover, it is found that the dependence of the most of the series increase in the post-crisis period.

The findings of this study will make major contribution on the literature since the study investigates the relation between crude oil prices and exchange rates/ stock market indices by Copula analysis for such a broad range of countries including both

developed/developing and oil exporter/importer ones. Furthermore, the 1-30 days dependence findings enlighten the change in the structure of relation in monthly period. As the first study to analyze relation between crude oil prices and financial market indicators in Turkey with Copula, the findings will contribute to the literature on economy and financial market of Turkey.

Findings of the study are expected to have important implications for monetary and fiscal policies as well as portfolio management and financial risk management. The findings will clarify the pressures on exchange rate and inflation originating from oil prices, stressing the difference for pre and post global crisis. Moreover, the role of crude oil as a financial instrument in asset allocation and risk management will be lightened for several financial markets while the findings will also improve the accuracy of risk estimates.

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APPENDIX A

ESTIMATED COPULA PARAMETERS & CORRELATION COEFFICIENTS

A.1 Exchange Rates Estimates

Table A.1.1: Gaussian Copula Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,42	-0,40	0,10	-0,41	-0,37	-0,31	-0,05	-0,18	-0,34	-0,26
2	-0,45	-0,45	0,11	-0,41	-0,43	-0,34	-0,11	-0,23	-0,36	-0,25
3	-0,49	-0,49	0,11	-0,43	-0,46	-0,33	-0,19	-0,24	-0,37	-0,25
4	-0,52	-0,53	0,12	-0,48	-0,47	-0,36	-0,15	-0,28	-0,40	-0,29
5	-0,50	-0,54	0,12	-0,44	-0,46	-0,35	-0,17	-0,22	-0,37	-0,28
6	-0,53	-0,56	0,12	-0,47	-0,49	-0,34	-0,14	-0,27	-0,39	-0,31
7	-0,53	-0,54	0,13	-0,42	-0,46	-0,32	-0,12	-0,21	-0,37	-0,29
8	-0,49	-0,53	0,14	-0,48	-0,43	-0,34	-0,07	-0,20	-0,41	-0,29
9	-0,53	-0,55	0,14	-0,43	-0,47	-0,36	-0,08	-0,21	-0,36	-0,29
10	-0,52	-0,54	0,11	-0,46	-0,51	-0,32	-0,07	-0,19	-0,40	-0,32
11	-0,51	-0,51	0,19	-0,48	-0,44	-0,37	-0,10	-0,17	-0,37	-0,28
12	-0,54	-0,50	0,17	-0,47	-0,44	-0,35	-0,08	-0,16	-0,39	-0,31
13	-0,48	-0,49	0,10	-0,44	-0,43	-0,33	-0,12	-0,22	-0,32	-0,26
14	-0,48	-0,50	0,16	-0,44	-0,45	-0,31	-0,13	-0,16	-0,35	-0,28
15	-0,50	-0,55	0,15	-0,48	-0,44	-0,36	-0,10	-0,25	-0,36	-0,26
16	-0,51	-0,58	0,10	-0,53	-0,55	-0,34	-0,11	-0,25	-0,41	-0,36
17	-0,50	-0,50	0,21	-0,47	-0,48	-0,28	-0,14	-0,15	-0,32	-0,27
18	-0,51	-0,58	0,16	-0,50	-0,50	-0,30	-0,06	-0,19	-0,38	-0,30
19	-0,52	-0,55	0,18	-0,47	-0,44	-0,31	-0,07	-0,21	-0,33	-0,28
20	-0,48	-0,55	0,17	-0,45	-0,44	-0,25	-0,06	-0,16	-0,33	-0,27
21	-0,52	-0,55	0,15	-0,51	-0,50	-0,29	-0,19	-0,24	-0,41	-0,30
22	-0,51	-0,54	0,17	-0,54	-0,48	-0,33	-0,13	-0,16	-0,35	-0,23
23	-0,50	-0,56	0,22	-0,49	-0,46	-0,35	-0,13	-0,16	-0,36	-0,23
24	-0,45	-0,58	0,19	-0,45	-0,45	-0,28	-0,20	-0,20	-0,38	-0,34
25	-0,45	-0,49	0,10	-0,44	-0,47	-0,25	-0,14	-0,08	-0,33	-0,24
26	-0,46	-0,55	0,19	-0,52	-0,45	-0,31	-0,11	-0,19	-0,41	-0,31
27	-0,55	-0,60	0,17	-0,52	-0,40	-0,32	-0,18	-0,19	-0,37	-0,35
28	-0,50	-0,57	0,18	-0,50	-0,53	-0,32	-0,20	-0,29	-0,48	-0,38
29	-0,56	-0,61	0,17	-0,52	-0,52	-0,34	-0,16	-0,22	-0,43	-0,30
30	-0,55	-0,59	0,12	-0,54	-0,45	-0,26	-0,12	-0,23	-0,44	-0,29
Av	-0,50	-0,54	0,15	-0,47	-0,46	-0,32	-0,12	-0,20	-0,38	-0,29
1-30 Δ	33%	48%	25%	30%	23%	-14%	140%	28%	30%	12%

Table A.1.2: Student's t-Copula Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,43	-0,41	0,09	-0,42	-0,38	-0,31	-0,05	-0,18	-0,34	-0,26
2	-0,48	-0,47	0,10	-0,43	-0,45	-0,35	-0,11	-0,25	-0,38	-0,27
3	-0,51	-0,51	0,11	-0,45	-0,48	-0,35	-0,20	-0,27	-0,39	-0,27
4	-0,54	-0,56	0,10	-0,50	-0,51	-0,38	-0,16	-0,31	-0,43	-0,32
5	-0,53	-0,56	0,11	-0,46	-0,50	-0,35	-0,18	-0,24	-0,39	-0,29
6	-0,57	-0,59	0,10	-0,50	-0,53	-0,36	-0,15	-0,29	-0,41	-0,33
7	-0,56	-0,56	0,09	-0,44	-0,49	-0,30	-0,13	-0,22	-0,38	-0,30
8	-0,54	-0,56	0,12	-0,50	-0,50	-0,37	-0,07	-0,23	-0,42	-0,29
9	-0,57	-0,58	0,13	-0,47	-0,54	-0,38	-0,09	-0,24	-0,39	-0,31
10	-0,55	-0,56	0,09	-0,50	-0,56	-0,35	-0,07	-0,21	-0,41	-0,32
11	-0,54	-0,55	0,21	-0,51	-0,48	-0,40	-0,11	-0,20	-0,39	-0,29
12	-0,58	-0,54	0,19	-0,51	-0,50	-0,38	-0,09	-0,20	-0,43	-0,34
13	-0,53	-0,53	0,10	-0,49	-0,48	-0,36	-0,12	-0,25	-0,36	-0,29
14	-0,52	-0,54	0,18	-0,47	-0,50	-0,35	-0,15	-0,19	-0,38	-0,30
15	-0,54	-0,60	0,17	-0,53	-0,50	-0,39	-0,11	-0,29	-0,41	-0,29
16	-0,55	-0,62	0,12	-0,58	-0,59	-0,39	-0,12	-0,30	-0,45	-0,41
17	-0,54	-0,55	0,22	-0,52	-0,55	-0,35	-0,16	-0,18	-0,37	-0,30
18	-0,56	-0,63	0,17	-0,55	-0,56	-0,32	-0,07	-0,23	-0,43	-0,32
19	-0,57	-0,60	0,22	-0,52	-0,49	-0,35	-0,08	-0,24	-0,39	-0,32
20	-0,51	-0,60	0,20	-0,47	-0,50	-0,28	-0,06	-0,19	-0,38	-0,29
21	-0,53	-0,60	0,16	-0,52	-0,54	-0,33	-0,21	-0,27	-0,46	-0,34
22	-0,55	-0,59	0,11	-0,59	-0,55	-0,39	-0,14	-0,20	-0,40	-0,27
23	-0,54	-0,61	0,26	-0,54	-0,55	-0,42	-0,15	-0,19	-0,42	-0,29
24	-0,49	-0,63	0,21	-0,50	-0,50	-0,33	-0,22	-0,27	-0,46	-0,39
25	-0,44	-0,53	0,02	-0,46	-0,53	-0,29	-0,16	-0,10	-0,38	-0,28
26	-0,52	-0,60	0,22	-0,57	-0,55	-0,36	-0,13	-0,22	-0,49	-0,36
27	-0,61	-0,65	0,17	-0,59	-0,46	-0,37	-0,21	-0,22	-0,44	-0,41
28	-0,55	-0,60	0,17	-0,52	-0,63	-0,38	-0,25	-0,34	-0,55	-0,43
29	-0,62	-0,66	0,12	-0,59	-0,59	-0,40	-0,16	-0,26	-0,50	-0,36
30	-0,62	-0,66	0,13	-0,61	-0,51	-0,32	-0,16	-0,28	-0,51	-0,35
Av	-0,54	-0,57	0,15	-0,51	-0,52	-0,36	-0,14	-0,24	-0,42	-0,32
1-30 Δ	45%	62%	49%	45%	36%	4%	192%	56%	48%	36%

Table A.1.3: Frank Copula Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-2,77	-2,62	0,50	-2,76	-2,34	-1,91	-0,35	-1,05	-2,16	-1,60
2	-3,19	-3,13	0,55	-2,77	-3,00	-2,15	-0,62	-1,52	-2,43	-1,63
3	-3,49	-3,44	0,58	-2,98	-3,23	-2,23	-1,09	-1,66	-2,46	-1,68
4	-3,73	-3,97	0,54	-3,37	-3,48	-2,36	-0,87	-1,95	-2,73	-2,01
5	-3,57	-3,88	0,53	-2,98	-3,36	-2,20	-0,98	-1,47	-2,44	-1,74
6	-4,02	-4,04	0,43	-3,34	-3,68	-2,25	-0,89	-1,79	-2,54	-1,96
7	-3,87	-3,75	0,41	-2,66	-3,26	-1,94	-0,70	-1,27	-2,28	-1,75
8	-3,78	-3,67	0,58	-3,39	-3,51	-2,34	-0,45	-1,41	-2,60	-1,71
9	-4,11	-3,88	0,58	-2,96	-3,77	-2,42	-0,45	-1,44	-2,39	-1,84
10	-3,91	-3,81	0,44	-3,28	-4,16	-2,18	-0,35	-1,24	-2,61	-2,01
11	-3,62	-3,60	0,98	-3,40	-3,20	-2,48	-0,54	-1,26	-2,33	-1,74
12	-4,05	-3,39	0,88	-3,36	-3,32	-2,31	-0,38	-1,24	-2,39	-1,84
13	-3,49	-3,39	0,50	-2,86	-3,24	-2,15	-0,54	-1,44	-1,99	-1,52
14	-3,32	-3,49	0,81	-2,91	-3,49	-2,31	-0,69	-1,26	-2,22	-1,68
15	-3,58	-3,83	0,80	-3,38	-3,41	-2,47	-0,54	-1,84	-2,48	-1,68
16	-3,68	-4,18	0,49	-3,93	-4,32	-2,51	-0,54	-1,86	-2,75	-2,18
17	-3,79	-3,56	1,22	-3,34	-3,96	-2,18	-0,73	-1,25	-2,35	-1,77
18	-3,56	-4,32	0,69	-3,63	-3,85	-2,01	-0,35	-1,52	-2,71	-1,85
19	-3,71	-3,95	1,10	-3,36	-3,40	-2,13	-0,46	-1,40	-2,38	-1,61
20	-3,32	-4,15	1,11	-3,03	-3,43	-1,88	-0,08	-1,35	-2,30	-1,63
21	-3,36	-3,97	0,84	-3,41	-3,75	-2,02	-0,98	-1,59	-2,58	-1,67
22	-3,70	-4,11	0,78	-4,11	-3,98	-2,54	-0,58	-1,39	-2,48	-1,62
23	-3,64	-4,08	1,32	-3,43	-3,92	-2,73	-0,55	-1,17	-2,75	-1,78
24	-3,04	-4,57	1,16	-3,34	-3,24	-2,16	-1,37	-1,61	-2,91	-2,42
25	-2,73	-3,47	0,19	-2,89	-3,78	-1,51	-0,58	-0,19	-2,28	-1,32
26	-2,95	-4,07	0,85	-3,87	-3,88	-2,20	-0,58	-1,39	-3,32	-1,98
27	-3,97	-4,74	0,98	-3,93	-3,17	-2,06	-0,92	-1,32	-2,78	-2,42
28	-3,58	-4,19	0,91	-3,69	-4,78	-2,31	-1,06	-1,87	-3,43	-2,64
29	-3,79	-4,41	0,81	-4,25	-4,18	-2,44	-0,88	-1,52	-3,04	-1,85
30	-4,16	-4,69	0,55	-4,19	-3,10	-1,88	-0,53	-1,58	-3,43	-1,87
Av	-3,58	-3,88	0,74	-3,36	-3,57	-2,21	-0,65	-1,43	-2,58	-1,83
1-30 Δ	50%	79%	11%	52%	33%	-2%	52%	50%	59%	17%

Table A.1.4: Pearson Coefficient Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,42	-0,41	0,11	-0,42	-0,35	-0,30	-0,04	-0,18	-0,35	-0,29
2	-0,45	-0,46	0,14	-0,42	-0,42	-0,35	-0,10	-0,20	-0,37	-0,27
3	-0,49	-0,51	0,14	-0,45	-0,44	-0,36	-0,16	-0,21	-0,38	-0,28
4	-0,50	-0,53	0,16	-0,47	-0,47	-0,38	-0,14	-0,22	-0,40	-0,30
5	-0,49	-0,54	0,15	-0,46	-0,46	-0,39	-0,14	-0,18	-0,39	-0,30
6	-0,54	-0,57	0,16	-0,49	-0,48	-0,40	-0,12	-0,20	-0,41	-0,34
7	-0,55	-0,56	0,20	-0,48	-0,46	-0,40	-0,12	-0,19	-0,41	-0,35
8	-0,51	-0,55	0,20	-0,51	-0,43	-0,40	-0,09	-0,19	-0,43	-0,35
9	-0,56	-0,59	0,21	-0,52	-0,47	-0,43	-0,12	-0,19	-0,42	-0,37
10	-0,57	-0,59	0,18	-0,52	-0,49	-0,42	-0,11	-0,22	-0,45	-0,40
11	-0,55	-0,57	0,22	-0,52	-0,46	-0,42	-0,14	-0,19	-0,41	-0,36
12	-0,57	-0,58	0,23	-0,54	-0,48	-0,44	-0,16	-0,20	-0,42	-0,37
13	-0,59	-0,59	0,24	-0,54	-0,48	-0,46	-0,17	-0,24	-0,43	-0,39
14	-0,57	-0,59	0,25	-0,53	-0,47	-0,43	-0,17	-0,21	-0,41	-0,38
15	-0,59	-0,62	0,24	-0,55	-0,47	-0,48	-0,16	-0,24	-0,44	-0,38
16	-0,60	-0,64	0,24	-0,59	-0,53	-0,46	-0,17	-0,26	-0,46	-0,42
17	-0,58	-0,60	0,26	-0,55	-0,50	-0,44	-0,15	-0,21	-0,41	-0,38
18	-0,57	-0,64	0,25	-0,56	-0,52	-0,48	-0,17	-0,24	-0,43	-0,39
19	-0,61	-0,63	0,25	-0,54	-0,51	-0,46	-0,15	-0,24	-0,42	-0,39
20	-0,61	-0,64	0,27	-0,56	-0,52	-0,45	-0,17	-0,21	-0,43	-0,40
21	-0,62	-0,64	0,27	-0,57	-0,53	-0,49	-0,21	-0,27	-0,46	-0,41
22	-0,61	-0,63	0,27	-0,58	-0,52	-0,50	-0,20	-0,23	-0,43	-0,36
23	-0,61	-0,64	0,30	-0,58	-0,52	-0,53	-0,18	-0,23	-0,44	-0,40
24	-0,61	-0,67	0,30	-0,61	-0,56	-0,52	-0,23	-0,27	-0,46	-0,44
25	-0,60	-0,64	0,28	-0,56	-0,52	-0,53	-0,20	-0,22	-0,45	-0,41
26	-0,62	-0,65	0,29	-0,58	-0,53	-0,52	-0,20	-0,25	-0,47	-0,42
27	-0,65	-0,68	0,31	-0,60	-0,55	-0,55	-0,20	-0,24	-0,47	-0,45
28	-0,67	-0,69	0,28	-0,63	-0,55	-0,57	-0,23	-0,29	-0,54	-0,48
29	-0,66	-0,68	0,31	-0,60	-0,55	-0,56	-0,22	-0,26	-0,50	-0,43
30	-0,65	-0,70	0,30	-0,60	-0,58	-0,55	-0,21	-0,26	-0,50	-0,44
Av	-0,57	-0,60	0,23	-0,54	-0,49	-0,46	-0,16	-0,22	-0,43	-0,38
1-30 Δ	57%	71%	164%	44%	66%	80%	364%	45%	44%	50%

Table A.1.5: Spearman Coefficient Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,39	-0,37	0,07	-0,39	-0,35	-0,28	-0,06	-0,16	-0,31	-0,24
2	-0,44	-0,45	0,08	-0,39	-0,43	-0,31	-0,11	-0,22	-0,36	-0,25
3	-0,49	-0,49	0,09	-0,41	-0,47	-0,32	-0,18	-0,23	-0,36	-0,25
4	-0,49	-0,53	0,07	-0,45	-0,49	-0,34	-0,15	-0,25	-0,37	-0,28
5	-0,47	-0,52	0,08	-0,42	-0,49	-0,31	-0,15	-0,20	-0,36	-0,25
6	-0,52	-0,53	0,07	-0,45	-0,48	-0,33	-0,14	-0,21	-0,36	-0,28
7	-0,50	-0,50	0,08	-0,39	-0,45	-0,29	-0,10	-0,20	-0,31	-0,23
8	-0,48	-0,48	0,09	-0,44	-0,45	-0,32	-0,10	-0,18	-0,35	-0,22
9	-0,51	-0,50	0,12	-0,41	-0,49	-0,34	-0,08	-0,17	-0,33	-0,23
10	-0,49	-0,49	0,09	-0,42	-0,49	-0,32	-0,07	-0,19	-0,34	-0,26
11	-0,48	-0,49	0,14	-0,47	-0,50	-0,35	-0,09	-0,20	-0,33	-0,27
12	-0,52	-0,47	0,14	-0,47	-0,47	-0,36	-0,13	-0,19	-0,36	-0,28
13	-0,50	-0,50	0,15	-0,43	-0,52	-0,33	-0,09	-0,22	-0,34	-0,29
14	-0,49	-0,52	0,14	-0,47	-0,51	-0,38	-0,11	-0,20	-0,34	-0,28
15	-0,51	-0,53	0,14	-0,49	-0,53	-0,36	-0,14	-0,25	-0,40	-0,32
16	-0,50	-0,55	0,13	-0,51	-0,54	-0,35	-0,11	-0,22	-0,38	-0,31
17	-0,54	-0,53	0,16	-0,48	-0,54	-0,35	-0,14	-0,23	-0,37	-0,32
18	-0,51	-0,57	0,11	-0,49	-0,56	-0,34	-0,11	-0,23	-0,41	-0,30
19	-0,52	-0,53	0,18	-0,46	-0,52	-0,35	-0,12	-0,23	-0,36	-0,30
20	-0,53	-0,58	0,16	-0,50	-0,59	-0,37	-0,14	-0,24	-0,38	-0,34
21	-0,50	-0,52	0,14	-0,44	-0,55	-0,35	-0,15	-0,21	-0,37	-0,27
22	-0,52	-0,55	0,08	-0,51	-0,57	-0,37	-0,12	-0,24	-0,38	-0,28
23	-0,53	-0,52	0,16	-0,49	-0,57	-0,40	-0,11	-0,19	-0,43	-0,33
24	-0,48	-0,53	0,12	-0,50	-0,60	-0,36	-0,16	-0,21	-0,38	-0,34
25	-0,47	-0,53	0,07	-0,51	-0,56	-0,35	-0,15	-0,18	-0,40	-0,29
26	-0,56	-0,58	0,12	-0,52	-0,58	-0,40	-0,15	-0,21	-0,45	-0,35
27	-0,56	-0,56	0,14	-0,50	-0,57	-0,39	-0,14	-0,18	-0,38	-0,34
28	-0,61	-0,61	0,10	-0,51	-0,61	-0,40	-0,18	-0,24	-0,46	-0,37
29	-0,55	-0,57	0,10	-0,52	-0,56	-0,39	-0,19	-0,20	-0,46	-0,32
30	-0,56	-0,60	0,08	-0,53	-0,63	-0,39	-0,17	-0,23	-0,53	-0,34
Av	-0,51	-0,52	0,11	-0,47	-0,52	-0,35	-0,13	-0,21	-0,38	-0,29
1-30 Δ	44%	61%	13%	37%	82%	40%	182%	41%	70%	40%

Table A.1.6: Kendall Coefficient Estimations of Exchange Rates for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,27	-0,26	0,05	-0,27	-0,24	-0,19	-0,04	-0,11	-0,22	-0,17
2	-0,31	-0,32	0,05	-0,27	-0,30	-0,22	-0,07	-0,15	-0,25	-0,17
3	-0,34	-0,34	0,06	-0,29	-0,33	-0,23	-0,12	-0,16	-0,25	-0,17
4	-0,35	-0,37	0,05	-0,32	-0,34	-0,23	-0,10	-0,17	-0,26	-0,19
5	-0,33	-0,37	0,05	-0,29	-0,34	-0,22	-0,10	-0,14	-0,25	-0,17
6	-0,36	-0,37	0,05	-0,32	-0,34	-0,23	-0,09	-0,14	-0,25	-0,19
7	-0,35	-0,35	0,05	-0,27	-0,31	-0,20	-0,07	-0,14	-0,21	-0,16
8	-0,34	-0,33	0,07	-0,31	-0,31	-0,23	-0,07	-0,13	-0,24	-0,15
9	-0,36	-0,35	0,08	-0,29	-0,35	-0,23	-0,06	-0,11	-0,23	-0,16
10	-0,35	-0,34	0,07	-0,30	-0,35	-0,22	-0,05	-0,13	-0,23	-0,18
11	-0,34	-0,34	0,10	-0,33	-0,35	-0,25	-0,06	-0,13	-0,23	-0,19
12	-0,37	-0,33	0,09	-0,33	-0,33	-0,25	-0,09	-0,13	-0,24	-0,19
13	-0,35	-0,35	0,10	-0,30	-0,37	-0,23	-0,06	-0,15	-0,23	-0,20
14	-0,35	-0,36	0,09	-0,32	-0,37	-0,27	-0,07	-0,14	-0,24	-0,20
15	-0,37	-0,38	0,09	-0,35	-0,38	-0,25	-0,09	-0,18	-0,27	-0,22
16	-0,37	-0,40	0,09	-0,37	-0,38	-0,25	-0,08	-0,16	-0,27	-0,21
17	-0,39	-0,37	0,11	-0,34	-0,39	-0,24	-0,09	-0,16	-0,27	-0,22
18	-0,36	-0,39	0,07	-0,34	-0,40	-0,23	-0,07	-0,16	-0,28	-0,20
19	-0,37	-0,37	0,12	-0,32	-0,37	-0,25	-0,08	-0,16	-0,26	-0,20
20	-0,38	-0,42	0,10	-0,35	-0,41	-0,25	-0,09	-0,17	-0,27	-0,23
21	-0,36	-0,37	0,10	-0,31	-0,39	-0,24	-0,10	-0,14	-0,26	-0,19
22	-0,37	-0,40	0,06	-0,35	-0,41	-0,26	-0,08	-0,17	-0,27	-0,19
23	-0,37	-0,36	0,11	-0,34	-0,40	-0,27	-0,08	-0,13	-0,30	-0,22
24	-0,34	-0,38	0,08	-0,35	-0,43	-0,25	-0,11	-0,15	-0,27	-0,24
25	-0,34	-0,37	0,05	-0,36	-0,39	-0,24	-0,10	-0,12	-0,28	-0,20
26	-0,39	-0,41	0,08	-0,36	-0,42	-0,28	-0,10	-0,14	-0,33	-0,23
27	-0,40	-0,40	0,09	-0,35	-0,42	-0,26	-0,09	-0,13	-0,28	-0,23
28	-0,43	-0,44	0,07	-0,35	-0,45	-0,28	-0,12	-0,16	-0,34	-0,25
29	-0,39	-0,41	0,07	-0,37	-0,40	-0,27	-0,13	-0,13	-0,31	-0,22
30	-0,41	-0,43	0,06	-0,38	-0,46	-0,27	-0,11	-0,16	-0,38	-0,23
Av	-0,36	-0,37	0,08	-0,33	-0,37	-0,24	-0,09	-0,15	-0,27	-0,20
1-30 Δ	50%	65%	19%	39%	92%	37%	188%	50%	76%	38%

Table A.1.7: Gaussian Copula Estimations of Exchange Rates for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,26	-0,24	-0,05	-0,24	-0,19	-0,12	-0,02	0,00	-0,17	-0,10
2	-0,27	-0,33	-0,07	-0,21	-0,23	-0,07	-0,05	-0,02	-0,17	-0,08
3	-0,32	-0,39	-0,07	-0,22	-0,24	-0,11	-0,12	0,01	-0,19	-0,07
4	-0,32	-0,43	-0,12	-0,25	-0,28	-0,09	-0,06	-0,01	-0,22	-0,08
5	-0,34	-0,47	-0,15	-0,19	-0,31	-0,09	-0,05	0,03	-0,17	-0,10
6	-0,38	-0,48	-0,14	-0,30	-0,34	-0,13	-0,09	0,00	-0,22	-0,16
7	-0,40	-0,50	-0,16	-0,27	-0,34	-0,11	-0,10	0,00	-0,19	-0,22
8	-0,39	-0,51	-0,26	-0,35	-0,38	-0,21	-0,10	0,04	-0,27	-0,17
9	-0,43	-0,54	-0,23	-0,35	-0,38	-0,11	-0,05	0,06	-0,27	-0,19
10	-0,44	-0,57	-0,24	-0,41	-0,45	-0,17	-0,04	-0,02	-0,33	-0,27
11	-0,45	-0,56	-0,19	-0,47	-0,40	-0,15	-0,05	-0,03	-0,34	-0,31
12	-0,45	-0,52	-0,17	-0,42	-0,36	-0,15	-0,10	0,04	-0,31	-0,24
13	-0,43	-0,54	-0,17	-0,32	-0,38	-0,18	-0,07	0,00	-0,36	-0,26
14	-0,48	-0,60	-0,19	-0,52	-0,42	-0,14	-0,13	-0,01	-0,40	-0,33
15	-0,36	-0,52	-0,13	-0,45	-0,34	-0,11	-0,09	-0,02	-0,35	-0,28
16	-0,47	-0,62	-0,24	-0,50	-0,37	-0,14	-0,08	0,07	-0,40	-0,29
17	-0,47	-0,57	-0,21	-0,45	-0,35	-0,07	-0,02	0,07	-0,41	-0,29
18	-0,40	-0,61	-0,22	-0,50	-0,41	-0,11	-0,04	0,04	-0,40	-0,24
19	-0,43	-0,55	-0,22	-0,38	-0,34	-0,04	-0,04	0,03	-0,34	-0,19
20	-0,42	-0,58	-0,19	-0,42	-0,38	-0,07	0,04	0,07	-0,34	-0,23
21	-0,41	-0,59	-0,27	-0,44	-0,41	0,00	-0,10	0,03	-0,26	-0,16
22	-0,42	-0,55	-0,24	-0,46	-0,39	-0,10	0,01	0,02	-0,34	-0,16
23	-0,47	-0,59	-0,15	-0,48	-0,38	-0,19	-0,06	0,12	-0,37	-0,27
24	-0,42	-0,62	-0,24	-0,37	-0,42	-0,12	-0,10	0,01	-0,38	-0,16
25	-0,45	-0,57	-0,17	-0,35	-0,37	-0,19	-0,01	0,15	-0,34	-0,26
26	-0,44	-0,58	-0,25	-0,48	-0,39	-0,12	0,07	0,12	-0,35	-0,20
27	-0,51	-0,60	-0,28	-0,49	-0,41	-0,20	-0,09	0,08	-0,38	-0,27
28	-0,42	-0,63	-0,28	-0,47	-0,45	-0,08	-0,13	0,05	-0,39	-0,23
29	-0,45	-0,63	-0,29	-0,37	-0,49	-0,21	-0,16	0,05	-0,43	-0,24
30	-0,46	-0,68	-0,35	-0,39	-0,49	-0,11	0,06	0,17	-0,39	-0,16
Av	-0,41	-0,54	-0,20	-0,38	-0,37	-0,12	-0,06	0,04	-0,32	-0,21
1-30 Δ	79%	184%	650%	65%	158%	-15%	-404%	-13713%	128%	60%

Table A.1.8: Gaussian Copula Estimations of Exchange Rates for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,49	-0,48	0,17	-0,49	-0,44	-0,39	-0,07	-0,24	-0,43	-0,35
2	-0,53	-0,50	0,19	-0,50	-0,50	-0,46	-0,13	-0,30	-0,46	-0,35
3	-0,53	-0,51	0,20	-0,49	-0,50	-0,44	-0,18	-0,32	-0,43	-0,34
4	-0,58	-0,58	0,24	-0,56	-0,54	-0,46	-0,16	-0,36	-0,47	-0,41
5	-0,54	-0,52	0,22	-0,50	-0,48	-0,42	-0,19	-0,26	-0,45	-0,33
6	-0,55	-0,54	0,22	-0,52	-0,49	-0,42	-0,14	-0,25	-0,45	-0,34
7	-0,54	-0,52	0,18	-0,48	-0,47	-0,38	-0,10	-0,26	-0,42	-0,33
8	-0,47	-0,46	0,25	-0,46	-0,43	-0,35	-0,05	-0,26	-0,41	-0,29
9	-0,52	-0,45	0,26	-0,49	-0,43	-0,31	-0,06	-0,23	-0,41	-0,27
10	-0,55	-0,50	0,33	-0,48	-0,40	-0,42	-0,03	-0,26	-0,42	-0,37
11	-0,49	-0,44	0,31	-0,45	-0,52	-0,37	-0,03	-0,24	-0,35	-0,25
12	-0,54	-0,48	0,30	-0,40	-0,48	-0,39	-0,04	-0,22	-0,34	-0,33
13	-0,57	-0,48	0,28	-0,46	-0,49	-0,38	-0,10	-0,20	-0,44	-0,32
14	-0,54	-0,44	0,33	-0,44	-0,46	-0,37	-0,05	-0,23	-0,38	-0,28
15	-0,55	-0,49	0,30	-0,46	-0,47	-0,37	-0,04	-0,28	-0,35	-0,37
16	-0,53	-0,45	0,43	-0,35	-0,33	-0,41	-0,06	-0,13	-0,30	-0,24
17	-0,55	-0,44	0,36	-0,40	-0,52	-0,35	-0,09	-0,19	-0,34	-0,27
18	-0,55	-0,50	0,37	-0,42	-0,41	-0,38	-0,09	-0,33	-0,41	-0,34
19	-0,48	-0,39	0,44	-0,39	-0,43	-0,36	-0,06	-0,20	-0,34	-0,31
20	-0,55	-0,50	0,39	-0,47	-0,45	-0,44	-0,12	-0,25	-0,47	-0,35
21	-0,57	-0,51	0,45	-0,46	-0,43	-0,44	-0,14	-0,25	-0,41	-0,34
22	-0,49	-0,55	0,36	-0,43	-0,44	-0,43	-0,20	-0,24	-0,41	-0,29
23	-0,61	-0,55	0,31	-0,50	-0,43	-0,39	-0,13	-0,30	-0,46	-0,43
24	-0,55	-0,43	0,41	-0,50	-0,46	-0,42	-0,19	-0,23	-0,39	-0,37
25	-0,49	-0,39	0,30	-0,45	-0,34	-0,23	-0,25	-0,27	-0,40	-0,33
26	-0,56	-0,48	0,30	-0,48	-0,41	-0,34	-0,20	-0,32	-0,46	-0,47
27	-0,46	-0,37	0,23	-0,44	-0,55	-0,45	-0,14	-0,32	-0,52	-0,33
28	-0,55	-0,51	0,29	-0,41	-0,42	-0,44	-0,13	-0,29	-0,37	-0,42
29	-0,58	-0,34	0,35	-0,34	-0,39	-0,35	-0,10	-0,26	-0,49	-0,35
30	-0,47	-0,39	0,43	-0,46	-0,43	-0,44	-0,13	-0,31	-0,56	-0,41
Av	-0,53	-0,47	0,31	-0,46	-0,45	-0,39	-0,11	-0,26	-0,42	-0,34
1-30 Δ	-4%	-18%	148%	-7%	-3%	14%	75%	30%	31%	16%

Table A.1.9: Student's t- Copula Estimations of Exchange Rates for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,28	-0,26	-0,06	-0,25	-0,20	-0,13	-0,02	0,00	-0,19	-0,10
2	-0,30	-0,36	-0,07	-0,22	-0,25	-0,08	-0,05	-0,02	-0,19	-0,09
3	-0,36	-0,43	-0,08	-0,25	-0,27	-0,13	-0,13	0,00	-0,21	-0,08
4	-0,36	-0,47	-0,13	-0,30	-0,32	-0,11	-0,06	-0,02	-0,26	-0,10
5	-0,39	-0,54	-0,19	-0,23	-0,37	-0,11	-0,06	0,02	-0,20	-0,12
6	-0,44	-0,55	-0,17	-0,36	-0,40	-0,16	-0,11	0,01	-0,27	-0,19
7	-0,46	-0,56	-0,21	-0,33	-0,41	-0,12	-0,12	0,00	-0,22	-0,25
8	-0,46	-0,58	-0,32	-0,43	-0,45	-0,23	-0,12	0,06	-0,32	-0,21
9	-0,50	-0,61	-0,29	-0,43	-0,45	-0,13	-0,06	0,07	-0,32	-0,23
10	-0,51	-0,64	-0,30	-0,48	-0,53	-0,22	-0,04	-0,02	-0,39	-0,33
11	-0,52	-0,65	-0,27	-0,53	-0,50	-0,18	-0,08	-0,04	-0,42	-0,38
12	-0,54	-0,62	-0,26	-0,52	-0,45	-0,20	-0,14	0,07	-0,41	-0,33
13	-0,52	-0,65	-0,24	-0,41	-0,49	-0,23	-0,10	0,01	-0,47	-0,32
14	-0,58	-0,69	-0,27	-0,61	-0,52	-0,14	-0,16	-0,01	-0,53	-0,40
15	-0,43	-0,59	-0,17	-0,52	-0,42	-0,13	-0,11	-0,02	-0,42	-0,34
16	-0,56	-0,70	-0,34	-0,59	-0,51	-0,21	-0,10	0,09	-0,50	-0,36
17	-0,57	-0,65	-0,26	-0,55	-0,46	-0,10	-0,03	0,09	-0,51	-0,34
18	-0,52	-0,68	-0,31	-0,57	-0,53	-0,15	-0,05	0,05	-0,49	-0,29
19	-0,53	-0,63	-0,28	-0,46	-0,44	-0,06	-0,05	0,04	-0,44	-0,22
20	-0,54	-0,67	-0,27	-0,53	-0,54	-0,10	0,05	0,08	-0,43	-0,29
21	-0,53	-0,67	-0,40	-0,55	-0,61	0,00	-0,14	0,01	-0,38	-0,24
22	-0,53	-0,63	-0,33	-0,57	-0,58	-0,13	-0,01	0,03	-0,49	-0,21
23	-0,59	-0,64	-0,23	-0,59	-0,57	-0,27	-0,11	0,15	-0,49	-0,37
24	-0,52	-0,68	-0,34	-0,49	-0,57	-0,16	-0,14	-0,05	-0,50	-0,23
25	-0,56	-0,67	-0,27	-0,46	-0,54	-0,27	-0,02	0,21	-0,48	-0,34
26	-0,54	-0,70	-0,32	-0,59	-0,63	-0,17	0,10	0,09	-0,48	-0,26
27	-0,61	-0,65	-0,29	-0,61	-0,62	-0,26	-0,12	0,09	-0,49	-0,35
28	-0,55	-0,76	-0,37	-0,61	-0,67	-0,16	-0,19	0,01	-0,54	-0,33
29	-0,58	-0,67	-0,33	-0,46	-0,64	-0,31	-0,23	0,05	-0,59	-0,33
30	-0,62	-0,78	-0,44	-0,53	-0,63	-0,18	0,09	0,19	-0,51	-0,26
Av	-0,50	-0,61	-0,26	-0,47	-0,48	-0,16	-0,08	0,04	-0,40	-0,26
1-30 Δ	125%	206%	670%	110%	211%	38%	-560%	-10852%	172%	153%

Table A.1.10: Student's t- Copula Estimations of Exchange Rates for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,51	-0,50	0,17	-0,52	-0,46	-0,41	-0,08	-0,26	-0,44	-0,36
2	-0,57	-0,53	0,19	-0,54	-0,54	-0,50	-0,14	-0,35	-0,50	-0,39
3	-0,57	-0,54	0,18	-0,51	-0,55	-0,48	-0,19	-0,37	-0,48	-0,39
4	-0,62	-0,61	0,23	-0,59	-0,60	-0,51	-0,17	-0,41	-0,51	-0,47
5	-0,57	-0,55	0,22	-0,54	-0,54	-0,47	-0,20	-0,29	-0,48	-0,38
6	-0,59	-0,57	0,19	-0,54	-0,54	-0,45	-0,15	-0,28	-0,47	-0,36
7	-0,60	-0,55	0,17	-0,51	-0,53	-0,44	-0,11	-0,31	-0,45	-0,36
8	-0,54	-0,49	0,25	-0,50	-0,49	-0,40	-0,06	-0,33	-0,42	-0,29
9	-0,58	-0,49	0,27	-0,51	-0,50	-0,34	-0,07	-0,30	-0,43	-0,28
10	-0,61	-0,53	0,36	-0,52	-0,51	-0,47	-0,04	-0,34	-0,46	-0,40
11	-0,50	-0,44	0,35	-0,49	-0,60	-0,41	-0,03	-0,28	-0,38	-0,25
12	-0,58	-0,50	0,34	-0,41	-0,59	-0,43	-0,05	-0,28	-0,36	-0,35
13	-0,62	-0,50	0,33	-0,52	-0,60	-0,45	-0,11	-0,24	-0,48	-0,32
14	-0,60	-0,44	0,37	-0,43	-0,56	-0,43	-0,05	-0,30	-0,39	-0,31
15	-0,58	-0,47	0,34	-0,43	-0,53	-0,42	0,02	-0,32	-0,39	-0,32
16	-0,57	-0,50	0,48	-0,40	-0,40	-0,45	-0,07	-0,15	-0,34	-0,24
17	-0,59	-0,50	0,36	-0,44	-0,60	-0,41	-0,11	-0,24	-0,40	-0,28
18	-0,60	-0,52	0,42	-0,38	-0,46	-0,43	-0,06	-0,40	-0,44	-0,34
19	-0,54	-0,45	0,51	-0,46	-0,52	-0,43	-0,04	-0,26	-0,38	-0,36
20	-0,60	-0,53	0,45	-0,49	-0,52	-0,50	-0,14	-0,30	-0,53	-0,42
21	-0,61	-0,57	0,52	-0,49	-0,50	-0,50	-0,12	-0,29	-0,47	-0,39
22	-0,56	-0,61	0,38	-0,49	-0,55	-0,49	-0,23	-0,29	-0,47	-0,34
23	-0,67	-0,62	0,39	-0,51	-0,56	-0,45	-0,10	-0,37	-0,49	-0,51
24	-0,60	-0,50	0,49	-0,49	-0,54	-0,49	-0,24	-0,28	-0,45	-0,44
25	-0,55	-0,46	0,37	-0,55	-0,41	-0,29	-0,23	-0,32	-0,46	-0,35
26	-0,63	-0,56	0,40	-0,60	-0,51	-0,43	-0,25	-0,40	-0,54	-0,56
27	-0,50	-0,42	0,29	-0,51	-0,61	-0,52	-0,19	-0,40	-0,60	-0,41
28	-0,60	-0,60	0,36	-0,51	-0,54	-0,54	-0,05	-0,38	-0,47	-0,51
29	-0,65	-0,40	0,44	-0,43	-0,48	-0,44	0,04	-0,34	-0,58	-0,43
30	-0,56	-0,46	0,52	-0,51	-0,52	-0,55	-0,12	-0,40	-0,63	-0,49
Av	-0,58	-0,51	0,35	-0,49	-0,53	-0,45	-0,11	-0,32	-0,46	-0,38
1-30 Δ	8%	-7%	200%	-2%	12%	35%	56%	53%	43%	36%

Table A.1.11: Frank Copula Estimations of Exchange Rates for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-1,72	-1,52	-0,35	-1,57	-1,19	-0,79	-0,10	-0,02	-1,11	-0,56
2	-1,86	-2,16	-0,31	-1,22	-1,41	-0,42	-0,29	-0,05	-1,06	-0,46
3	-2,31	-2,62	-0,41	-1,37	-1,64	-0,59	-0,77	-0,06	-1,12	-0,42
4	-2,24	-3,06	-0,74	-1,81	-2,04	-0,51	-0,40	-0,12	-1,32	-0,54
5	-2,40	-3,42	-1,07	-1,30	-2,34	-0,50	-0,41	0,04	-1,11	-0,63
6	-2,83	-3,43	-1,08	-2,16	-2,33	-0,79	-0,78	-0,01	-1,45	-1,06
7	-2,81	-3,54	-1,03	-1,81	-2,43	-0,51	-0,66	0,14	-1,20	-1,50
8	-2,81	-3,61	-1,87	-2,67	-2,54	-1,38	-0,87	0,42	-1,71	-1,21
9	-3,11	-3,86	-1,46	-2,39	-2,64	-0,68	-0,50	0,44	-1,74	-1,36
10	-3,28	-4,40	-1,61	-2,99	-3,49	-1,36	-0,25	0,06	-2,12	-1,79
11	-3,17	-4,42	-1,50	-3,64	-3,40	-1,09	-0,44	0,03	-2,25	-2,02
12	-3,29	-3,81	-1,33	-3,23	-2,77	-1,03	-0,71	0,45	-2,18	-1,63
13	-3,16	-4,28	-1,21	-2,34	-3,20	-1,24	-0,56	0,29	-2,45	-1,82
14	-3,69	-4,87	-1,40	-4,22	-3,46	-1,05	-0,72	-0,07	-3,21	-2,51
15	-2,56	-3,71	-0,96	-3,37	-2,66	-0,56	-0,80	-0,04	-2,44	-1,83
16	-3,46	-5,08	-1,74	-4,02	-3,40	-1,26	-0,45	0,46	-3,04	-1,98
17	-3,57	-4,46	-1,42	-3,71	-2,97	-0,61	-0,37	0,48	-2,79	-1,94
18	-2,92	-5,29	-1,60	-3,80	-3,76	-0,78	-0,40	0,11	-3,08	-1,65
19	-3,14	-4,43	-1,60	-2,82	-3,03	-0,48	-0,41	0,05	-2,71	-1,26
20	-3,01	-4,94	-1,24	-3,28	-3,89	-0,74	-0,03	0,45	-2,33	-1,60
21	-2,96	-5,13	-1,92	-3,40	-4,38	0,03	-0,90	0,13	-1,61	-1,10
22	-3,19	-4,59	-1,64	-3,65	-4,54	-0,83	-0,22	-0,17	-2,54	-1,00
23	-3,38	-4,79	-1,32	-3,77	-3,66	-1,61	-0,61	0,91	-2,76	-2,01
24	-3,14	-5,13	-1,38	-2,90	-3,98	-0,91	-0,70	-0,15	-2,64	-1,14
25	-3,40	-4,59	-1,40	-2,51	-3,51	-1,60	-0,05	1,31	-2,60	-1,70
26	-3,16	-5,67	-1,86	-3,87	-4,51	-0,90	0,47	0,56	-3,20	-1,35
27	-3,98	-5,49	-2,12	-4,20	-4,74	-1,40	-0,82	0,33	-2,88	-2,05
28	-3,23	-6,64	-2,16	-3,68	-5,13	-0,62	-0,88	0,15	-3,37	-1,80
29	-3,46	-5,31	-2,05	-2,64	-4,80	-1,34	-1,13	0,22	-3,27	-1,95
30	-3,93	-6,99	-2,88	-3,34	-4,75	-0,82	0,46	1,19	-3,37	-1,39
Av	-3,04	-4,38	-1,42	-2,92	-3,29	-0,88	-0,48	0,25	-2,29	-1,44
1-30 Δ	129%	358%	732%	113%	301%	4%	-539%	-7652%	203%	148%

Table A.1.12: Frank Copula Estimations of Exchange Rates for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-3,58	-3,40	1,04	-3,61	-3,09	-2,63	-0,51	-1,59	-2,94	-2,30
2	-4,13	-3,77	1,08	-3,78	-3,95	-3,46	-0,81	-2,30	-3,40	-2,51
3	-4,10	-3,74	1,08	-3,49	-3,88	-3,21	-1,08	-2,39	-3,20	-2,46
4	-4,68	-4,51	1,28	-4,33	-4,54	-3,49	-1,04	-2,88	-3,52	-3,08
5	-4,08	-3,79	1,27	-3,77	-3,87	-3,15	-1,15	-1,81	-3,04	-2,39
6	-4,28	-4,04	1,14	-3,71	-3,77	-3,00	-0,73	-1,79	-3,07	-2,25
7	-4,63	-3,55	0,94	-3,41	-3,74	-2,96	-0,74	-2,04	-2,84	-2,19
8	-3,82	-2,98	1,44	-3,50	-3,47	-2,54	-0,25	-2,06	-2,64	-1,77
9	-4,27	-3,25	1,58	-3,52	-3,48	-2,10	-0,37	-1,89	-2,56	-1,78
10	-4,65	-3,54	2,07	-3,28	-3,63	-2,96	-0,26	-2,05	-2,70	-2,33
11	-3,47	-2,71	1,85	-2,91	-4,41	-2,34	-0,08	-1,72	-2,24	-1,52
12	-4,09	-3,28	1,94	-2,55	-4,38	-2,85	-0,11	-1,75	-2,12	-1,71
13	-4,02	-3,37	1,93	-3,63	-4,62	-2,91	-0,49	-1,54	-2,74	-2,13
14	-4,51	-2,78	2,02	-3,00	-4,00	-2,77	-0,18	-1,94	-2,31	-1,85
15	-4,05	-3,10	1,96	-2,88	-3,74	-2,48	0,24	-1,78	-1,94	-1,85
16	-3,82	-3,06	3,08	-2,27	-2,62	-2,89	-0,26	-0,88	-1,85	-1,34
17	-4,14	-2,95	2,25	-2,81	-4,39	-2,58	-0,40	-1,49	-1,98	-1,72
18	-4,08	-3,36	2,36	-2,73	-3,16	-2,51	-0,44	-2,56	-2,58	-1,70
19	-3,63	-2,91	2,89	-2,43	-3,59	-2,53	-0,18	-1,75	-2,18	-2,01
20	-3,91	-3,69	2,82	-3,28	-3,43	-3,22	-0,54	-1,95	-2,92	-2,22
21	-4,14	-3,51	3,28	-3,09	-3,41	-2,95	-0,83	-1,74	-2,57	-1,90
22	-3,90	-4,30	2,33	-3,33	-4,03	-3,13	-1,05	-1,88	-3,06	-2,00
23	-4,30	-3,88	1,93	-3,45	-3,86	-2,57	-0,84	-2,06	-2,87	-2,57
24	-4,06	-3,32	2,72	-3,57	-3,67	-2,80	-0,88	-1,72	-2,65	-2,19
25	-3,72	-3,10	1,75	-3,84	-2,68	-1,78	-1,47	-2,02	-2,61	-2,09
26	-4,34	-3,95	1,79	-4,21	-3,42	-2,72	-1,59	-2,47	-3,40	-3,40
27	-3,57	-2,70	1,28	-3,46	-4,45	-3,22	-0,79	-2,23	-4,28	-2,39
28	-4,08	-3,91	1,80	-3,33	-3,46	-3,26	-0,46	-2,35	-2,72	-2,73
29	-4,42	-2,12	2,37	-2,48	-3,09	-2,66	-0,28	-1,89	-4,14	-2,14
30	-3,52	-2,66	3,02	-3,31	-3,10	-3,36	-0,67	-2,27	-4,12	-2,96
Av	-4,07	-3,37	1,94	-3,30	-3,70	-2,83	-0,61	-1,96	-2,84	-2,18
1-30 Δ	-2%	-22%	191%	-8%	0%	27%	31%	42%	40%	28%

Table A.1.13: Pearson Correlation Estimations of Exchange Rates for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,25	-0,24	-0,04	-0,23	-0,19	-0,12	-0,03	0,00	-0,17	-0,12
2	-0,29	-0,36	-0,06	-0,21	-0,25	-0,08	-0,06	-0,01	-0,17	-0,10
3	-0,33	-0,41	-0,07	-0,21	-0,25	-0,09	-0,12	0,04	-0,17	-0,06
4	-0,35	-0,45	-0,11	-0,24	-0,29	-0,09	-0,11	0,01	-0,21	-0,09
5	-0,36	-0,48	-0,12	-0,24	-0,31	-0,08	-0,09	0,03	-0,19	-0,10
6	-0,40	-0,48	-0,11	-0,28	-0,33	-0,13	-0,09	0,01	-0,25	-0,15
7	-0,40	-0,49	-0,11	-0,27	-0,33	-0,09	-0,14	0,03	-0,24	-0,19
8	-0,39	-0,51	-0,18	-0,35	-0,37	-0,15	-0,11	0,04	-0,30	-0,19
9	-0,43	-0,54	-0,14	-0,35	-0,36	-0,14	-0,10	0,05	-0,31	-0,19
10	-0,44	-0,56	-0,16	-0,42	-0,42	-0,17	-0,13	0,01	-0,37	-0,26
11	-0,45	-0,56	-0,12	-0,45	-0,37	-0,16	-0,17	0,00	-0,35	-0,26
12	-0,44	-0,52	-0,13	-0,41	-0,37	-0,15	-0,17	0,04	-0,34	-0,23
13	-0,43	-0,55	-0,13	-0,41	-0,39	-0,14	-0,19	0,01	-0,34	-0,24
14	-0,45	-0,60	-0,15	-0,49	-0,42	-0,15	-0,20	0,01	-0,39	-0,27
15	-0,45	-0,57	-0,15	-0,43	-0,39	-0,12	-0,14	0,03	-0,36	-0,22
16	-0,48	-0,61	-0,19	-0,48	-0,39	-0,15	-0,18	0,06	-0,38	-0,24
17	-0,47	-0,56	-0,18	-0,45	-0,38	-0,07	-0,12	0,06	-0,36	-0,23
18	-0,42	-0,60	-0,20	-0,48	-0,41	-0,09	-0,17	0,06	-0,41	-0,22
19	-0,43	-0,55	-0,17	-0,37	-0,35	-0,02	-0,11	0,10	-0,30	-0,16
20	-0,42	-0,58	-0,16	-0,45	-0,39	-0,03	-0,13	0,04	-0,33	-0,19
21	-0,41	-0,58	-0,25	-0,46	-0,41	-0,05	-0,23	0,04	-0,33	-0,17
22	-0,43	-0,55	-0,28	-0,45	-0,40	-0,08	-0,15	0,07	-0,33	-0,14
23	-0,43	-0,58	-0,13	-0,51	-0,37	-0,17	-0,13	0,07	-0,36	-0,21
24	-0,42	-0,60	-0,22	-0,49	-0,42	-0,16	-0,23	0,04	-0,35	-0,19
25	-0,45	-0,56	-0,22	-0,53	-0,36	-0,18	-0,21	0,05	-0,33	-0,20
26	-0,44	-0,59	-0,26	-0,49	-0,41	-0,11	-0,13	0,08	-0,36	-0,17
27	-0,49	-0,62	-0,28	-0,51	-0,43	-0,21	-0,17	0,10	-0,38	-0,21
28	-0,41	-0,61	-0,27	-0,49	-0,47	-0,13	-0,24	0,06	-0,40	-0,17
29	-0,46	-0,63	-0,27	-0,58	-0,50	-0,23	-0,26	0,07	-0,43	-0,18
30	-0,46	-0,67	-0,36	-0,54	-0,49	-0,10	-0,25	0,14	-0,35	-0,10
Av	-0,42	-0,54	-0,17	-0,41	-0,37	-0,12	-0,15	0,05	-0,32	-0,18
1-30 Δ	85%	175%	860%	131%	151%	-21%	853%	-5084%	106%	-12%

Table A.1.14: Pearson Correlation Estimations of Exchange Rates for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,48	-0,46	0,17	-0,48	-0,39	-0,37	-0,05	-0,22	-0,42	-0,39
2	-0,51	-0,49	0,22	-0,48	-0,47	-0,43	-0,11	-0,24	-0,45	-0,35
3	-0,52	-0,53	0,23	-0,50	-0,48	-0,43	-0,17	-0,27	-0,44	-0,34
4	-0,55	-0,55	0,27	-0,54	-0,51	-0,47	-0,14	-0,27	-0,48	-0,39
5	-0,52	-0,54	0,25	-0,51	-0,47	-0,44	-0,14	-0,23	-0,46	-0,36
6	-0,55	-0,57	0,28	-0,55	-0,50	-0,47	-0,11	-0,23	-0,47	-0,37
7	-0,60	-0,58	0,29	-0,54	-0,49	-0,49	-0,07	-0,23	-0,48	-0,42
8	-0,55	-0,56	0,35	-0,55	-0,45	-0,47	-0,05	-0,23	-0,49	-0,41
9	-0,58	-0,55	0,33	-0,54	-0,47	-0,46	-0,07	-0,25	-0,45	-0,39
10	-0,56	-0,56	0,39	-0,54	-0,45	-0,51	-0,09	-0,22	-0,45	-0,40
11	-0,57	-0,58	0,36	-0,53	-0,52	-0,49	-0,05	-0,24	-0,42	-0,38
12	-0,59	-0,59	0,40	-0,54	-0,52	-0,51	-0,08	-0,23	-0,45	-0,41
13	-0,58	-0,59	0,39	-0,54	-0,51	-0,49	-0,08	-0,23	-0,45	-0,40
14	-0,63	-0,61	0,40	-0,58	-0,52	-0,53	-0,09	-0,26	-0,48	-0,43
15	-0,64	-0,64	0,40	-0,57	-0,53	-0,52	-0,09	-0,30	-0,48	-0,45
16	-0,63	-0,59	0,44	-0,53	-0,46	-0,54	-0,11	-0,22	-0,44	-0,39
17	-0,63	-0,62	0,44	-0,58	-0,55	-0,54	-0,12	-0,27	-0,45	-0,44
18	-0,67	-0,65	0,41	-0,61	-0,51	-0,58	-0,14	-0,33	-0,53	-0,48
19	-0,63	-0,62	0,48	-0,57	-0,53	-0,54	-0,14	-0,27	-0,49	-0,45
20	-0,67	-0,66	0,45	-0,60	-0,55	-0,57	-0,13	-0,29	-0,51	-0,49
21	-0,68	-0,65	0,47	-0,60	-0,54	-0,59	-0,15	-0,32	-0,53	-0,48
22	-0,64	-0,65	0,45	-0,60	-0,54	-0,61	-0,17	-0,28	-0,50	-0,43
23	-0,71	-0,70	0,44	-0,63	-0,57	-0,61	-0,13	-0,35	-0,57	-0,55
24	-0,67	-0,67	0,49	-0,61	-0,55	-0,61	-0,16	-0,32	-0,55	-0,52
25	-0,70	-0,67	0,47	-0,63	-0,57	-0,60	-0,13	-0,31	-0,56	-0,54
26	-0,74	-0,67	0,47	-0,66	-0,57	-0,62	-0,13	-0,36	-0,59	-0,56
27	-0,71	-0,69	0,45	-0,63	-0,57	-0,65	-0,15	-0,36	-0,61	-0,56
28	-0,72	-0,70	0,47	-0,61	-0,58	-0,61	-0,17	-0,34	-0,53	-0,52
29	-0,70	-0,66	0,48	-0,58	-0,56	-0,60	-0,14	-0,29	-0,56	-0,51
30	-0,71	-0,70	0,49	-0,63	-0,61	-0,64	-0,12	-0,36	-0,61	-0,59
Av	-0,62	-0,61	0,39	-0,57	-0,52	-0,53	-0,12	-0,28	-0,50	-0,45
1-30 Δ	49%	50%	179%	31%	58%	72%	130%	63%	45%	53%

Table A.1.15: Spearman Correlation Estimations of Exchange Rates for Pre-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USD RUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,26	-0,23	-0,06	-0,24	-0,18	-0,12	-0,01	0,00	-0,17	-0,09
2	-0,30	-0,35	-0,06	-0,18	-0,24	-0,07	-0,06	0,00	-0,17	-0,08
3	-0,35	-0,40	-0,08	-0,21	-0,26	-0,09	-0,13	0,02	-0,17	-0,07
4	-0,34	-0,45	-0,13	-0,26	-0,32	-0,10	-0,10	0,00	-0,20	-0,11
5	-0,35	-0,48	-0,15	-0,24	-0,35	-0,09	-0,09	0,02	-0,20	-0,10
6	-0,43	-0,48	-0,18	-0,31	-0,35	-0,11	-0,10	0,02	-0,26	-0,16
7	-0,41	-0,47	-0,16	-0,28	-0,34	-0,07	-0,16	0,05	-0,24	-0,17
8	-0,41	-0,48	-0,25	-0,37	-0,36	-0,14	-0,13	0,04	-0,30	-0,18
9	-0,46	-0,51	-0,20	-0,35	-0,35	-0,11	-0,10	0,07	-0,29	-0,20
10	-0,47	-0,55	-0,18	-0,46	-0,43	-0,19	-0,12	0,00	-0,38	-0,29
11	-0,45	-0,55	-0,18	-0,51	-0,43	-0,15	-0,13	-0,02	-0,36	-0,34
12	-0,48	-0,49	-0,19	-0,45	-0,36	-0,16	-0,14	0,04	-0,34	-0,26
13	-0,46	-0,56	-0,18	-0,43	-0,44	-0,15	-0,20	0,00	-0,36	-0,25
14	-0,52	-0,58	-0,22	-0,52	-0,43	-0,12	-0,18	-0,03	-0,43	-0,37
15	-0,45	-0,55	-0,19	-0,43	-0,43	-0,11	-0,19	0,02	-0,36	-0,28
16	-0,50	-0,62	-0,23	-0,54	-0,42	-0,18	-0,19	0,07	-0,42	-0,30
17	-0,50	-0,55	-0,21	-0,47	-0,38	-0,10	-0,16	0,07	-0,38	-0,30
18	-0,43	-0,60	-0,24	-0,50	-0,47	-0,12	-0,22	0,04	-0,43	-0,28
19	-0,43	-0,51	-0,16	-0,37	-0,38	-0,09	-0,14	0,06	-0,33	-0,24
20	-0,42	-0,54	-0,17	-0,50	-0,43	-0,14	-0,14	0,02	-0,31	-0,27
21	-0,43	-0,58	-0,27	-0,47	-0,46	-0,02	-0,23	0,03	-0,31	-0,18
22	-0,42	-0,54	-0,22	-0,46	-0,49	-0,12	-0,13	0,06	-0,28	-0,10
23	-0,45	-0,53	-0,16	-0,54	-0,40	-0,20	-0,15	0,09	-0,38	-0,28
24	-0,44	-0,57	-0,21	-0,50	-0,44	-0,20	-0,27	-0,02	-0,36	-0,26
25	-0,42	-0,55	-0,21	-0,58	-0,43	-0,21	-0,24	0,07	-0,37	-0,26
26	-0,48	-0,57	-0,23	-0,50	-0,46	-0,17	-0,10	0,11	-0,37	-0,26
27	-0,55	-0,54	-0,22	-0,51	-0,47	-0,26	-0,21	0,05	-0,34	-0,25
28	-0,48	-0,63	-0,27	-0,50	-0,50	-0,14	-0,23	0,04	-0,40	-0,32
29	-0,50	-0,52	-0,29	-0,55	-0,54	-0,15	-0,30	0,04	-0,40	-0,26
30	-0,44	-0,67	-0,29	-0,57	-0,49	-0,09	-0,29	0,12	-0,48	-0,21
Av	-0,43	-0,52	-0,19	-0,43	-0,40	-0,13	-0,16	0,04	-0,33	-0,22
1-30 Δ	67%	189%	417%	132%	170%	-28%	1998%	-4322%	188%	141%

Table A.1.16: Spearman Correlation Estimations of Exchange Rates for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,47	-0,45	0,15	-0,47	-0,43	-0,38	-0,08	-0,24	-0,40	-0,34
2	-0,53	-0,51	0,16	-0,50	-0,52	-0,46	-0,14	-0,33	-0,47	-0,36
3	-0,55	-0,52	0,15	-0,49	-0,53	-0,46	-0,20	-0,33	-0,45	-0,35
4	-0,57	-0,57	0,19	-0,55	-0,56	-0,47	-0,18	-0,36	-0,47	-0,39
5	-0,50	-0,50	0,18	-0,48	-0,53	-0,42	-0,14	-0,27	-0,41	-0,32
6	-0,54	-0,52	0,19	-0,48	-0,51	-0,44	-0,10	-0,28	-0,38	-0,27
7	-0,56	-0,51	0,20	-0,49	-0,53	-0,42	-0,09	-0,27	-0,38	-0,28
8	-0,52	-0,46	0,26	-0,47	-0,49	-0,41	-0,06	-0,26	-0,37	-0,24
9	-0,54	-0,50	0,24	-0,47	-0,50	-0,39	-0,04	-0,31	-0,35	-0,27
10	-0,55	-0,50	0,31	-0,49	-0,53	-0,47	-0,05	-0,27	-0,39	-0,28
11	-0,46	-0,45	0,29	-0,41	-0,54	-0,41	0,01	-0,23	-0,30	-0,21
12	-0,53	-0,50	0,36	-0,45	-0,55	-0,44	0,02	-0,28	-0,34	-0,25
13	-0,52	-0,51	0,31	-0,49	-0,56	-0,45	-0,05	-0,27	-0,37	-0,27
14	-0,59	-0,49	0,32	-0,49	-0,59	-0,40	-0,04	-0,33	-0,41	-0,33
15	-0,56	-0,49	0,33	-0,46	-0,56	-0,46	0,01	-0,28	-0,33	-0,32
16	-0,59	-0,51	0,37	-0,44	-0,55	-0,50	-0,05	-0,29	-0,38	-0,29
17	-0,58	-0,51	0,32	-0,50	-0,65	-0,42	-0,02	-0,33	-0,38	-0,32
18	-0,59	-0,56	0,32	-0,47	-0,58	-0,48	-0,04	-0,35	-0,43	-0,33
19	-0,54	-0,50	0,35	-0,48	-0,64	-0,46	-0,07	-0,34	-0,40	-0,34
20	-0,59	-0,53	0,40	-0,52	-0,61	-0,49	-0,03	-0,37	-0,40	-0,35
21	-0,57	-0,44	0,41	-0,43	-0,61	-0,48	-0,09	-0,31	-0,41	-0,32
22	-0,54	-0,55	0,32	-0,52	-0,61	-0,50	-0,07	-0,32	-0,47	-0,31
23	-0,60	-0,58	0,35	-0,50	-0,63	-0,46	-0,14	-0,38	-0,46	-0,42
24	-0,55	-0,53	0,41	-0,50	-0,63	-0,48	-0,07	-0,32	-0,42	-0,36
25	-0,58	-0,52	0,30	-0,48	-0,67	-0,45	-0,08	-0,34	-0,43	-0,35
26	-0,63	-0,54	0,35	-0,57	-0,67	-0,50	-0,05	-0,37	-0,44	-0,42
27	-0,59	-0,56	0,27	-0,48	-0,66	-0,54	-0,06	-0,40	-0,51	-0,42
28	-0,59	-0,58	0,37	-0,50	-0,66	-0,47	-0,10	-0,33	-0,45	-0,39
29	-0,60	-0,52	0,34	-0,50	-0,62	-0,51	-0,04	-0,28	-0,58	-0,35
30	-0,63	-0,51	0,31	-0,54	-0,68	-0,52	-0,07	-0,39	-0,58	-0,50
Av	-0,56	-0,51	0,29	-0,49	-0,58	-0,46	-0,07	-0,31	-0,42	-0,33
1-30 Δ	35%	14%	103%	15%	58%	38%	-17%	66%	44%	50%

Table A.1.17: Kendall Correlation Estimations of Exchange Rates for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,18	-0,16	-0,04	-0,16	-0,12	-0,08	-0,01	0,00	-0,11	-0,06
2	-0,20	-0,24	-0,04	-0,12	-0,16	-0,04	-0,04	0,00	-0,11	-0,05
3	-0,24	-0,27	-0,05	-0,14	-0,17	-0,06	-0,09	0,01	-0,12	-0,05
4	-0,24	-0,30	-0,09	-0,18	-0,21	-0,07	-0,07	0,00	-0,13	-0,07
5	-0,23	-0,33	-0,10	-0,16	-0,23	-0,06	-0,07	0,02	-0,13	-0,07
6	-0,29	-0,33	-0,11	-0,20	-0,23	-0,08	-0,07	0,02	-0,17	-0,10
7	-0,27	-0,32	-0,09	-0,18	-0,23	-0,05	-0,11	0,03	-0,17	-0,12
8	-0,27	-0,34	-0,16	-0,25	-0,24	-0,10	-0,08	0,03	-0,20	-0,12
9	-0,30	-0,34	-0,13	-0,23	-0,24	-0,07	-0,07	0,05	-0,19	-0,13
10	-0,31	-0,39	-0,12	-0,31	-0,30	-0,13	-0,10	0,00	-0,26	-0,18
11	-0,29	-0,38	-0,13	-0,35	-0,30	-0,12	-0,09	-0,01	-0,25	-0,24
12	-0,33	-0,35	-0,12	-0,30	-0,26	-0,12	-0,10	0,02	-0,23	-0,18
13	-0,30	-0,37	-0,12	-0,28	-0,30	-0,11	-0,14	0,00	-0,24	-0,16
14	-0,35	-0,41	-0,14	-0,35	-0,30	-0,08	-0,12	-0,03	-0,30	-0,26
15	-0,29	-0,39	-0,12	-0,29	-0,30	-0,07	-0,13	0,01	-0,25	-0,18
16	-0,35	-0,45	-0,16	-0,37	-0,31	-0,13	-0,14	0,04	-0,29	-0,20
17	-0,34	-0,40	-0,15	-0,32	-0,27	-0,07	-0,11	0,04	-0,27	-0,22
18	-0,29	-0,43	-0,16	-0,32	-0,32	-0,09	-0,13	0,02	-0,28	-0,17
19	-0,31	-0,36	-0,11	-0,24	-0,28	-0,07	-0,09	0,02	-0,21	-0,15
20	-0,28	-0,39	-0,10	-0,34	-0,32	-0,07	-0,09	0,00	-0,22	-0,18
21	-0,29	-0,44	-0,18	-0,32	-0,35	-0,01	-0,16	0,01	-0,21	-0,13
22	-0,29	-0,40	-0,16	-0,31	-0,37	-0,07	-0,09	0,03	-0,19	-0,07
23	-0,29	-0,36	-0,11	-0,37	-0,29	-0,16	-0,10	0,07	-0,26	-0,18
24	-0,30	-0,43	-0,15	-0,35	-0,34	-0,12	-0,20	-0,02	-0,27	-0,20
25	-0,30	-0,39	-0,14	-0,42	-0,30	-0,16	-0,17	0,06	-0,27	-0,17
26	-0,31	-0,44	-0,17	-0,34	-0,38	-0,11	-0,06	0,08	-0,27	-0,17
27	-0,36	-0,43	-0,17	-0,34	-0,38	-0,18	-0,16	0,04	-0,25	-0,17
28	-0,32	-0,48	-0,19	-0,32	-0,40	-0,09	-0,15	0,04	-0,26	-0,18
29	-0,33	-0,37	-0,20	-0,39	-0,39	-0,13	-0,21	0,03	-0,24	-0,17
30	-0,29	-0,51	-0,22	-0,39	-0,37	-0,05	-0,22	0,10	-0,33	-0,13
Av	-0,29	-0,37	-0,13	-0,29	-0,29	-0,09	-0,11	0,02	-0,22	-0,15
1-30 Δ	62%	225%	478%	137%	205%	-41%	2195%	-4592%	198%	119%

Table A.1.18: Kendall Correlation Estimations of Exchange Rates for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	USDCAD	USDNOK	USDJPY	USDAUD	USDRUB	USDBRL	USDCNY	USDINR	USDZAR	USDTRY
1	-0,33	-0,32	0,10	-0,34	-0,30	-0,26	-0,06	-0,16	-0,28	-0,24
2	-0,38	-0,36	0,11	-0,36	-0,37	-0,33	-0,09	-0,23	-0,33	-0,26
3	-0,40	-0,37	0,11	-0,35	-0,38	-0,32	-0,13	-0,23	-0,32	-0,25
4	-0,41	-0,41	0,12	-0,39	-0,41	-0,34	-0,12	-0,25	-0,33	-0,27
5	-0,37	-0,36	0,12	-0,34	-0,38	-0,29	-0,09	-0,19	-0,29	-0,23
6	-0,39	-0,37	0,13	-0,35	-0,37	-0,31	-0,07	-0,19	-0,27	-0,20
7	-0,42	-0,36	0,14	-0,35	-0,38	-0,30	-0,06	-0,19	-0,27	-0,20
8	-0,38	-0,33	0,19	-0,35	-0,35	-0,29	-0,04	-0,18	-0,26	-0,17
9	-0,40	-0,36	0,17	-0,33	-0,35	-0,27	-0,02	-0,22	-0,25	-0,19
10	-0,41	-0,36	0,21	-0,35	-0,38	-0,33	-0,03	-0,19	-0,28	-0,20
11	-0,34	-0,32	0,20	-0,29	-0,38	-0,29	0,01	-0,16	-0,21	-0,15
12	-0,38	-0,35	0,24	-0,32	-0,40	-0,32	0,02	-0,19	-0,23	-0,17
13	-0,39	-0,37	0,22	-0,37	-0,40	-0,32	-0,03	-0,19	-0,27	-0,20
14	-0,43	-0,35	0,23	-0,35	-0,42	-0,28	-0,03	-0,23	-0,28	-0,24
15	-0,42	-0,35	0,23	-0,33	-0,40	-0,32	0,01	-0,19	-0,23	-0,23
16	-0,43	-0,37	0,26	-0,31	-0,39	-0,34	-0,03	-0,20	-0,27	-0,20
17	-0,44	-0,36	0,23	-0,36	-0,47	-0,30	-0,01	-0,23	-0,26	-0,23
18	-0,43	-0,39	0,21	-0,32	-0,41	-0,34	-0,03	-0,24	-0,30	-0,23
19	-0,42	-0,35	0,25	-0,34	-0,46	-0,32	-0,05	-0,24	-0,29	-0,24
20	-0,44	-0,37	0,28	-0,38	-0,43	-0,35	-0,02	-0,26	-0,29	-0,25
21	-0,41	-0,31	0,29	-0,31	-0,45	-0,34	-0,05	-0,22	-0,29	-0,23
22	-0,39	-0,39	0,22	-0,38	-0,44	-0,35	-0,04	-0,24	-0,34	-0,22
23	-0,45	-0,42	0,25	-0,36	-0,45	-0,33	-0,08	-0,27	-0,33	-0,30
24	-0,41	-0,37	0,28	-0,36	-0,46	-0,35	-0,04	-0,23	-0,29	-0,25
25	-0,43	-0,36	0,21	-0,35	-0,49	-0,33	-0,05	-0,25	-0,31	-0,24
26	-0,45	-0,38	0,24	-0,41	-0,48	-0,35	-0,02	-0,25	-0,31	-0,29
27	-0,44	-0,41	0,20	-0,34	-0,48	-0,39	-0,03	-0,29	-0,38	-0,30
28	-0,44	-0,41	0,27	-0,36	-0,47	-0,33	-0,05	-0,24	-0,34	-0,27
29	-0,45	-0,36	0,23	-0,36	-0,43	-0,35	-0,02	-0,20	-0,42	-0,25
30	-0,47	-0,37	0,22	-0,40	-0,49	-0,37	-0,06	-0,29	-0,43	-0,34
Av	-0,41	-0,36	0,21	-0,35	-0,42	-0,32	-0,04	-0,22	-0,30	-0,23
1-30 Δ	42%	15%	108%	18%	65%	40%	1%	79%	52%	43%

A.2 Stock Market Indices Estimations

Table A.2.1: Gaussian Copula Estimations of Stock Market Indices for 2005-2013

Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,44	0,40	0,13	0,13	0,33	0,34	0,11	0,22	0,30	0,08
2	0,49	0,47	0,30	0,31	0,39	0,40	0,13	0,26	0,37	0,19
3	0,50	0,48	0,29	0,32	0,38	0,40	0,12	0,25	0,38	0,19
4	0,50	0,54	0,33	0,32	0,43	0,41	0,13	0,26	0,41	0,23
5	0,51	0,53	0,29	0,32	0,42	0,38	0,10	0,24	0,44	0,20
6	0,52	0,52	0,33	0,36	0,44	0,42	0,11	0,26	0,42	0,22
7	0,48	0,48	0,29	0,32	0,36	0,40	0,10	0,25	0,37	0,18
8	0,48	0,47	0,31	0,35	0,42	0,38	0,11	0,24	0,36	0,19
9	0,49	0,52	0,32	0,37	0,45	0,42	0,15	0,27	0,39	0,21
10	0,47	0,47	0,29	0,37	0,45	0,41	0,17	0,25	0,36	0,21
11	0,55	0,55	0,35	0,41	0,47	0,43	0,15	0,31	0,43	0,14
12	0,50	0,52	0,31	0,41	0,47	0,40	0,18	0,21	0,42	0,17
13	0,49	0,47	0,25	0,36	0,45	0,38	0,19	0,23	0,38	0,14
14	0,44	0,49	0,30	0,41	0,47	0,45	0,17	0,27	0,41	0,13
15	0,51	0,49	0,34	0,41	0,46	0,42	0,17	0,25	0,42	0,17
16	0,50	0,54	0,33	0,44	0,50	0,46	0,23	0,32	0,46	0,29
17	0,44	0,46	0,29	0,36	0,42	0,42	0,21	0,20	0,42	0,15
18	0,52	0,49	0,34	0,40	0,53	0,43	0,19	0,26	0,47	0,22
19	0,49	0,53	0,35	0,44	0,54	0,44	0,12	0,30	0,49	0,20
20	0,39	0,47	0,35	0,41	0,50	0,46	0,13	0,19	0,45	0,20
21	0,47	0,48	0,32	0,43	0,49	0,46	0,13	0,32	0,44	0,15
22	0,41	0,48	0,30	0,39	0,50	0,40	0,09	0,29	0,33	0,24
23	0,54	0,51	0,33	0,44	0,50	0,45	0,10	0,27	0,46	0,26
24	0,52	0,55	0,35	0,42	0,52	0,44	0,14	0,30	0,53	0,24
25	0,34	0,42	0,22	0,31	0,46	0,43	0,17	0,23	0,43	0,18
26	0,57	0,56	0,39	0,51	0,50	0,47	0,18	0,32	0,49	0,24
27	0,47	0,50	0,30	0,42	0,59	0,46	0,07	0,30	0,52	0,25
28	0,56	0,59	0,37	0,38	0,50	0,39	0,17	0,40	0,50	0,34
29	0,51	0,53	0,35	0,38	0,57	0,44	0,11	0,32	0,46	0,19
30	0,52	0,51	0,34	0,40	0,55	0,45	0,16	0,34	0,43	0,21
Av	0,49	0,50	0,31	0,38	0,47	0,42	0,14	0,27	0,43	0,20
1-30 Δ	18%	27%	151%	202%	68%	35%	48%	58%	43%	152%

Table A.2.2: Student's t-Copula Estimations of Stock Market Indices for 2005-2013

Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,47	0,40	0,13	0,13	0,33	0,34	0,12	0,22	0,30	0,08
2	0,52	0,50	0,30	0,33	0,40	0,42	0,15	0,27	0,39	0,20
3	0,54	0,51	0,30	0,33	0,40	0,43	0,15	0,27	0,40	0,20
4	0,55	0,57	0,34	0,34	0,46	0,45	0,16	0,28	0,45	0,24
5	0,55	0,55	0,30	0,33	0,45	0,40	0,13	0,25	0,45	0,21
6	0,55	0,55	0,34	0,37	0,47	0,46	0,15	0,29	0,45	0,23
7	0,52	0,51	0,29	0,31	0,41	0,41	0,12	0,24	0,39	0,17
8	0,49	0,51	0,29	0,34	0,48	0,41	0,18	0,24	0,40	0,18
9	0,54	0,56	0,32	0,35	0,50	0,46	0,17	0,27	0,41	0,21
10	0,51	0,51	0,26	0,34	0,50	0,46	0,21	0,25	0,40	0,20
11	0,58	0,57	0,35	0,35	0,50	0,46	0,21	0,31	0,44	0,15
12	0,55	0,56	0,34	0,45	0,52	0,45	0,21	0,25	0,47	0,19
13	0,54	0,51	0,28	0,37	0,50	0,42	0,23	0,26	0,43	0,15
14	0,49	0,53	0,33	0,45	0,51	0,49	0,20	0,30	0,46	0,12
15	0,56	0,54	0,38	0,43	0,50	0,47	0,19	0,27	0,47	0,18
16	0,55	0,57	0,36	0,45	0,55	0,51	0,29	0,36	0,51	0,30
17	0,50	0,50	0,35	0,40	0,49	0,47	0,30	0,21	0,49	0,19
18	0,58	0,54	0,39	0,45	0,58	0,48	0,23	0,31	0,51	0,25
19	0,55	0,58	0,39	0,49	0,60	0,50	0,15	0,35	0,54	0,24
20	0,43	0,51	0,41	0,45	0,54	0,51	0,15	0,26	0,52	0,25
21	0,52	0,53	0,36	0,44	0,55	0,51	0,16	0,30	0,44	0,18
22	0,47	0,52	0,34	0,44	0,56	0,45	0,11	0,32	0,39	0,26
23	0,59	0,56	0,37	0,49	0,56	0,51	0,12	0,32	0,51	0,31
24	0,59	0,61	0,42	0,50	0,59	0,51	0,18	0,38	0,57	0,29
25	0,38	0,45	0,22	0,31	0,53	0,48	0,21	0,23	0,46	0,17
26	0,63	0,62	0,46	0,46	0,57	0,53	0,22	0,32	0,48	0,28
27	0,54	0,57	0,37	0,47	0,65	0,52	0,09	0,36	0,56	0,29
28	0,63	0,66	0,42	0,43	0,61	0,44	0,21	0,44	0,53	0,37
29	0,57	0,59	0,40	0,43	0,64	0,51	0,14	0,31	0,50	0,19
30	0,59	0,58	0,42	0,46	0,62	0,53	0,23	0,41	0,50	0,25
Av	0,54	0,54	0,34	0,40	0,52	0,47	0,18	0,29	0,46	0,22
1-30 Δ	27%	44%	229%	255%	89%	56%	96%	92%	66%	226%

Table A.2.3: Clayton Copula Estimations of Stock Market Indices for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	ASS1	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,71	0,61	0,18	0,19	0,45	0,47	0,14	0,31	0,46	0,14
2	0,88	0,80	0,39	0,46	0,57	0,64	0,16	0,37	0,60	0,24
3	0,87	0,80	0,41	0,45	0,55	0,58	0,16	0,34	0,62	0,28
4	0,88	0,90	0,46	0,49	0,65	0,63	0,16	0,37	0,67	0,33
5	0,85	0,84	0,42	0,45	0,64	0,54	0,13	0,32	0,68	0,29
6	0,85	0,86	0,48	0,52	0,68	0,66	0,19	0,38	0,71	0,33
7	0,70	0,76	0,44	0,44	0,58	0,62	0,13	0,34	0,57	0,29
8	0,86	0,79	0,54	0,54	0,84	0,73	0,20	0,41	0,63	0,33
9	0,78	0,92	0,50	0,59	0,88	0,82	0,25	0,45	0,73	0,37
10	0,76	0,84	0,51	0,61	0,90	0,86	0,25	0,40	0,72	0,36
11	0,87	0,94	0,63	0,70	0,87	0,76	0,21	0,48	0,81	0,26
12	0,90	0,87	0,49	0,65	0,76	0,67	0,24	0,35	0,78	0,27
13	0,87	0,80	0,50	0,57	0,76	0,71	0,31	0,34	0,76	0,23
14	0,69	0,86	0,57	0,75	0,95	0,82	0,35	0,44	0,75	0,27
15	0,93	0,95	0,59	0,70	0,91	0,73	0,26	0,38	0,82	0,34
16	0,92	0,94	0,65	0,75	1,01	0,76	0,36	0,49	0,89	0,45
17	0,66	0,74	0,45	0,64	0,80	0,60	0,35	0,39	0,77	0,33
18	0,97	0,81	0,67	0,76	0,94	0,82	0,30	0,47	0,84	0,43
19	0,89	0,91	0,62	0,83	0,96	0,80	0,18	0,45	0,91	0,37
20	0,55	0,64	0,57	0,67	0,93	0,80	0,20	0,35	0,77	0,34
21	0,72	0,69	0,49	0,76	0,80	0,75	0,13	0,50	0,74	0,29
22	0,68	0,70	0,58	0,70	0,78	0,62	0,16	0,50	0,57	0,41
23	0,82	0,79	0,52	0,65	0,81	0,75	0,13	0,47	0,75	0,44
24	0,93	0,91	0,57	0,75	0,77	0,92	0,28	0,44	0,98	0,43
25	0,52	0,66	0,39	0,53	0,74	0,74	0,31	0,33	0,73	0,31
26	0,77	0,80	0,51	0,81	0,73	0,71	0,28	0,48	0,75	0,31
27	0,75	0,86	0,51	0,78	1,13	0,85	0,10	0,46	0,90	0,45
28	1,08	1,09	0,75	0,76	1,18	0,86	0,29	0,69	0,96	0,59
29	0,91	0,92	0,79	0,68	1,03	0,83	0,25	0,59	0,91	0,40
30	0,90	0,96	0,66	0,81	1,02	0,94	0,40	0,59	0,81	0,40
Av	0,82	0,83	0,53	0,63	0,82	0,73	0,23	0,43	0,75	0,34
1-30 Δ	27%	56%	273%	316%	125%	102%	183%	90%	74%	194%

Table A.2.4: Frank Copula Estimations of Stock Market Indices for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	3,11	2,60	0,74	0,76	2,04	2,11	0,69	1,30	1,90	0,41
2	3,67	3,48	1,81	2,05	2,62	2,77	0,92	1,69	2,52	1,17
3	3,81	3,55	1,79	2,08	2,59	2,84	0,94	1,60	2,65	1,22
4	3,94	4,16	2,09	2,15	3,07	2,89	1,02	1,70	2,97	1,45
5	3,86	3,80	1,83	2,09	2,91	2,52	0,78	1,46	2,99	1,18
6	3,72	3,97	2,02	2,34	3,17	2,99	0,91	1,75	2,98	1,26
7	3,43	3,51	1,67	1,96	2,65	2,61	0,75	1,54	2,47	0,87
8	3,41	3,51	1,76	2,17	3,20	2,66	1,05	1,46	2,61	0,99
9	3,84	4,02	1,79	2,14	3,36	3,10	1,02	1,68	2,72	1,25
10	3,58	3,55	1,68	2,33	3,42	3,06	1,32	1,50	2,69	1,17
11	4,03	4,11	2,09	2,46	3,42	2,94	1,22	1,87	3,02	0,85
12	3,82	4,01	2,06	2,77	3,36	2,66	1,26	1,45	3,13	1,10
13	3,55	3,53	1,70	2,29	3,10	2,55	1,35	1,54	2,86	0,80
14	3,15	3,63	1,91	2,85	3,31	2,98	1,21	1,73	3,08	0,65
15	3,58	3,64	2,14	2,51	3,31	2,91	1,20	1,45	3,01	1,03
16	3,76	3,96	2,19	2,92	3,63	3,18	1,68	2,01	3,54	1,62
17	3,33	3,39	2,26	2,55	3,28	3,04	1,84	1,44	3,47	1,19
18	4,04	3,56	2,37	2,87	3,82	3,03	1,61	1,88	3,39	1,44
19	3,43	4,04	2,39	3,11	3,91	3,17	1,05	2,12	3,68	1,33
20	2,76	3,48	2,50	2,84	3,78	3,32	0,86	1,45	3,62	1,43
21	3,24	3,31	2,03	2,74	3,70	3,15	1,03	1,98	3,10	1,05
22	2,84	3,23	2,01	2,38	3,61	2,64	0,83	1,98	2,21	1,48
23	4,08	3,99	2,13	2,96	3,85	3,27	0,80	1,90	3,12	1,85
24	3,85	4,17	2,42	2,80	4,02	3,19	1,15	2,39	3,76	1,59
25	1,93	2,83	1,15	1,68	3,62	2,85	1,16	1,38	2,81	0,96
26	3,87	4,17	2,48	3,26	3,69	3,18	1,34	2,00	3,21	1,37
27	3,21	3,67	1,96	2,92	4,67	3,25	0,60	2,00	3,70	1,64
28	4,16	4,83	2,48	2,67	4,40	2,75	1,31	2,64	3,65	2,27
29	3,81	4,45	2,35	2,51	4,60	3,31	0,86	2,04	3,40	1,11
30	3,93	3,98	2,35	2,83	4,52	3,25	1,28	2,31	2,94	1,47
Av	3,56	3,74	2,01	2,47	3,49	2,94	1,10	1,77	3,04	1,24
1-30 Δ	26%	53%	220%	273%	122%	54%	85%	79%	55%	259%

Table A.2.5: Gumbel Copula Estimations of Stock Market Indices for 2005-2013 Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	SPTSX	OSEBX	NKY	ASS1	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	1,41	1,34	1,08	1,09	1,25	1,27	1,07	1,15	1,23	1,05
2	1,50	1,47	1,21	1,25	1,35	1,35	1,10	1,21	1,31	1,13
3	1,53	1,49	1,22	1,27	1,35	1,37	1,09	1,20	1,34	1,13
4	1,56	1,59	1,25	1,26	1,41	1,38	1,10	1,21	1,38	1,15
5	1,55	1,51	1,23	1,27	1,39	1,33	1,08	1,19	1,41	1,13
6	1,51	1,52	1,25	1,31	1,40	1,39	1,10	1,20	1,38	1,13
7	1,49	1,48	1,21	1,27	1,34	1,36	1,07	1,20	1,34	1,09
8	1,48	1,46	1,22	1,29	1,41	1,35	1,10	1,18	1,35	1,10
9	1,54	1,57	1,23	1,29	1,44	1,41	1,12	1,21	1,37	1,14
10	1,49	1,49	1,23	1,35	1,47	1,41	1,13	1,20	1,35	1,14
11	1,60	1,61	1,26	1,35	1,47	1,40	1,14	1,24	1,44	1,09
12	1,54	1,57	1,23	1,36	1,47	1,36	1,14	1,16	1,42	1,10
13	1,53	1,49	1,20	1,31	1,41	1,34	1,14	1,17	1,36	1,09
14	1,42	1,48	1,22	1,37	1,41	1,41	1,09	1,18	1,38	1,07
15	1,50	1,52	1,24	1,36	1,45	1,40	1,10	1,20	1,41	1,12
16	1,59	1,61	1,26	1,46	1,51	1,50	1,18	1,30	1,52	1,25
17	1,47	1,45	1,25	1,32	1,41	1,42	1,21	1,18	1,48	1,10
18	1,58	1,49	1,29	1,39	1,57	1,39	1,15	1,21	1,53	1,15
19	1,50	1,56	1,32	1,41	1,60	1,41	1,08	1,26	1,47	1,13
20	1,35	1,50	1,32	1,38	1,48	1,45	1,06	1,16	1,48	1,20
21	1,43	1,52	1,22	1,37	1,52	1,42	1,09	1,27	1,47	1,11
22	1,35	1,46	1,23	1,31	1,54	1,35	1,04	1,23	1,27	1,22
23	1,56	1,55	1,22	1,36	1,56	1,45	1,06	1,24	1,41	1,24
24	1,53	1,62	1,31	1,41	1,57	1,41	1,08	1,34	1,61	1,23
25	1,23	1,40	1,13	1,24	1,49	1,37	1,11	1,19	1,41	1,16
26	1,65	1,73	1,39	1,58	1,60	1,47	1,14	1,31	1,56	1,23
27	1,48	1,58	1,26	1,41	1,78	1,40	1,04	1,26	1,59	1,23
28	1,64	1,79	1,34	1,38	1,62	1,38	1,11	1,40	1,65	1,40
29	1,51	1,61	1,28	1,34	1,67	1,42	1,04	1,30	1,56	1,16
30	1,53	1,56	1,29	1,36	1,64	1,44	1,12	1,30	1,40	1,19
Av	1,50	1,54	1,25	1,34	1,49	1,39	1,10	1,23	1,43	1,15
1-30 Δ	8%	17%	20%	25%	32%	14%	5%	13%	14%	14%

Table A.2.6: Pearson Coefficient Estimations of Stock Market Indices for 2005-2013

Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,29	0,43	0,16	0,15	0,34	0,35	0,11	0,23	0,32	0,03
2	0,46	0,49	0,31	0,32	0,40	0,41	0,13	0,26	0,40	0,16
3	0,48	0,50	0,32	0,35	0,39	0,41	0,11	0,27	0,41	0,19
4	0,48	0,52	0,34	0,34	0,40	0,41	0,12	0,28	0,40	0,24
5	0,49	0,52	0,32	0,34	0,42	0,41	0,10	0,27	0,41	0,24
6	0,53	0,52	0,36	0,38	0,45	0,43	0,11	0,28	0,41	0,24
7	0,48	0,52	0,34	0,37	0,42	0,44	0,11	0,29	0,37	0,23
8	0,52	0,51	0,36	0,40	0,46	0,42	0,12	0,30	0,35	0,23
9	0,52	0,55	0,39	0,44	0,51	0,47	0,16	0,32	0,41	0,26
10	0,51	0,54	0,37	0,44	0,52	0,47	0,17	0,33	0,39	0,27
11	0,55	0,57	0,40	0,46	0,53	0,48	0,17	0,36	0,43	0,22
12	0,58	0,59	0,40	0,48	0,55	0,48	0,19	0,35	0,44	0,23
13	0,57	0,58	0,41	0,46	0,57	0,49	0,21	0,36	0,44	0,26
14	0,56	0,57	0,40	0,49	0,57	0,50	0,21	0,37	0,44	0,26
15	0,60	0,59	0,42	0,49	0,57	0,49	0,18	0,36	0,44	0,26
16	0,59	0,60	0,43	0,51	0,59	0,51	0,23	0,41	0,47	0,30
17	0,55	0,57	0,40	0,48	0,57	0,49	0,20	0,36	0,43	0,23
18	0,60	0,60	0,42	0,50	0,60	0,50	0,21	0,38	0,47	0,27
19	0,62	0,62	0,43	0,52	0,61	0,51	0,19	0,41	0,49	0,27
20	0,59	0,59	0,41	0,51	0,61	0,51	0,20	0,37	0,47	0,26
21	0,59	0,59	0,41	0,51	0,62	0,51	0,22	0,42	0,45	0,25
22	0,61	0,61	0,41	0,51	0,60	0,48	0,19	0,39	0,44	0,26
23	0,65	0,63	0,43	0,54	0,62	0,51	0,19	0,40	0,49	0,29
24	0,67	0,65	0,45	0,54	0,63	0,52	0,21	0,45	0,52	0,31
25	0,62	0,61	0,39	0,49	0,63	0,51	0,23	0,41	0,46	0,27
26	0,68	0,64	0,44	0,56	0,63	0,53	0,24	0,45	0,48	0,30
27	0,67	0,65	0,44	0,53	0,66	0,54	0,19	0,45	0,54	0,30
28	0,72	0,69	0,48	0,58	0,66	0,58	0,24	0,50	0,53	0,36
29	0,67	0,64	0,44	0,54	0,65	0,53	0,24	0,45	0,49	0,28
30	0,68	0,63	0,43	0,54	0,65	0,54	0,26	0,45	0,46	0,29
Av	0,57	0,58	0,39	0,46	0,55	0,48	0,18	0,36	0,44	0,25
1-30 Δ	135%	45%	172%	259%	94%	53%	140%	95%	44%	908%

Table A.2.7: Spearman Coefficient Estimations of Stock Market Indices for 2005-2013
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,44	0,36	0,11	0,11	0,30	0,30	0,11	0,19	0,27	0,18
2	0,48	0,46	0,27	0,29	0,37	0,38	0,14	0,24	0,36	0,20
3	0,50	0,48	0,27	0,31	0,35	0,40	0,14	0,24	0,38	0,20
4	0,49	0,52	0,29	0,29	0,41	0,39	0,15	0,24	0,38	0,22
5	0,48	0,50	0,26	0,29	0,40	0,37	0,12	0,23	0,39	0,18
6	0,49	0,51	0,27	0,30	0,43	0,40	0,14	0,24	0,37	0,17
7	0,43	0,48	0,24	0,27	0,37	0,36	0,14	0,23	0,31	0,12
8	0,44	0,46	0,23	0,29	0,39	0,34	0,16	0,21	0,31	0,12
9	0,49	0,51	0,25	0,30	0,44	0,40	0,17	0,24	0,33	0,16
10	0,45	0,45	0,23	0,31	0,41	0,38	0,19	0,23	0,32	0,15
11	0,50	0,51	0,31	0,35	0,44	0,41	0,18	0,27	0,37	0,15
12	0,52	0,55	0,32	0,42	0,48	0,43	0,19	0,28	0,41	0,19
13	0,46	0,52	0,29	0,36	0,45	0,42	0,22	0,29	0,40	0,18
14	0,49	0,50	0,31	0,41	0,45	0,44	0,21	0,27	0,41	0,16
15	0,48	0,50	0,31	0,38	0,43	0,44	0,19	0,25	0,39	0,15
16	0,48	0,50	0,29	0,40	0,46	0,44	0,24	0,28	0,42	0,17
17	0,49	0,48	0,31	0,39	0,45	0,45	0,23	0,23	0,43	0,14
18	0,53	0,49	0,34	0,42	0,50	0,46	0,25	0,28	0,41	0,18
19	0,52	0,53	0,33	0,45	0,52	0,48	0,23	0,32	0,48	0,15
20	0,52	0,52	0,33	0,45	0,50	0,48	0,22	0,25	0,48	0,18
21	0,46	0,47	0,25	0,39	0,50	0,43	0,23	0,27	0,38	0,13
22	0,49	0,50	0,28	0,38	0,50	0,43	0,21	0,26	0,38	0,16
23	0,54	0,52	0,32	0,42	0,50	0,44	0,22	0,26	0,41	0,21
24	0,53	0,50	0,30	0,40	0,51	0,44	0,22	0,32	0,46	0,19
25	0,44	0,44	0,22	0,32	0,50	0,43	0,21	0,22	0,36	0,14
26	0,60	0,58	0,33	0,45	0,53	0,46	0,29	0,31	0,44	0,18
27	0,53	0,50	0,30	0,41	0,53	0,48	0,22	0,28	0,47	0,18
28	0,56	0,57	0,32	0,44	0,53	0,49	0,28	0,32	0,45	0,20
29	0,55	0,51	0,26	0,38	0,52	0,46	0,22	0,24	0,43	0,10
30	0,62	0,59	0,28	0,43	0,59	0,50	0,23	0,31	0,38	0,18
Av	0,50	0,50	0,28	0,36	0,46	0,42	0,20	0,26	0,39	0,17
1-30 Δ	42%	63%	146%	275%	100%	66%	116%	58%	38%	-2%

Table A.2.8: Kendall Coefficient Estimations of Stock Market Indices for 2005-2013

Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S.Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,31	0,26	0,08	0,08	0,20	0,21	0,07	0,13	0,19	0,12
2	0,35	0,33	0,18	0,20	0,26	0,27	0,09	0,17	0,25	0,14
3	0,36	0,34	0,19	0,21	0,25	0,27	0,10	0,17	0,27	0,14
4	0,35	0,37	0,20	0,20	0,28	0,27	0,10	0,17	0,27	0,15
5	0,34	0,35	0,17	0,20	0,28	0,26	0,08	0,16	0,27	0,13
6	0,34	0,36	0,18	0,21	0,30	0,27	0,10	0,17	0,26	0,12
7	0,30	0,34	0,16	0,19	0,26	0,25	0,10	0,16	0,22	0,08
8	0,31	0,33	0,16	0,20	0,28	0,24	0,11	0,15	0,22	0,08
9	0,35	0,37	0,18	0,21	0,31	0,28	0,11	0,16	0,23	0,11
10	0,32	0,32	0,16	0,22	0,29	0,27	0,13	0,16	0,23	0,10
11	0,35	0,37	0,21	0,24	0,31	0,29	0,12	0,19	0,26	0,10
12	0,36	0,39	0,22	0,29	0,34	0,30	0,13	0,19	0,29	0,13
13	0,34	0,38	0,20	0,25	0,33	0,29	0,15	0,20	0,28	0,12
14	0,35	0,36	0,21	0,29	0,33	0,31	0,14	0,19	0,29	0,11
15	0,34	0,35	0,22	0,26	0,31	0,31	0,13	0,18	0,27	0,10
16	0,35	0,36	0,20	0,29	0,33	0,31	0,17	0,20	0,30	0,12
17	0,35	0,35	0,22	0,28	0,32	0,31	0,15	0,16	0,31	0,10
18	0,38	0,35	0,24	0,30	0,35	0,32	0,17	0,19	0,29	0,13
19	0,36	0,38	0,22	0,31	0,37	0,33	0,16	0,22	0,34	0,11
20	0,36	0,38	0,21	0,31	0,36	0,33	0,15	0,17	0,34	0,12
21	0,33	0,33	0,18	0,28	0,35	0,30	0,16	0,18	0,27	0,09
22	0,34	0,36	0,19	0,27	0,36	0,29	0,15	0,19	0,27	0,11
23	0,38	0,37	0,21	0,29	0,35	0,31	0,16	0,18	0,29	0,14
24	0,38	0,36	0,21	0,29	0,35	0,30	0,15	0,22	0,33	0,13
25	0,31	0,31	0,15	0,22	0,35	0,30	0,14	0,16	0,25	0,09
26	0,43	0,42	0,23	0,32	0,37	0,32	0,20	0,21	0,32	0,13
27	0,38	0,36	0,20	0,30	0,38	0,33	0,16	0,20	0,34	0,12
28	0,40	0,41	0,22	0,31	0,37	0,34	0,19	0,23	0,32	0,14
29	0,39	0,36	0,18	0,27	0,37	0,32	0,15	0,17	0,31	0,08
30	0,43	0,42	0,19	0,30	0,42	0,37	0,16	0,21	0,27	0,12
Av	0,35	0,36	0,19	0,25	0,32	0,30	0,14	0,18	0,28	0,11
1-30 Δ	39%	64%	146%	283%	103%	75%	117%	60%	42%	-3%

Table A.2.9: Gaussian Copula Estimations of Stock Market Indices for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,34	0,24	0,07	0,08	0,17	0,14	0,01	0,12	0,16	0,06
2	0,33	0,35	0,15	0,18	0,23	0,19	-0,05	0,17	0,21	0,12
3	0,37	0,31	0,08	0,16	0,19	0,24	-0,06	0,12	0,24	0,10
4	0,34	0,39	0,14	0,10	0,24	0,21	-0,01	0,16	0,23	0,17
5	0,37	0,33	0,05	0,09	0,25	0,20	-0,06	0,08	0,26	0,15
6	0,37	0,31	0,06	0,13	0,24	0,20	-0,06	0,08	0,21	0,14
7	0,34	0,32	0,06	0,09	0,21	0,29	-0,05	0,10	0,25	0,16
8	0,40	0,32	0,02	0,07	0,28	0,25	-0,06	0,01	0,21	0,15
9	0,41	0,42	0,10	0,15	0,28	0,23	0,00	0,03	0,24	0,18
10	0,46	0,43	0,13	0,13	0,35	0,27	0,04	0,06	0,33	0,24
11	0,40	0,43	0,09	0,22	0,31	0,37	0,04	0,10	0,27	0,21
12	0,47	0,42	0,09	0,19	0,32	0,37	0,06	0,00	0,27	0,19
13	0,24	0,45	0,15	0,23	0,31	0,27	0,05	0,13	0,33	0,18
14	0,42	0,45	0,18	0,31	0,34	0,44	0,08	0,17	0,35	0,17
15	0,51	0,46	0,17	0,30	0,28	0,32	0,05	0,11	0,33	0,19
16	0,46	0,43	0,14	0,27	0,32	0,39	0,09	0,18	0,36	0,17
17	0,41	0,38	0,15	0,22	0,30	0,37	0,03	0,10	0,28	0,11
18	0,46	0,38	0,13	0,23	0,28	0,35	0,04	0,12	0,31	0,10
19	0,36	0,39	0,10	0,23	0,30	0,31	0,00	0,12	0,30	0,08
20	0,43	0,39	0,17	0,28	0,31	0,38	-0,02	0,11	0,36	0,15
21	0,38	0,34	0,07	0,24	0,23	0,30	-0,06	0,11	0,28	0,03
22	0,37	0,35	0,03	0,14	0,30	0,28	0,05	0,08	0,22	0,03
23	0,51	0,45	0,10	0,22	0,36	0,42	-0,05	0,17	0,21	0,19
24	0,45	0,38	0,10	0,23	0,33	0,38	0,02	0,19	0,41	-0,01
25	0,42	0,38	0,09	0,21	0,33	0,37	-0,05	0,14	0,32	0,08
26	0,46	0,42	0,12	0,24	0,27	0,39	0,07	0,13	0,38	0,10
27	0,47	0,43	0,09	0,21	0,40	0,40	0,00	0,14	0,37	0,09
28	0,45	0,41	0,03	0,17	0,26	0,35	-0,02	0,09	0,32	0,06
29	0,45	0,39	0,07	0,17	0,31	0,38	0,07	0,09	0,34	0,02
30	0,43	0,36	-0,01	0,02	0,33	0,34	-0,06	0,06	0,08	0,05
Av	0,41	0,38	0,10	0,18	0,29	0,31	0,00	0,11	0,28	0,12
1-30 Δ	27%	52%	-116%	-71%	93%	150%	-534%	-51%	-48%	-27%

Table A.2.10: Gaussian Copula Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,48	0,48	0,17	0,16	0,41	0,44	0,17	0,28	0,38	0,26
2	0,55	0,52	0,37	0,37	0,47	0,50	0,23	0,31	0,45	0,27
3	0,52	0,55	0,37	0,38	0,48	0,50	0,23	0,32	0,43	0,24
4	0,56	0,58	0,43	0,45	0,50	0,51	0,25	0,36	0,49	0,32
5	0,51	0,53	0,37	0,41	0,44	0,45	0,22	0,30	0,44	0,23
6	0,48	0,51	0,36	0,42	0,46	0,45	0,28	0,34	0,42	0,22
7	0,49	0,48	0,33	0,40	0,39	0,41	0,22	0,31	0,36	0,17
8	0,50	0,46	0,35	0,41	0,41	0,36	0,23	0,30	0,35	0,15
9	0,50	0,48	0,36	0,44	0,45	0,38	0,26	0,33	0,40	0,10
10	0,52	0,56	0,42	0,50	0,52	0,44	0,30	0,38	0,47	0,20
11	0,49	0,55	0,37	0,46	0,47	0,45	0,34	0,35	0,45	0,12
12	0,50	0,50	0,34	0,45	0,51	0,40	0,25	0,29	0,39	0,14
13	0,45	0,48	0,38	0,45	0,46	0,40	0,20	0,31	0,42	0,14
14	0,52	0,55	0,36	0,47	0,56	0,37	0,19	0,31	0,40	0,20
15	0,46	0,51	0,36	0,46	0,55	0,44	0,30	0,36	0,41	0,16
16	0,49	0,51	0,35	0,39	0,44	0,37	0,24	0,24	0,46	0,09
17	0,40	0,40	0,35	0,42	0,55	0,42	0,24	0,28	0,43	0,15
18	0,38	0,61	0,39	0,47	0,56	0,48	0,29	0,32	0,49	0,28
19	0,34	0,41	0,37	0,39	0,36	0,33	0,23	0,22	0,31	0,21
20	0,50	0,56	0,46	0,49	0,56	0,49	0,28	0,37	0,49	0,31
21	0,49	0,54	0,39	0,44	0,60	0,50	0,31	0,44	0,44	0,22
22	0,23	0,34	0,39	0,56	0,52	0,41	0,23	0,31	0,35	0,25
23	0,35	0,57	0,43	0,48	0,60	0,55	0,31	0,49	0,54	0,34
24	0,36	0,33	0,40	0,44	0,55	0,45	0,30	0,34	0,48	0,27
25	0,42	0,42	0,39	0,32	0,51	0,35	0,10	0,42	0,39	0,33
26	0,40	0,55	0,48	0,48	0,52	0,38	0,21	0,51	0,46	0,43
27	0,44	0,58	0,32	0,48	0,57	0,51	0,35	0,51	0,46	0,33
28	0,36	0,52	0,34	0,40	0,58	0,49	0,41	0,41	0,47	0,33
29	0,39	0,48	0,37	0,35	0,56	0,44	0,34	0,43	0,45	0,27
30	0,60	0,52	0,40	0,44	0,58	0,43	0,43	0,45	0,40	0,30
Av	0,46	0,50	0,37	0,43	0,51	0,44	0,26	0,35	0,43	0,23
1-30 Δ	25%	7%	144%	166%	42%	-2%	154%	61%	4%	15%

Table A.2.11: Student's t-Copula Estimations of Stock Market Indices for Pre-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,36	0,26	0,07	0,08	0,18	0,15	0,02	0,13	0,17	0,06
2	0,36	0,39	0,16	0,19	0,24	0,21	-0,05	0,19	0,23	0,13
3	0,41	0,34	0,09	0,18	0,21	0,27	-0,06	0,14	0,27	0,11
4	0,38	0,43	0,16	0,11	0,27	0,23	-0,01	0,19	0,26	0,20
5	0,44	0,38	0,06	0,10	0,29	0,23	-0,07	0,09	0,30	0,18
6	0,43	0,36	0,07	0,15	0,28	0,25	-0,07	0,09	0,26	0,17
7	0,40	0,38	0,08	0,11	0,25	0,34	-0,06	0,12	0,30	0,20
8	0,46	0,38	0,03	0,09	0,34	0,30	-0,07	0,02	0,26	0,20
9	0,47	0,47	0,13	0,19	0,33	0,29	0,00	0,04	0,29	0,21
10	0,53	0,50	0,16	0,17	0,42	0,35	0,06	0,08	0,41	0,30
11	0,48	0,51	0,12	0,28	0,39	0,44	0,05	0,13	0,33	0,26
12	0,58	0,50	0,13	0,26	0,44	0,47	0,09	-0,01	0,37	0,26
13	0,33	0,53	0,22	0,31	0,41	0,36	0,08	0,18	0,42	0,24
14	0,53	0,52	0,25	0,41	0,43	0,52	0,12	0,24	0,45	0,24
15	0,59	0,51	0,22	0,35	0,35	0,42	0,06	0,14	0,42	0,25
16	0,57	0,51	0,21	0,35	0,41	0,49	0,16	0,24	0,46	0,24
17	0,52	0,47	0,20	0,30	0,40	0,46	0,16	0,13	0,35	0,15
18	0,54	0,45	0,17	0,33	0,37	0,43	0,05	0,16	0,39	0,15
19	0,45	0,46	0,14	0,31	0,40	0,38	0,03	0,15	0,37	0,10
20	0,54	0,48	0,23	0,37	0,44	0,47	-0,03	0,15	0,44	0,21
21	0,50	0,44	0,11	0,33	0,33	0,40	-0,09	0,16	0,38	0,06
22	0,51	0,44	0,05	0,22	0,44	0,39	0,08	0,06	0,33	0,05
23	0,62	0,54	0,13	0,33	0,50	0,55	-0,08	0,25	0,32	0,29
24	0,58	0,51	0,15	0,31	0,44	0,50	0,04	0,24	0,53	-0,01
25	0,55	0,50	0,14	0,30	0,47	0,49	-0,09	0,21	0,44	0,14
26	0,58	0,52	0,19	0,31	0,38	0,49	0,15	0,19	0,47	0,14
27	0,59	0,53	0,14	0,29	0,53	0,50	0,16	0,21	0,47	0,14
28	0,63	0,55	0,05	0,27	0,40	0,47	0,07	0,13	0,45	0,12
29	0,60	0,52	0,11	0,25	0,44	0,53	0,10	0,14	0,46	0,04
30	0,58	0,49	0,00	0,06	0,47	0,51	-0,02	0,04	0,13	0,10
Av	0,50	0,46	0,13	0,24	0,38	0,40	0,03	0,14	0,36	0,16
1-30 Δ	60%	94%	-99%	-32%	161%	252%	-240%	-65%	-21%	55%

Table A.2.12: Student's t-Copula Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,53	0,49	0,17	0,17	0,43	0,46	0,17	0,28	0,40	0,26
2	0,62	0,56	0,39	0,42	0,50	0,54	0,27	0,34	0,47	0,27
3	0,59	0,59	0,39	0,41	0,53	0,54	0,27	0,35	0,49	0,25
4	0,63	0,64	0,46	0,49	0,56	0,56	0,29	0,39	0,55	0,34
5	0,58	0,59	0,41	0,45	0,50	0,49	0,28	0,35	0,49	0,24
6	0,53	0,57	0,38	0,44	0,52	0,48	0,33	0,34	0,46	0,19
7	0,55	0,56	0,36	0,41	0,48	0,46	0,28	0,33	0,44	0,18
8	0,54	0,53	0,36	0,42	0,51	0,40	0,33	0,32	0,43	0,14
9	0,52	0,53	0,40	0,47	0,50	0,47	0,33	0,38	0,47	0,09
10	0,58	0,64	0,47	0,55	0,57	0,51	0,37	0,44	0,56	0,24
11	0,53	0,56	0,37	0,46	0,52	0,49	0,39	0,37	0,47	0,12
12	0,53	0,50	0,38	0,44	0,52	0,41	0,29	0,30	0,45	0,13
13	0,52	0,53	0,43	0,50	0,54	0,46	0,24	0,34	0,50	0,18
14	0,56	0,61	0,40	0,43	0,61	0,44	0,23	0,39	0,49	0,23
15	0,51	0,56	0,37	0,43	0,58	0,49	0,35	0,40	0,44	0,17
16	0,53	0,58	0,40	0,45	0,52	0,41	0,27	0,28	0,51	0,10
17	0,45	0,48	0,43	0,45	0,61	0,46	0,30	0,29	0,45	0,15
18	0,43	0,66	0,44	0,51	0,60	0,51	0,34	0,32	0,54	0,34
19	0,39	0,47	0,43	0,36	0,42	0,37	0,26	0,17	0,41	0,25
20	0,57	0,62	0,53	0,55	0,63	0,55	0,30	0,42	0,56	0,37
21	0,55	0,58	0,44	0,47	0,65	0,56	0,35	0,47	0,45	0,27
22	0,25	0,42	0,44	0,60	0,60	0,46	0,26	0,36	0,35	0,32
23	0,41	0,64	0,36	0,45	0,68	0,60	0,39	0,53	0,60	0,40
24	0,43	0,41	0,44	0,35	0,64	0,45	0,34	0,42	0,48	0,32
25	0,48	0,48	0,46	0,39	0,58	0,43	0,12	0,48	0,43	0,36
26	0,47	0,63	0,57	0,56	0,62	0,45	0,21	0,60	0,54	0,47
27	0,47	0,66	0,37	0,54	0,66	0,59	0,45	0,58	0,53	0,39
28	0,45	0,63	0,41	0,48	0,65	0,59	0,50	0,49	0,57	0,41
29	0,47	0,55	0,45	0,38	0,64	0,52	0,44	0,49	0,54	0,30
30	0,67	0,57	0,44	0,46	0,65	0,52	0,53	0,53	0,43	0,37
Av	0,51	0,56	0,41	0,45	0,57	0,49	0,32	0,39	0,48	0,26
1-30 Δ	28%	17%	166%	173%	53%	14%	205%	90%	8%	45%

Table A.2.13: Clayton Copula Estimations of Stock Market Indices for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	ASS1	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,46	0,31	0,06	0,09	0,19	0,18	0,02	0,14	0,19	0,10
2	0,46	0,48	0,14	0,21	0,28	0,27	0,00	0,20	0,31	0,14
3	0,52	0,46	0,09	0,16	0,23	0,32	0,00	0,10	0,34	0,10
4	0,53	0,54	0,16	0,16	0,30	0,29	0,00	0,18	0,34	0,18
5	0,50	0,45	0,06	0,10	0,28	0,27	0,00	0,05	0,34	0,17
6	0,55	0,44	0,13	0,18	0,32	0,32	0,00	0,12	0,29	0,18
7	0,48	0,41	0,09	0,11	0,32	0,44	0,00	0,09	0,29	0,20
8	0,49	0,38	0,09	0,13	0,38	0,42	0,00	0,03	0,24	0,19
9	0,54	0,52	0,12	0,16	0,37	0,37	0,00	0,04	0,27	0,19
10	0,69	0,57	0,18	0,22	0,49	0,49	0,01	0,06	0,44	0,33
11	0,62	0,59	0,22	0,30	0,46	0,55	0,00	0,14	0,41	0,25
12	0,74	0,56	0,16	0,24	0,53	0,58	0,00	0,00	0,38	0,27
13	0,34	0,54	0,25	0,24	0,44	0,36	0,00	0,11	0,38	0,17
14	0,65	0,57	0,33	0,42	0,47	0,62	0,07	0,21	0,52	0,24
15	0,84	0,63	0,28	0,36	0,49	0,47	0,00	0,05	0,49	0,26
16	0,76	0,58	0,27	0,35	0,53	0,61	0,07	0,21	0,54	0,22
17	0,65	0,51	0,18	0,19	0,47	0,47	0,10	0,00	0,28	0,09
18	0,63	0,45	0,16	0,24	0,41	0,45	0,00	0,06	0,34	0,02
19	0,58	0,49	0,16	0,30	0,41	0,47	0,00	0,00	0,43	0,05
20	0,68	0,50	0,21	0,26	0,47	0,50	0,00	0,00	0,37	0,10
21	0,57	0,41	0,06	0,14	0,31	0,41	0,00	0,00	0,29	0,00
22	0,61	0,42	0,04	0,14	0,40	0,39	0,06	0,00	0,27	0,00
23	0,74	0,56	0,14	0,27	0,50	0,56	0,00	0,08	0,29	0,14
24	0,68	0,54	0,15	0,24	0,46	0,49	0,15	0,04	0,55	0,00
25	0,59	0,46	0,05	0,14	0,48	0,50	0,00	0,00	0,31	0,00
26	0,61	0,48	0,05	0,12	0,38	0,47	0,01	0,00	0,33	0,00
27	0,67	0,53	0,04	0,17	0,51	0,52	0,05	0,01	0,36	0,05
28	0,76	0,52	0,00	0,16	0,38	0,50	0,23	0,00	0,37	0,00
29	0,67	0,49	0,02	0,11	0,41	0,53	0,08	0,00	0,34	0,00
30	0,62	0,47	0,00	0,07	0,41	0,50	0,00	0,00	0,10	0,03
Av	0,61	0,50	0,13	0,20	0,40	0,44	0,03	0,06	0,35	0,12
1-30 Δ	33%	50%	-100%	-27%	111%	175%	-100%	-100%	-50%	-68%

Table A.2.14: Clayton Copula Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,84	0,82	0,23	0,25	0,63	0,68	0,22	0,44	0,65	0,38
2	1,14	0,99	0,55	0,62	0,76	0,91	0,32	0,51	0,82	0,40
3	0,98	0,97	0,57	0,58	0,74	0,87	0,36	0,46	0,77	0,35
4	1,01	1,08	0,71	0,72	0,85	0,92	0,33	0,60	0,87	0,56
5	0,99	1,01	0,63	0,71	0,79	0,73	0,36	0,48	0,87	0,40
6	0,92	0,94	0,60	0,70	0,81	0,86	0,37	0,64	0,69	0,37
7	0,73	0,85	0,52	0,58	0,64	0,62	0,34	0,46	0,69	0,40
8	0,89	0,88	0,62	0,69	0,86	0,70	0,44	0,54	0,63	0,37
9	0,99	0,99	0,61	0,84	0,84	0,92	0,44	0,59	0,83	0,25
10	0,93	1,11	0,71	0,97	0,81	0,78	0,55	0,73	0,95	0,41
11	0,81	1,12	0,69	0,76	1,00	0,90	0,48	0,62	0,86	0,30
12	0,91	0,99	0,64	0,90	1,03	0,82	0,45	0,51	0,78	0,41
13	0,80	0,81	0,66	0,94	0,95	0,75	0,40	0,68	0,82	0,35
14	1,12	0,95	0,63	0,93	1,20	0,85	0,32	0,65	0,82	0,53
15	0,84	1,05	0,78	1,14	1,30	0,97	0,60	0,70	0,81	0,39
16	0,93	1,01	0,59	0,87	0,90	0,67	0,42	0,47	0,86	0,31
17	0,90	0,99	0,84	1,04	1,33	1,09	0,42	0,75	0,98	0,44
18	0,66	1,03	0,74	0,86	1,24	0,89	0,44	0,61	0,82	0,53
19	0,44	0,65	0,73	0,90	0,75	0,80	0,45	0,43	0,71	0,52
20	0,70	0,80	0,71	0,94	1,03	0,87	0,60	0,66	0,76	0,66
21	0,94	1,12	0,83	1,11	1,46	1,08	0,57	1,01	0,92	0,55
22	0,49	0,78	0,86	1,17	0,94	0,74	0,44	0,55	0,61	0,58
23	0,74	1,13	0,92	1,14	1,43	1,44	0,49	1,11	1,17	0,77
24	0,67	0,58	1,02	1,11	0,86	0,80	0,60	0,61	0,88	0,67
25	0,83	0,74	0,92	0,84	0,89	0,78	0,34	0,87	0,89	0,69
26	1,08	1,12	1,02	1,28	0,94	0,86	0,55	1,02	0,98	1,00
27	0,80	0,85	0,57	0,98	1,08	0,92	0,58	0,79	0,68	0,52
28	0,82	1,00	0,76	0,98	1,11	1,07	0,64	0,81	0,82	0,66
29	0,66	0,79	0,80	0,98	0,98	0,76	0,62	0,83	0,92	0,56
30	1,12	1,21	1,10	1,55	1,30	1,19	0,85	0,99	1,00	0,78
Av	0,86	0,95	0,72	0,90	0,98	0,87	0,47	0,67	0,83	0,50
1-30 Δ	32%	48%	381%	517%	107%	76%	290%	126%	55%	106%

Table A.2.15: Frank Copula Estimations of Stock Market Indices for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	ASS1	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	2,26	1,54	0,30	0,44	0,99	0,85	0,17	0,67	0,89	0,25
2	2,24	2,61	0,81	1,13	1,48	1,23	-0,16	1,07	1,40	0,77
3	2,50	2,16	0,47	0,97	1,04	1,58	-0,20	0,69	1,53	0,66
4	2,32	2,65	0,84	0,56	1,43	1,25	0,03	0,89	1,45	1,03
5	2,62	2,16	0,24	0,53	1,43	1,29	-0,44	0,37	1,48	0,85
6	2,44	2,05	0,24	0,69	1,50	1,48	-0,45	0,43	1,15	0,85
7	2,16	2,28	0,23	0,41	1,23	1,70	-0,30	0,40	1,38	0,87
8	2,59	2,21	0,03	0,27	1,78	1,62	-0,45	-0,19	1,14	0,80
9	2,89	3,00	0,53	0,91	1,75	1,70	-0,13	0,18	1,25	1,07
10	3,54	3,25	0,95	1,03	2,40	2,06	0,27	0,41	2,19	1,61
11	2,69	3,05	0,54	1,33	2,06	2,65	0,35	0,52	1,65	1,20
12	3,30	3,01	0,68	1,11	2,23	2,65	0,40	0,18	1,79	1,20
13	2,04	3,43	1,17	1,54	2,16	1,87	0,50	0,95	2,10	1,20
14	3,11	3,10	1,40	2,34	2,26	3,04	0,65	1,01	2,54	1,11
15	3,63	3,14	1,19	1,99	1,82	2,25	0,63	0,57	2,30	0,96
16	3,22	2,96	1,07	1,89	1,93	2,73	0,95	1,18	2,53	0,99
17	3,04	2,70	1,28	1,65	2,00	2,67	0,78	0,57	1,85	0,56
18	3,58	2,60	1,22	2,05	1,99	2,56	0,54	0,99	2,28	0,74
19	2,52	2,93	0,90	1,84	2,16	2,26	0,34	0,99	2,19	0,42
20	3,30	2,98	1,28	2,08	2,38	2,68	-0,03	0,68	2,62	1,10
21	2,60	2,19	0,57	1,69	1,46	1,98	-0,18	0,71	2,05	0,09
22	2,65	2,34	0,38	0,98	2,24	1,95	0,75	0,52	1,60	0,04
23	3,78	3,15	0,70	1,60	2,59	3,02	-0,04	1,29	1,39	1,21
24	3,12	2,74	0,76	1,84	2,26	2,71	0,54	1,37	3,26	0,07
25	2,94	2,62	0,70	1,57	2,40	2,46	-0,15	0,92	2,47	0,53
26	3,46	3,20	0,95	1,86	1,78	2,69	0,92	1,02	3,00	0,49
27	3,74	3,43	0,89	1,80	3,02	2,90	0,47	1,01	2,84	0,47
28	3,81	3,07	0,40	1,40	2,18	2,55	0,24	0,78	2,44	0,39
29	3,58	3,06	0,75	1,26	2,16	2,72	0,76	0,73	2,43	0,10
30	3,51	2,85	0,08	0,45	2,49	2,68	-0,05	0,33	0,67	0,55
Av	2,97	2,75	0,72	1,31	1,95	2,19	0,22	0,71	1,93	0,74
1-30 Δ	55%	86%	-73%	3%	151%	217%	-126%	-51%	-24%	122%

Table A.2.16: Frank Copula Estimations of Stock Market Indices for Post-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	3,70	3,39	0,99	1,00	2,87	3,06	1,04	1,78	2,65	1,56
2	4,74	4,07	2,51	2,70	3,50	3,88	1,66	2,18	3,34	1,71
3	4,41	4,43	2,55	2,73	3,79	3,78	1,76	2,22	3,43	1,51
4	4,94	4,97	3,10	3,34	4,08	4,04	1,88	2,51	3,90	2,13
5	4,29	4,35	2,64	3,10	3,55	3,34	1,81	2,22	3,44	1,40
6	3,78	4,23	2,42	3,08	3,58	3,24	2,14	2,21	3,23	1,02
7	3,95	4,29	2,24	2,65	3,42	3,02	1,84	2,17	3,05	1,03
8	3,84	3,70	2,23	2,82	3,44	2,56	2,13	1,97	2,86	0,76
9	3,85	3,85	2,49	3,37	3,69	3,17	2,11	2,55	3,39	0,50
10	4,23	5,09	3,01	3,78	3,99	3,35	2,31	2,95	4,17	1,38
11	3,70	4,07	2,29	3,04	3,57	3,21	2,38	2,31	3,20	0,60
12	3,84	3,81	2,49	3,15	3,64	2,64	1,67	1,88	3,13	0,66
13	3,47	3,61	2,79	3,25	3,90	3,09	1,39	2,30	3,42	0,99
14	3,85	4,34	2,58	3,04	4,59	2,82	1,38	2,41	3,31	1,31
15	3,45	3,85	2,45	3,00	4,10	3,00	2,02	2,38	3,03	0,93
16	3,79	4,12	2,60	3,02	3,67	2,50	1,60	1,67	3,60	0,56
17	2,88	3,19	2,72	2,98	3,97	3,01	1,79	2,00	3,31	0,95
18	2,23	4,68	2,68	2,97	4,44	3,36	2,03	1,97	3,53	1,75
19	2,52	3,07	2,56	2,38	2,81	2,24	1,42	1,22	2,58	1,42
20	3,56	4,33	3,40	3,38	4,20	3,56	2,01	2,80	3,61	2,34
21	3,45	3,96	2,85	2,90	4,90	3,61	2,26	3,07	3,18	1,57
22	1,49	2,58	2,72	3,92	3,80	2,80	1,65	2,02	2,01	1,73
23	2,27	4,36	2,61	3,19	4,52	4,23	2,07	3,65	4,17	2,35
24	2,26	2,19	2,89	2,77	4,28	2,96	2,15	2,07	3,51	1,96
25	2,93	3,07	2,78	1,68	3,98	2,70	0,64	2,77	2,76	2,10
26	3,29	4,23	3,74	3,01	4,50	2,99	1,62	3,77	3,49	3,23
27	3,18	4,71	2,08	3,00	5,47	4,06	2,43	3,88	3,23	2,29
28	2,46	4,01	2,34	2,40	4,90	4,01	2,95	2,92	3,15	2,43
29	3,28	3,59	2,86	2,38	4,87	3,29	2,57	3,30	3,52	1,81
30	4,59	4,06	3,10	3,39	4,43	3,40	3,00	3,12	2,82	2,21
Av	3,47	3,94	2,62	2,91	4,02	3,23	1,92	2,48	3,27	1,54
1-30 Δ	24%	20%	213%	239%	54%	11%	188%	75%	6%	42%

Table A.2.17: Gumbel Copula Estimations of Stock Market Indices for Pre-Crisis Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	ASS1	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	1,25	1,16	1,03	1,05	1,08	1,07	1,01	1,06	1,08	1,02
2	1,26	1,30	1,08	1,11	1,15	1,12	1,00	1,11	1,12	1,06
3	1,33	1,22	1,03	1,11	1,11	1,18	1,00	1,08	1,16	1,05
4	1,30	1,34	1,09	1,04	1,17	1,15	1,00	1,12	1,15	1,12
5	1,39	1,28	1,05	1,08	1,19	1,17	1,00	1,07	1,19	1,12
6	1,33	1,25	1,01	1,06	1,16	1,15	1,00	1,02	1,14	1,07
7	1,30	1,32	1,01	1,05	1,11	1,22	1,00	1,06	1,19	1,10
8	1,41	1,30	1,00	1,02	1,21	1,22	1,00	1,00	1,18	1,10
9	1,45	1,40	1,07	1,12	1,19	1,21	1,00	1,01	1,19	1,12
10	1,52	1,45	1,10	1,11	1,30	1,26	1,00	1,06	1,31	1,18
11	1,38	1,44	1,03	1,20	1,29	1,38	1,05	1,04	1,23	1,15
12	1,57	1,45	1,07	1,17	1,34	1,41	1,10	1,00	1,29	1,16
13	1,30	1,57	1,15	1,27	1,32	1,28	1,07	1,12	1,36	1,18
14	1,54	1,46	1,19	1,40	1,36	1,48	1,09	1,16	1,40	1,16
15	1,58	1,41	1,12	1,32	1,21	1,36	1,03	1,11	1,34	1,14
16	1,57	1,46	1,15	1,31	1,27	1,44	1,12	1,19	1,38	1,15
17	1,50	1,40	1,16	1,31	1,30	1,42	1,05	1,11	1,27	1,10
18	1,54	1,38	1,12	1,34	1,28	1,32	1,03	1,15	1,35	1,10
19	1,35	1,44	1,09	1,24	1,37	1,24	1,04	1,15	1,24	1,05
20	1,52	1,46	1,16	1,36	1,42	1,39	1,00	1,17	1,39	1,19
21	1,46	1,38	1,10	1,34	1,24	1,33	1,01	1,16	1,37	1,09
22	1,47	1,41	1,06	1,17	1,43	1,29	1,05	1,14	1,29	1,05
23	1,68	1,54	1,15	1,34	1,51	1,56	1,00	1,26	1,29	1,26
24	1,62	1,50	1,12	1,30	1,38	1,48	1,01	1,30	1,57	1,01
25	1,56	1,48	1,17	1,34	1,44	1,44	1,03	1,23	1,47	1,13
26	1,67	1,56	1,21	1,34	1,28	1,42	1,14	1,21	1,54	1,10
27	1,73	1,62	1,18	1,30	1,57	1,42	1,06	1,20	1,47	1,11
28	1,84	1,60	1,11	1,27	1,40	1,39	1,00	1,19	1,45	1,15
29	1,73	1,59	1,12	1,21	1,39	1,47	1,04	1,23	1,43	1,07
30	1,65	1,47	1,08	1,06	1,42	1,52	1,00	1,17	1,13	1,13
Av	1,49	1,42	1,10	1,21	1,30	1,33	1,03	1,13	1,30	1,11
1-30 Δ	32%	27%	5%	1%	32%	42%	-1%	10%	4%	11%

Table A.2.18: Gumbel Copula Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	1,52	1,47	1,11	1,12	1,38	1,42	1,11	1,22	1,34	1,18
2	1,66	1,57	1,30	1,34	1,49	1,53	1,19	1,28	1,44	1,21
3	1,61	1,60	1,30	1,34	1,51	1,50	1,18	1,27	1,43	1,17
4	1,72	1,72	1,38	1,43	1,57	1,55	1,21	1,32	1,52	1,23
5	1,60	1,59	1,32	1,39	1,45	1,43	1,20	1,26	1,45	1,12
6	1,54	1,60	1,32	1,43	1,48	1,43	1,26	1,29	1,46	1,12
7	1,54	1,54	1,28	1,37	1,43	1,39	1,22	1,29	1,42	1,09
8	1,56	1,52	1,29	1,40	1,48	1,33	1,25	1,26	1,41	1,07
9	1,56	1,53	1,32	1,45	1,51	1,42	1,27	1,31	1,47	1,05
10	1,57	1,77	1,35	1,51	1,59	1,51	1,30	1,36	1,59	1,13
11	1,50	1,60	1,29	1,45	1,53	1,44	1,31	1,31	1,47	1,08
12	1,58	1,59	1,36	1,47	1,58	1,38	1,20	1,25	1,46	1,06
13	1,47	1,54	1,35	1,44	1,49	1,38	1,16	1,29	1,49	1,10
14	1,58	1,67	1,37	1,47	1,70	1,40	1,15	1,35	1,50	1,15
15	1,50	1,54	1,36	1,45	1,63	1,39	1,23	1,30	1,45	1,09
16	1,43	1,55	1,29	1,33	1,47	1,28	1,20	1,18	1,50	1,00
17	1,36	1,42	1,35	1,37	1,55	1,37	1,19	1,27	1,49	1,09
18	1,28	1,73	1,35	1,42	1,69	1,48	1,26	1,26	1,54	1,19
19	1,30	1,39	1,31	1,31	1,33	1,25	1,16	1,15	1,34	1,16
20	1,56	1,67	1,50	1,47	1,67	1,49	1,23	1,38	1,56	1,34
21	1,46	1,52	1,34	1,33	1,66	1,46	1,27	1,36	1,45	1,15
22	1,19	1,32	1,32	1,57	1,62	1,41	1,15	1,23	1,29	1,23
23	1,28	1,63	1,45	1,51	1,72	1,62	1,29	1,58	1,65	1,33
24	1,29	1,26	1,34	1,42	1,72	1,55	1,26	1,26	1,60	1,30
25	1,35	1,47	1,34	1,18	1,54	1,32	1,03	1,36	1,38	1,29
26	1,48	1,62	1,58	1,41	1,74	1,43	1,20	1,56	1,52	1,52
27	1,50	1,77	1,26	1,42	1,79	1,61	1,33	1,54	1,48	1,36
28	1,30	1,64	1,29	1,30	1,74	1,57	1,44	1,41	1,54	1,35
29	1,42	1,47	1,32	1,30	1,68	1,43	1,33	1,44	1,51	1,24
30	1,69	1,61	1,39	1,48	1,61	1,41	1,44	1,39	1,39	1,24
Av	1,48	1,56	1,34	1,40	1,58	1,44	1,23	1,32	1,47	1,19
1-30 Δ	11%	10%	25%	32%	17%	-1%	30%	14%	3%	5%

Table A.2.19: Pearson Correlation Estimations of Stock Market Indices for Pre-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,29	0,50	0,19	0,18	0,39	0,44	0,17	0,29	0,39	0,29
2	0,49	0,53	0,37	0,37	0,45	0,49	0,22	0,31	0,46	0,31
3	0,47	0,54	0,38	0,40	0,42	0,48	0,21	0,32	0,43	0,28
4	0,52	0,57	0,42	0,43	0,46	0,49	0,22	0,35	0,48	0,31
5	0,49	0,56	0,41	0,44	0,42	0,46	0,20	0,34	0,45	0,26
6	0,53	0,57	0,42	0,45	0,46	0,48	0,27	0,39	0,42	0,24
7	0,52	0,59	0,43	0,47	0,51	0,49	0,24	0,37	0,44	0,28
8	0,57	0,58	0,45	0,49	0,52	0,46	0,23	0,39	0,41	0,28
9	0,55	0,59	0,44	0,50	0,57	0,46	0,30	0,41	0,42	0,24
10	0,57	0,61	0,47	0,54	0,57	0,49	0,29	0,42	0,46	0,26
11	0,57	0,62	0,47	0,55	0,58	0,51	0,34	0,44	0,49	0,24
12	0,58	0,61	0,48	0,57	0,61	0,51	0,32	0,43	0,44	0,28
13	0,55	0,62	0,47	0,57	0,62	0,50	0,30	0,44	0,45	0,27
14	0,60	0,64	0,50	0,58	0,63	0,50	0,29	0,46	0,46	0,29
15	0,60	0,67	0,49	0,61	0,69	0,56	0,41	0,49	0,50	0,30
16	0,61	0,65	0,48	0,56	0,65	0,52	0,32	0,45	0,49	0,28
17	0,60	0,66	0,51	0,60	0,66	0,54	0,34	0,51	0,52	0,31
18	0,71	0,73	0,54	0,66	0,72	0,58	0,37	0,56	0,57	0,38
19	0,63	0,66	0,51	0,60	0,67	0,52	0,36	0,49	0,46	0,35
20	0,68	0,71	0,54	0,67	0,72	0,58	0,40	0,56	0,57	0,37
21	0,65	0,70	0,52	0,64	0,72	0,57	0,41	0,57	0,51	0,36
22	0,69	0,71	0,53	0,66	0,68	0,54	0,33	0,52	0,53	0,36
23	0,73	0,74	0,56	0,70	0,74	0,62	0,46	0,63	0,60	0,43
24	0,68	0,71	0,55	0,66	0,74	0,59	0,42	0,58	0,54	0,41
25	0,73	0,75	0,56	0,68	0,75	0,60	0,41	0,60	0,61	0,44
26	0,78	0,76	0,61	0,75	0,76	0,62	0,39	0,65	0,62	0,47
27	0,75	0,77	0,56	0,73	0,74	0,61	0,48	0,64	0,55	0,46
28	0,69	0,72	0,53	0,66	0,74	0,57	0,49	0,58	0,53	0,43
29	0,72	0,72	0,53	0,68	0,73	0,57	0,43	0,60	0,54	0,40
30	0,75	0,73	0,59	0,73	0,75	0,60	0,49	0,64	0,58	0,46
Av	0,61	0,65	0,48	0,57	0,62	0,53	0,34	0,48	0,50	0,33
1-30 Δ	161%	47%	210%	298%	91%	38%	185%	123%	47%	57%

Table A.2.20: Pearson Correlation Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,33	0,24	0,07	0,07	0,17	0,14	0,00	0,13	0,16	0,03
2	0,34	0,35	0,13	0,16	0,23	0,20	-0,05	0,16	0,23	0,09
3	0,36	0,32	0,08	0,14	0,19	0,22	-0,07	0,11	0,22	0,07
4	0,34	0,37	0,11	0,11	0,24	0,21	-0,05	0,15	0,22	0,17
5	0,37	0,35	0,07	0,10	0,26	0,21	-0,07	0,08	0,26	0,16
6	0,38	0,34	0,08	0,15	0,24	0,25	-0,07	0,10	0,23	0,14
7	0,36	0,36	0,10	0,13	0,25	0,31	-0,06	0,11	0,24	0,17
8	0,38	0,32	0,08	0,15	0,28	0,32	-0,07	0,09	0,23	0,16
9	0,40	0,39	0,11	0,15	0,28	0,31	-0,03	0,11	0,25	0,18
10	0,45	0,41	0,14	0,23	0,34	0,38	0,00	0,13	0,34	0,25
11	0,46	0,42	0,16	0,21	0,30	0,37	-0,03	0,16	0,31	0,21
12	0,47	0,41	0,16	0,23	0,32	0,38	-0,02	0,11	0,32	0,20
13	0,44	0,41	0,15	0,19	0,29	0,38	-0,03	0,14	0,33	0,18
14	0,49	0,43	0,19	0,30	0,34	0,45	-0,02	0,18	0,36	0,20
15	0,43	0,38	0,15	0,19	0,27	0,34	-0,06	0,08	0,28	0,14
16	0,46	0,42	0,14	0,23	0,31	0,40	0,02	0,16	0,36	0,19
17	0,42	0,37	0,14	0,18	0,30	0,36	-0,06	0,07	0,27	0,13
18	0,45	0,38	0,14	0,22	0,27	0,35	-0,02	0,12	0,31	0,11
19	0,41	0,38	0,13	0,22	0,28	0,32	-0,11	0,05	0,30	0,08
20	0,43	0,37	0,15	0,24	0,28	0,37	-0,11	0,07	0,32	0,13
21	0,37	0,32	0,07	0,17	0,21	0,30	-0,12	0,05	0,26	0,02
22	0,38	0,34	0,03	0,12	0,25	0,28	-0,06	0,05	0,23	0,04
23	0,49	0,45	0,14	0,23	0,34	0,41	-0,13	0,11	0,36	0,18
24	0,44	0,39	0,08	0,20	0,30	0,36	-0,08	0,11	0,39	0,08
25	0,41	0,36	0,07	0,17	0,29	0,35	-0,11	0,07	0,30	0,08
26	0,44	0,38	0,07	0,19	0,26	0,37	-0,06	0,06	0,34	0,09
27	0,47	0,40	0,05	0,18	0,34	0,40	-0,15	0,09	0,33	0,11
28	0,43	0,38	0,02	0,16	0,24	0,35	-0,16	0,06	0,30	0,08
29	0,45	0,37	0,07	0,16	0,30	0,38	-0,15	0,03	0,31	0,05
30	0,39	0,32	-0,06	0,07	0,22	0,33	-0,17	-0,01	0,22	-0,04
Av	0,41	0,37	0,10	0,18	0,27	0,33	-0,07	0,10	0,29	0,12
1-30 Δ	16%	35%	-186%	-2%	29%	139%	-10728%	-108%	41%	-207%

Table A.2.21: Spearman Correlation Estimations of Stock Market Indices for Pre-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,34	0,23	0,05	0,07	0,16	0,13	0,03	0,11	0,14	0,11
2	0,33	0,37	0,11	0,16	0,22	0,19	-0,01	0,15	0,22	0,12
3	0,37	0,33	0,08	0,14	0,16	0,22	-0,03	0,10	0,21	0,12
4	0,33	0,38	0,10	0,08	0,22	0,19	-0,03	0,13	0,18	0,15
5	0,37	0,37	0,06	0,10	0,24	0,21	-0,04	0,09	0,22	0,13
6	0,36	0,36	0,06	0,14	0,23	0,25	-0,06	0,08	0,17	0,14
7	0,34	0,39	0,07	0,11	0,23	0,26	-0,04	0,09	0,18	0,13
8	0,32	0,32	0,02	0,08	0,24	0,25	-0,05	0,02	0,15	0,12
9	0,39	0,46	0,06	0,13	0,27	0,30	-0,01	0,10	0,19	0,16
10	0,46	0,45	0,14	0,26	0,33	0,37	0,03	0,15	0,32	0,24
11	0,44	0,44	0,14	0,21	0,26	0,38	0,03	0,19	0,24	0,18
12	0,43	0,43	0,16	0,29	0,27	0,39	0,04	0,13	0,30	0,18
13	0,46	0,47	0,14	0,23	0,26	0,37	0,03	0,16	0,30	0,19
14	0,47	0,45	0,20	0,36	0,29	0,40	0,05	0,17	0,35	0,16
15	0,42	0,36	0,13	0,19	0,22	0,33	0,00	0,07	0,24	0,10
16	0,44	0,40	0,13	0,26	0,26	0,37	0,08	0,16	0,32	0,13
17	0,39	0,35	0,20	0,25	0,25	0,36	0,02	0,09	0,29	0,07
18	0,48	0,36	0,21	0,29	0,25	0,36	0,05	0,15	0,33	0,11
19	0,35	0,41	0,16	0,31	0,29	0,34	-0,03	0,19	0,32	0,09
20	0,45	0,41	0,20	0,34	0,28	0,36	-0,05	0,08	0,40	0,16
21	0,37	0,28	0,11	0,26	0,20	0,28	-0,03	0,10	0,29	0,02
22	0,32	0,29	0,07	0,17	0,25	0,25	-0,02	0,05	0,23	-0,04
23	0,50	0,39	0,11	0,25	0,35	0,41	-0,09	0,22	0,35	0,19
24	0,44	0,37	0,06	0,25	0,26	0,35	-0,06	0,17	0,42	0,11
25	0,37	0,36	0,07	0,21	0,28	0,34	-0,11	0,15	0,34	0,08
26	0,46	0,43	0,11	0,24	0,28	0,40	0,00	0,12	0,40	0,06
27	0,52	0,44	0,08	0,25	0,33	0,42	-0,09	0,13	0,41	0,04
28	0,47	0,38	0,01	0,16	0,25	0,33	-0,09	0,09	0,32	0,00
29	0,40	0,31	0,06	0,08	0,21	0,35	-0,09	0,05	0,32	-0,10
30	0,48	0,40	-0,02	0,07	0,31	0,39	-0,14	0,03	0,23	-0,01
Av	0,41	0,38	0,10	0,20	0,26	0,32	-0,02	0,12	0,28	0,10
1-30 Δ	41%	71%	-147%	0%	93%	197%	-593%	-73%	65%	-109%

Table A.2.22: Spearman Correlation Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,49	0,44	0,15	0,15	0,38	0,41	0,16	0,25	0,36	0,23
2	0,56	0,51	0,36	0,36	0,45	0,50	0,24	0,29	0,44	0,26
3	0,53	0,56	0,37	0,38	0,50	0,50	0,26	0,32	0,47	0,24
4	0,58	0,59	0,40	0,42	0,51	0,51	0,27	0,31	0,50	0,27
5	0,51	0,56	0,36	0,41	0,47	0,44	0,25	0,33	0,45	0,20
6	0,50	0,55	0,35	0,40	0,44	0,42	0,31	0,33	0,43	0,14
7	0,51	0,58	0,34	0,37	0,45	0,44	0,27	0,32	0,42	0,16
8	0,51	0,55	0,35	0,40	0,47	0,39	0,30	0,32	0,41	0,15
9	0,48	0,54	0,36	0,45	0,51	0,41	0,30	0,32	0,46	0,14
10	0,58	0,62	0,42	0,51	0,52	0,45	0,30	0,35	0,53	0,20
11	0,55	0,51	0,37	0,45	0,49	0,43	0,33	0,29	0,43	0,11
12	0,52	0,55	0,42	0,48	0,50	0,44	0,29	0,31	0,44	0,15
13	0,56	0,58	0,44	0,49	0,55	0,47	0,27	0,32	0,43	0,20
14	0,57	0,62	0,44	0,48	0,58	0,49	0,31	0,36	0,48	0,22
15	0,52	0,55	0,35	0,48	0,56	0,49	0,36	0,37	0,44	0,21
16	0,60	0,62	0,48	0,50	0,57	0,52	0,33	0,37	0,51	0,25
17	0,51	0,57	0,44	0,53	0,58	0,48	0,37	0,36	0,52	0,24
18	0,56	0,65	0,41	0,53	0,63	0,53	0,39	0,40	0,52	0,29
19	0,55	0,60	0,43	0,48	0,57	0,47	0,34	0,30	0,42	0,25
20	0,58	0,65	0,47	0,56	0,60	0,52	0,36	0,42	0,51	0,29
21	0,54	0,61	0,40	0,52	0,67	0,48	0,37	0,39	0,44	0,25
22	0,60	0,62	0,44	0,52	0,60	0,50	0,32	0,39	0,45	0,25
23	0,63	0,67	0,42	0,60	0,66	0,62	0,45	0,45	0,57	0,30
24	0,51	0,56	0,44	0,51	0,65	0,48	0,40	0,37	0,46	0,26
25	0,56	0,61	0,42	0,52	0,62	0,52	0,40	0,36	0,50	0,26
26	0,64	0,68	0,51	0,59	0,71	0,53	0,33	0,45	0,55	0,30
27	0,61	0,65	0,38	0,57	0,66	0,50	0,50	0,42	0,42	0,26
28	0,57	0,62	0,38	0,54	0,74	0,55	0,47	0,33	0,51	0,27
29	0,70	0,73	0,48	0,59	0,78	0,55	0,42	0,43	0,52	0,27
30	0,65	0,65	0,40	0,58	0,65	0,53	0,44	0,44	0,45	0,34
Av	0,56	0,59	0,40	0,48	0,57	0,49	0,34	0,35	0,47	0,23
1-30 Δ	33%	46%	166%	296%	71%	28%	179%	75%	27%	48%

Table A.2.23: Kendall Correlation Estimations of Stock Market Indices for Pre-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,23	0,16	0,03	0,04	0,11	0,09	0,02	0,07	0,09	0,08
2	0,23	0,26	0,07	0,11	0,15	0,13	-0,01	0,10	0,15	0,08
3	0,25	0,22	0,05	0,09	0,11	0,15	-0,02	0,07	0,14	0,08
4	0,23	0,25	0,07	0,05	0,15	0,13	-0,02	0,09	0,12	0,10
5	0,25	0,25	0,04	0,06	0,16	0,15	-0,03	0,06	0,15	0,09
6	0,24	0,24	0,04	0,09	0,15	0,16	-0,04	0,05	0,11	0,09
7	0,24	0,27	0,05	0,08	0,15	0,18	-0,03	0,06	0,13	0,09
8	0,22	0,22	0,01	0,06	0,16	0,17	-0,03	0,02	0,10	0,08
9	0,27	0,30	0,05	0,09	0,18	0,20	-0,01	0,06	0,14	0,11
10	0,32	0,31	0,09	0,18	0,21	0,25	0,02	0,09	0,21	0,16
11	0,30	0,30	0,09	0,14	0,16	0,27	0,02	0,13	0,17	0,12
12	0,28	0,29	0,12	0,19	0,17	0,26	0,02	0,09	0,20	0,12
13	0,32	0,32	0,09	0,15	0,17	0,25	0,01	0,10	0,20	0,12
14	0,32	0,30	0,13	0,24	0,20	0,27	0,02	0,11	0,24	0,11
15	0,28	0,25	0,08	0,12	0,14	0,22	0,00	0,04	0,18	0,06
16	0,31	0,28	0,10	0,17	0,17	0,25	0,06	0,12	0,21	0,09
17	0,27	0,24	0,16	0,17	0,17	0,24	0,01	0,06	0,19	0,05
18	0,32	0,25	0,15	0,19	0,15	0,23	0,01	0,11	0,21	0,08
19	0,20	0,28	0,11	0,22	0,19	0,21	-0,02	0,13	0,21	0,07
20	0,29	0,28	0,14	0,22	0,19	0,23	-0,03	0,05	0,26	0,10
21	0,26	0,19	0,07	0,18	0,12	0,19	-0,03	0,06	0,21	0,02
22	0,20	0,20	0,07	0,12	0,18	0,18	-0,03	0,03	0,15	-0,03
23	0,34	0,27	0,10	0,17	0,25	0,30	-0,06	0,16	0,23	0,14
24	0,30	0,25	0,08	0,18	0,18	0,23	-0,04	0,13	0,30	0,07
25	0,27	0,26	0,06	0,14	0,19	0,24	-0,07	0,11	0,21	0,05
26	0,28	0,30	0,09	0,16	0,18	0,25	-0,02	0,08	0,27	0,06
27	0,36	0,31	0,07	0,20	0,23	0,29	-0,08	0,08	0,29	0,04
28	0,33	0,26	0,02	0,12	0,17	0,19	-0,08	0,06	0,24	-0,01
29	0,26	0,23	0,05	0,07	0,13	0,20	-0,08	0,03	0,21	-0,07
30	0,30	0,27	0,00	0,06	0,21	0,28	-0,11	0,02	0,17	0,00
Av	0,28	0,26	0,08	0,14	0,17	0,21	-0,02	0,08	0,19	0,07
1-30 Δ	30%	69%	-85%	32%	95%	212%	-676%	-72%	79%	-100%

Table A.2.24: Kendall Correlation Estimations of Stock Market Indices for Post-Crisis
Period

	Canada	Norway	Japan	Australia	Russia	Brazil	China	India	S. Africa	Turkey
Day	SPTSX	OSEBX	NKY	AS51	INDEXCF	IBOV	SHCOMP	SENSEX	TOP40	XU030
1	0,36	0,32	0,10	0,10	0,27	0,29	0,11	0,18	0,26	0,16
2	0,42	0,37	0,25	0,26	0,33	0,36	0,17	0,21	0,32	0,18
3	0,39	0,41	0,26	0,27	0,36	0,36	0,18	0,22	0,34	0,16
4	0,43	0,44	0,28	0,30	0,37	0,36	0,19	0,22	0,36	0,18
5	0,37	0,41	0,25	0,29	0,34	0,31	0,18	0,23	0,32	0,13
6	0,36	0,41	0,25	0,29	0,32	0,30	0,22	0,24	0,31	0,10
7	0,38	0,43	0,24	0,26	0,33	0,31	0,20	0,23	0,31	0,10
8	0,37	0,41	0,25	0,29	0,35	0,28	0,22	0,24	0,30	0,10
9	0,35	0,39	0,25	0,32	0,37	0,29	0,21	0,24	0,34	0,09
10	0,43	0,46	0,30	0,37	0,40	0,32	0,21	0,25	0,39	0,14
11	0,40	0,38	0,26	0,32	0,36	0,31	0,23	0,21	0,32	0,08
12	0,39	0,41	0,29	0,34	0,38	0,32	0,20	0,23	0,33	0,11
13	0,41	0,42	0,30	0,36	0,41	0,34	0,20	0,24	0,33	0,14
14	0,43	0,45	0,30	0,34	0,44	0,36	0,22	0,27	0,36	0,16
15	0,37	0,41	0,25	0,35	0,40	0,35	0,25	0,26	0,33	0,15
16	0,43	0,45	0,33	0,35	0,43	0,37	0,23	0,26	0,36	0,16
17	0,38	0,43	0,32	0,38	0,43	0,34	0,26	0,26	0,39	0,17
18	0,42	0,47	0,27	0,37	0,43	0,38	0,26	0,29	0,38	0,19
19	0,40	0,45	0,30	0,36	0,42	0,34	0,24	0,22	0,32	0,18
20	0,44	0,50	0,33	0,40	0,44	0,38	0,26	0,30	0,38	0,21
21	0,41	0,48	0,28	0,38	0,50	0,35	0,27	0,27	0,34	0,17
22	0,44	0,45	0,31	0,37	0,44	0,36	0,23	0,27	0,34	0,18
23	0,47	0,50	0,30	0,44	0,49	0,46	0,32	0,32	0,43	0,21
24	0,38	0,44	0,31	0,37	0,50	0,34	0,29	0,26	0,37	0,20
25	0,42	0,46	0,30	0,36	0,45	0,36	0,27	0,25	0,36	0,18
26	0,48	0,51	0,37	0,44	0,53	0,39	0,22	0,32	0,40	0,20
27	0,45	0,49	0,26	0,41	0,48	0,37	0,36	0,32	0,32	0,17
28	0,44	0,46	0,28	0,40	0,55	0,42	0,32	0,24	0,40	0,20
29	0,53	0,55	0,33	0,42	0,57	0,41	0,29	0,31	0,40	0,19
30	0,46	0,49	0,28	0,42	0,48	0,42	0,31	0,31	0,32	0,21
Av	0,41	0,44	0,28	0,34	0,42	0,35	0,24	0,26	0,35	0,16
1-30 Δ	27%	54%	172%	316%	76%	42%	185%	77%	26%	36%

A.3 Turkish Market Indicators Estimates

Table A.3.1: Gaussian Copula Estimations of Turkish Market Indicators for 2005-2013
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,01	-0,02	0,21	0,21	0,22	0,20	0,15	0,12	0,15
2	-0,11	-0,04	0,22	0,23	0,26	0,25	0,18	0,11	0,14
3	-0,21	-0,06	0,23	0,25	0,28	0,26	0,22	0,10	0,13
4	-0,21	0,01	0,24	0,24	0,29	0,30	0,19	0,08	0,13
5	-0,21	0,01	0,24	0,25	0,30	0,32	0,21	0,08	0,11
6	-0,22	0,03	0,24	0,25	0,32	0,34	0,23	0,10	0,12
7	-0,26	-0,02	0,24	0,25	0,31	0,31	0,21	0,09	0,08
8	-0,18	0,04	0,20	0,22	0,29	0,33	0,21	0,05	0,00
9	-0,19	0,03	0,14	0,15	0,26	0,33	0,16	-0,01	0,02
10	-0,15	0,02	0,08	0,09	0,19	0,25	0,16	-0,02	-0,06
11	-0,28	-0,01	0,19	0,21	0,31	0,37	0,24	0,03	0,05
12	-0,25	-0,04	0,17	0,19	0,28	0,36	0,19	0,03	-0,01
13	-0,25	-0,07	0,18	0,19	0,27	0,33	0,24	0,00	0,01
14	-0,21	-0,01	0,15	0,17	0,26	0,34	0,23	-0,01	-0,05
15	-0,29	0,01	0,19	0,21	0,31	0,39	0,22	0,07	-0,04
16	-0,28	-0,03	0,19	0,21	0,34	0,37	0,28	0,09	0,00
17	-0,27	-0,03	0,18	0,21	0,34	0,37	0,25	0,09	-0,03
18	-0,33	-0,06	0,20	0,22	0,33	0,38	0,30	0,08	0,02
19	-0,25	-0,03	0,21	0,24	0,32	0,37	0,30	0,10	0,01
20	-0,25	-0,03	0,19	0,18	0,30	0,33	0,29	0,01	-0,06
21	-0,31	-0,02	0,17	0,18	0,34	0,37	0,31	0,09	0,01
22	-0,25	0,02	0,23	0,23	0,39	0,43	0,42	0,16	0,01
23	-0,24	0,03	0,15	0,18	0,29	0,35	0,26	0,12	0,01
24	-0,30	0,07	0,27	0,30	0,45	0,46	0,36	0,11	0,10
25	-0,26	-0,03	0,20	0,23	0,28	0,39	0,38	0,14	0,00
26	-0,34	0,02	0,28	0,30	0,40	0,47	0,41	0,17	0,02
27	-0,29	-0,02	0,25	0,28	0,38	0,46	0,36	0,08	0,06
28	-0,21	-0,06	0,25	0,27	0,35	0,43	0,37	0,18	0,04
29	-0,30	0,03	0,21	0,23	0,31	0,40	0,32	0,03	-0,04
30	-0,31	0,04	0,28	0,28	0,42	0,49	0,40	0,14	0,08
Av	-0,24	-0,01	0,21	0,22	0,31	0,36	0,27	0,08	0,03
1-30 Δ	2979%	-288%	32%	33%	91%	143%	171%	20%	-43%

Table A.3.2: Student's t-Copula Estimations of Turkish Market Indicators for 2005-2013

Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS
1	-0,01	-0,01	0,21	0,21	0,22	0,20	0,15	0,12
2	-0,12	-0,03	0,22	0,22	0,25	0,25	0,18	0,11
3	-0,21	-0,04	0,24	0,25	0,29	0,28	0,23	0,10
4	-0,24	0,02	0,25	0,25	0,30	0,32	0,19	0,09
5	-0,23	0,03	0,24	0,25	0,31	0,34	0,22	0,07
6	-0,22	0,03	0,25	0,26	0,34	0,36	0,25	0,09
7	-0,28	0,01	0,25	0,26	0,33	0,34	0,22	0,07
8	-0,20	0,05	0,19	0,20	0,31	0,36	0,22	0,03
9	-0,19	0,04	0,15	0,16	0,28	0,36	0,18	-0,03
10	-0,14	0,03	0,08	0,10	0,22	0,29	0,17	-0,05
11	-0,30	0,00	0,20	0,23	0,35	0,41	0,27	0,03
12	-0,27	-0,03	0,18	0,20	0,31	0,39	0,21	0,00
13	-0,28	-0,07	0,22	0,23	0,31	0,37	0,27	0,03
14	-0,23	-0,01	0,18	0,20	0,28	0,39	0,25	0,01
15	-0,32	0,04	0,21	0,23	0,34	0,41	0,24	0,04
16	-0,26	0,00	0,21	0,23	0,36	0,41	0,32	0,05
17	-0,30	-0,02	0,21	0,24	0,39	0,42	0,29	0,08
18	-0,37	-0,05	0,23	0,26	0,37	0,39	0,34	0,05
19	-0,28	0,01	0,25	0,28	0,38	0,41	0,35	0,07
20	-0,30	-0,01	0,23	0,22	0,35	0,38	0,33	-0,03
21	-0,36	0,02	0,20	0,23	0,39	0,41	0,34	0,04
22	-0,30	0,08	0,25	0,26	0,42	0,48	0,45	0,15
23	-0,27	0,08	0,21	0,24	0,34	0,41	0,29	0,16
24	-0,35	0,10	0,31	0,36	0,51	0,52	0,42	0,12
25	-0,30	0,05	0,22	0,26	0,35	0,44	0,43	0,15
26	-0,40	0,08	0,33	0,37	0,48	0,55	0,49	0,13
27	-0,33	0,04	0,30	0,33	0,45	0,53	0,41	0,05
28	-0,23	0,02	0,27	0,29	0,41	0,48	0,43	0,15
29	-0,36	0,07	0,23	0,24	0,37	0,46	0,33	-0,02
30	-0,35	0,02	0,32	0,32	0,49	0,57	0,46	0,16
Av	-0,27	0,02	0,23	0,25	0,35	0,40	0,30	0,07
1-30 Δ	2374%	-240%	56%	55%	122%	182%	219%	38%

Table A.3.3: Clayton Copula Estimations of Turkish Market Indicators for 2005-2013

Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,03	0,02	0,28	0,29	0,30	0,27	0,22	0,16	0,18
2	0,00	0,01	0,30	0,31	0,35	0,34	0,25	0,16	0,17
3	0,00	0,00	0,33	0,34	0,39	0,37	0,32	0,18	0,18
4	0,00	0,01	0,36	0,36	0,40	0,42	0,29	0,17	0,17
5	0,00	0,00	0,34	0,35	0,42	0,43	0,33	0,16	0,14
6	0,00	0,07	0,36	0,37	0,45	0,49	0,34	0,17	0,15
7	0,00	0,01	0,36	0,37	0,41	0,47	0,34	0,16	0,11
8	0,00	0,08	0,33	0,35	0,41	0,49	0,36	0,14	0,05
9	0,00	0,10	0,22	0,24	0,38	0,50	0,33	0,06	0,05
10	0,00	0,08	0,17	0,19	0,33	0,44	0,31	0,08	0,00
11	0,00	0,04	0,33	0,36	0,49	0,58	0,44	0,11	0,06
12	0,00	0,00	0,35	0,38	0,51	0,63	0,35	0,17	0,04
13	0,00	0,00	0,28	0,30	0,41	0,51	0,43	0,08	0,04
14	0,00	0,06	0,37	0,41	0,52	0,65	0,51	0,12	0,04
15	0,00	0,03	0,31	0,34	0,44	0,57	0,40	0,13	0,00
16	0,00	0,02	0,37	0,41	0,56	0,63	0,52	0,18	0,05
17	0,00	0,00	0,30	0,34	0,53	0,59	0,50	0,15	0,00
18	0,00	0,00	0,36	0,39	0,50	0,68	0,62	0,17	0,01
19	0,00	0,05	0,40	0,44	0,55	0,72	0,65	0,26	0,02
20	0,00	0,00	0,31	0,32	0,39	0,51	0,60	0,09	0,00
21	0,00	0,06	0,34	0,37	0,56	0,70	0,63	0,21	0,01
22	0,00	0,09	0,46	0,43	0,65	0,63	0,77	0,31	0,03
23	0,00	0,12	0,33	0,36	0,46	0,65	0,52	0,20	0,00
24	0,00	0,14	0,46	0,51	0,65	0,77	0,65	0,29	0,16
25	0,00	0,09	0,35	0,34	0,45	0,80	0,77	0,22	0,00
26	0,00	0,19	0,38	0,39	0,51	0,67	0,74	0,25	0,00
27	0,00	0,00	0,41	0,44	0,57	0,77	0,70	0,13	0,05
28	0,00	0,09	0,42	0,46	0,60	0,78	0,64	0,32	0,00
29	0,00	0,11	0,41	0,44	0,51	0,71	0,75	0,19	0,00
30	0,00	0,16	0,54	0,52	0,71	0,87	0,85	0,34	0,09
Av	0,00	0,05	0,35	0,37	0,48	0,59	0,50	0,18	0,06
1-30 Δ	-100%	568%	91%	80%	137%	221%	293%	115%	-48%

Table A.3.4: Frank Copula Estimations of Turkish Market Indicators for 2005-2013

Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,07	-0,03	1,20	1,22	1,29	1,16	0,84	0,65	0,83
2	-0,73	-0,16	1,26	1,31	1,49	1,48	1,02	0,62	0,77
3	-1,28	-0,13	1,39	1,47	1,72	1,71	1,35	0,59	0,79
4	-1,48	0,13	1,52	1,57	1,88	2,03	1,15	0,54	0,75
5	-1,38	0,21	1,36	1,41	1,82	2,05	1,14	0,41	0,61
6	-1,20	0,26	1,35	1,43	2,03	2,20	1,32	0,53	0,70
7	-1,68	0,11	1,39	1,46	1,92	2,19	1,25	0,37	0,38
8	-1,18	0,38	1,06	1,19	1,82	2,22	1,25	0,16	-0,16
9	-1,07	0,33	0,69	0,81	1,56	2,23	1,04	-0,26	-0,02
10	-0,75	0,26	0,36	0,50	1,25	1,75	0,87	-0,36	-0,29
11	-1,71	0,05	1,15	1,30	2,08	2,51	1,53	0,12	0,28
12	-1,55	-0,11	0,99	1,14	1,76	2,38	1,12	0,00	-0,06
13	-1,78	-0,39	1,28	1,40	1,96	2,32	1,48	0,09	0,11
14	-1,26	-0,08	1,01	1,15	1,69	2,40	1,40	-0,10	-0,30
15	-1,86	0,31	1,16	1,25	1,85	2,42	1,35	0,13	-0,34
16	-1,67	0,07	1,18	1,33	2,18	2,47	1,78	0,24	-0,07
17	-1,75	0,00	1,20	1,38	2,31	2,57	1,74	0,44	-0,18
18	-2,19	-0,16	1,29	1,43	2,10	2,39	1,83	0,20	0,16
19	-1,44	0,07	1,35	1,57	2,11	2,35	1,92	0,38	0,08
20	-1,84	-0,02	1,31	1,33	2,07	2,36	2,02	-0,26	-0,21
21	-2,12	0,11	1,13	1,39	2,34	2,53	1,94	0,37	0,05
22	-1,78	0,30	1,49	1,58	2,66	3,12	2,64	0,86	0,12
23	-1,58	0,46	1,18	1,33	1,99	2,50	1,67	0,48	0,05
24	-2,07	0,48	1,81	2,14	3,29	3,18	2,37	0,61	0,71
25	-1,61	0,10	1,24	1,43	1,97	2,84	2,69	0,79	-0,12
26	-2,16	0,40	1,71	1,85	2,75	3,29	2,72	0,78	0,12
27	-1,98	0,17	1,52	1,68	2,59	3,25	2,30	0,16	0,56
28	-1,34	0,08	1,61	1,69	2,49	3,10	2,45	0,91	0,29
29	-1,95	0,46	1,26	1,30	1,91	2,38	1,93	0,02	-0,31
30	-2,14	0,14	1,98	2,00	3,08	3,50	2,87	0,99	0,62
Av	-1,55	0,13	1,28	1,40	2,06	2,43	1,70	0,35	0,20
1-30 Δ	2848%	-531%	65%	64%	138%	201%	243%	53%	-26%

Table A.3.5: Gumbel Copula Estimations of Turkish Market Indicators for 2005-2013

Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	1,01	1,00	1,13	1,13	1,14	1,12	1,08	1,07	1,09
2	1,00	1,00	1,13	1,14	1,17	1,16	1,11	1,06	1,07
3	1,00	1,00	1,17	1,18	1,20	1,19	1,15	1,06	1,07
4	1,00	1,02	1,17	1,17	1,23	1,24	1,12	1,05	1,07
5	1,00	1,03	1,16	1,17	1,22	1,25	1,11	1,04	1,05
6	1,00	1,00	1,15	1,16	1,23	1,25	1,12	1,05	1,07
7	1,00	1,00	1,17	1,18	1,23	1,25	1,12	1,06	1,02
8	1,00	1,00	1,13	1,14	1,22	1,29	1,12	1,02	1,00
9	1,00	1,00	1,06	1,07	1,19	1,27	1,06	1,00	1,00
10	1,00	1,00	1,04	1,05	1,12	1,19	1,06	1,00	1,00
11	1,00	1,01	1,12	1,14	1,25	1,33	1,14	1,02	1,02
12	1,00	1,00	1,10	1,12	1,21	1,30	1,10	1,01	1,00
13	1,00	1,00	1,16	1,17	1,22	1,27	1,13	1,03	1,00
14	1,00	1,00	1,11	1,13	1,21	1,30	1,15	1,00	1,00
15	1,00	1,03	1,14	1,15	1,27	1,35	1,13	1,04	1,00
16	1,00	1,00	1,14	1,16	1,28	1,32	1,18	1,06	1,01
17	1,00	1,00	1,13	1,16	1,31	1,33	1,18	1,07	1,01
18	1,00	1,00	1,15	1,16	1,29	1,36	1,22	1,06	1,05
19	1,00	1,00	1,13	1,16	1,27	1,30	1,20	1,03	1,01
20	1,00	1,01	1,16	1,14	1,27	1,28	1,20	1,00	1,00
21	1,00	1,00	1,13	1,15	1,32	1,35	1,20	1,10	1,00
22	1,00	1,06	1,21	1,21	1,41	1,46	1,38	1,15	1,03
23	1,00	1,03	1,14	1,16	1,22	1,31	1,20	1,07	1,00
24	1,00	1,09	1,23	1,28	1,49	1,43	1,29	1,05	1,07
25	1,00	1,00	1,21	1,22	1,27	1,40	1,36	1,11	1,04
26	1,00	1,00	1,29	1,30	1,43	1,53	1,41	1,15	1,05
27	1,00	1,02	1,21	1,23	1,39	1,50	1,28	1,07	1,05
28	1,00	1,00	1,24	1,24	1,33	1,40	1,30	1,17	1,08
29	1,00	1,05	1,18	1,17	1,26	1,32	1,27	1,03	1,00
30	1,00	1,07	1,32	1,30	1,41	1,52	1,40	1,12	1,12
Av	1,00	1,01	1,16	1,17	1,27	1,32	1,19	1,06	1,03
1-30 Δ	-1%	7%	17%	15%	24%	35%	29%	5%	3%

Table A.3.6: Pearson Correlation Estimations of Turkish Market Indicators for 2005-2013

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,01	-0,04	0,23	0,24	0,24	0,22	0,17	0,13	0,16
2	-0,10	-0,06	0,25	0,26	0,29	0,26	0,21	0,10	0,16
3	-0,20	-0,07	0,26	0,27	0,31	0,29	0,23	0,11	0,15
4	-0,21	-0,03	0,25	0,26	0,32	0,32	0,22	0,09	0,13
5	-0,24	-0,03	0,25	0,27	0,35	0,35	0,24	0,09	0,11
6	-0,27	-0,03	0,26	0,28	0,36	0,38	0,26	0,11	0,11
7	-0,29	-0,06	0,25	0,27	0,36	0,36	0,26	0,11	0,07
8	-0,30	-0,04	0,23	0,26	0,39	0,41	0,28	0,10	0,01
9	-0,29	-0,03	0,21	0,24	0,36	0,39	0,25	0,08	0,01
10	-0,29	-0,06	0,19	0,23	0,37	0,39	0,29	0,10	-0,02
11	-0,36	-0,06	0,25	0,29	0,42	0,45	0,34	0,11	0,01
12	-0,37	-0,08	0,25	0,28	0,42	0,46	0,31	0,14	-0,03
13	-0,34	-0,08	0,24	0,28	0,42	0,44	0,35	0,11	0,01
14	-0,38	-0,09	0,26	0,30	0,45	0,48	0,38	0,15	-0,01
15	-0,35	-0,05	0,25	0,29	0,44	0,47	0,35	0,12	-0,04
16	-0,38	-0,08	0,26	0,30	0,47	0,48	0,41	0,15	0,00
17	-0,38	-0,08	0,25	0,29	0,46	0,48	0,38	0,16	-0,03
18	-0,39	-0,08	0,26	0,31	0,47	0,49	0,42	0,14	0,00
19	-0,38	-0,06	0,27	0,31	0,46	0,49	0,42	0,13	-0,02
20	-0,39	-0,08	0,24	0,29	0,45	0,49	0,43	0,11	-0,07
21	-0,42	-0,09	0,25	0,30	0,46	0,49	0,43	0,14	-0,04
22	-0,42	-0,09	0,28	0,32	0,50	0,55	0,50	0,13	-0,04
23	-0,40	-0,08	0,26	0,31	0,49	0,54	0,45	0,14	-0,05
24	-0,47	-0,10	0,34	0,39	0,56	0,60	0,51	0,20	0,01
25	-0,42	-0,11	0,27	0,31	0,50	0,54	0,49	0,14	-0,05
26	-0,45	-0,11	0,33	0,38	0,54	0,58	0,50	0,21	-0,04
27	-0,42	-0,12	0,31	0,36	0,53	0,57	0,48	0,15	0,00
28	-0,48	-0,14	0,34	0,39	0,56	0,61	0,53	0,22	-0,02
29	-0,45	-0,10	0,31	0,35	0,53	0,57	0,49	0,16	-0,05
30	-0,44	-0,11	0,31	0,35	0,55	0,59	0,50	0,19	-0,01
Av	-0,34	-0,07	0,26	0,30	0,43	0,46	0,37	0,13	0,01
1-30 Δ	4845%	146%	31%	50%	126%	173%	196%	49%	-103%

Table A.3.7: Spearman Correlation Estimations of Turkish Market Indicators for 2005-2013

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,01	0,00	0,18	0,19	0,20	0,18	0,13	0,10	0,13
2	-0,12	-0,02	0,20	0,20	0,23	0,24	0,16	0,09	0,12
3	-0,19	0,00	0,21	0,21	0,25	0,27	0,19	0,08	0,12
4	-0,19	0,05	0,22	0,23	0,29	0,31	0,19	0,05	0,12
5	-0,19	0,06	0,18	0,19	0,26	0,30	0,16	0,03	0,08
6	-0,20	0,04	0,18	0,20	0,29	0,33	0,20	0,05	0,10
7	-0,22	0,05	0,18	0,20	0,27	0,31	0,21	0,02	0,06
8	-0,21	0,04	0,15	0,17	0,29	0,33	0,23	0,00	0,00
9	-0,21	0,04	0,13	0,15	0,27	0,35	0,20	-0,02	-0,01
10	-0,21	0,02	0,13	0,15	0,26	0,31	0,20	-0,01	-0,02
11	-0,26	0,00	0,19	0,22	0,34	0,38	0,28	0,03	0,02
12	-0,28	0,04	0,14	0,17	0,30	0,36	0,24	0,00	-0,03
13	-0,28	0,00	0,21	0,23	0,33	0,37	0,27	0,03	0,04
14	-0,29	0,01	0,19	0,21	0,32	0,40	0,26	0,01	-0,02
15	-0,28	0,04	0,18	0,21	0,31	0,36	0,23	0,02	-0,04
16	-0,30	0,04	0,19	0,21	0,32	0,37	0,30	0,04	-0,01
17	-0,29	0,01	0,18	0,20	0,32	0,37	0,30	0,05	-0,01
18	-0,33	0,03	0,17	0,19	0,31	0,35	0,31	0,00	0,00
19	-0,26	0,07	0,19	0,20	0,27	0,32	0,27	-0,02	-0,01
20	-0,34	0,03	0,18	0,20	0,31	0,37	0,32	-0,02	-0,03
21	-0,33	0,05	0,16	0,19	0,30	0,33	0,30	0,01	-0,02
22	-0,31	0,04	0,15	0,18	0,32	0,40	0,37	-0,02	-0,04
23	-0,26	0,09	0,11	0,14	0,28	0,34	0,32	-0,01	-0,03
24	-0,35	0,04	0,20	0,23	0,38	0,43	0,35	0,06	0,04
25	-0,30	0,04	0,14	0,16	0,32	0,37	0,36	0,02	-0,06
26	-0,35	0,01	0,21	0,23	0,38	0,42	0,39	0,07	-0,02
27	-0,33	0,03	0,20	0,22	0,38	0,42	0,36	0,03	0,05
28	-0,36	0,04	0,20	0,22	0,36	0,41	0,36	0,06	0,01
29	-0,33	0,08	0,11	0,13	0,27	0,32	0,32	-0,05	-0,08
30	-0,34	0,02	0,18	0,21	0,35	0,47	0,39	0,04	0,03
Av	-0,26	0,03	0,18	0,19	0,30	0,35	0,27	0,03	0,02
1-30 Δ	5407%	-852%	-2%	16%	79%	167%	196%	-64%	-78%

Table A.3.8: Kendall Correlation Estimations of Turkish Market Indicators for 2005-2013

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,00	0,00	0,12	0,13	0,13	0,12	0,09	0,07	0,09
2	-0,08	-0,01	0,13	0,14	0,16	0,16	0,11	0,06	0,08
3	-0,13	0,00	0,14	0,15	0,17	0,19	0,13	0,06	0,08
4	-0,13	0,03	0,15	0,16	0,20	0,21	0,13	0,04	0,08
5	-0,13	0,04	0,12	0,13	0,18	0,21	0,11	0,02	0,05
6	-0,13	0,03	0,13	0,14	0,20	0,23	0,14	0,03	0,07
7	-0,15	0,03	0,13	0,13	0,19	0,22	0,14	0,01	0,03
8	-0,14	0,02	0,10	0,11	0,20	0,24	0,16	0,00	0,00
9	-0,15	0,03	0,09	0,10	0,18	0,24	0,14	-0,01	-0,01
10	-0,14	0,01	0,09	0,11	0,18	0,22	0,14	-0,01	-0,01
11	-0,18	0,00	0,13	0,15	0,23	0,27	0,19	0,02	0,01
12	-0,19	0,03	0,10	0,12	0,20	0,25	0,16	0,00	-0,02
13	-0,20	0,00	0,15	0,16	0,22	0,26	0,19	0,03	0,03
14	-0,20	0,01	0,13	0,15	0,22	0,27	0,18	0,01	-0,01
15	-0,20	0,03	0,13	0,14	0,21	0,25	0,16	0,01	-0,02
16	-0,21	0,02	0,13	0,15	0,22	0,26	0,20	0,03	-0,01
17	-0,20	0,01	0,12	0,14	0,22	0,25	0,20	0,04	-0,01
18	-0,22	0,02	0,11	0,12	0,21	0,24	0,21	-0,01	0,00
19	-0,18	0,04	0,13	0,13	0,18	0,22	0,18	-0,01	-0,01
20	-0,24	0,01	0,13	0,14	0,21	0,25	0,22	-0,01	-0,02
21	-0,23	0,04	0,11	0,13	0,20	0,23	0,21	0,01	-0,01
22	-0,21	0,03	0,10	0,12	0,23	0,28	0,25	-0,02	-0,03
23	-0,18	0,06	0,08	0,10	0,18	0,23	0,22	-0,01	-0,02
24	-0,24	0,02	0,13	0,16	0,26	0,30	0,24	0,04	0,03
25	-0,20	0,03	0,10	0,11	0,22	0,25	0,25	0,02	-0,04
26	-0,24	0,01	0,13	0,15	0,26	0,29	0,28	0,03	-0,01
27	-0,22	0,03	0,14	0,15	0,26	0,29	0,26	0,02	0,04
28	-0,26	0,03	0,13	0,14	0,24	0,29	0,25	0,03	0,00
29	-0,23	0,06	0,08	0,10	0,19	0,22	0,24	-0,03	-0,06
30	-0,23	0,03	0,12	0,15	0,24	0,32	0,28	0,03	0,01
Av	-0,18	0,02	0,12	0,13	0,21	0,24	0,19	0,02	0,01
1-30 Δ	5084%	-2668%	-4%	16%	79%	172%	214%	-61%	-86%

Table A.3.9: Gaussian Copula Estimations of Turkish Market Indicators for Pre-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,04	-0,02	0,12	0,13	0,13	0,10	0,11	0,10	0,08
2	-0,09	-0,05	0,11	0,11	0,13	0,13	0,10	0,03	0,03
3	-0,13	-0,01	0,12	0,12	0,13	0,17	0,13	-0,01	0,02
4	-0,08	0,06	0,15	0,15	0,17	0,24	0,09	0,00	0,02
5	-0,07	0,12	0,13	0,13	0,14	0,28	0,13	-0,05	-0,04
6	-0,06	0,10	0,19	0,19	0,23	0,33	0,15	-0,05	-0,01
7	-0,17	0,06	0,18	0,17	0,27	0,37	0,23	-0,04	-0,08
8	-0,20	0,05	0,16	0,17	0,20	0,38	0,24	-0,05	-0,07
9	-0,19	0,05	0,10	0,11	0,20	0,42	0,22	-0,13	-0,13
10	-0,23	0,07	0,08	0,09	0,17	0,36	0,19	-0,12	-0,12
11	-0,22	0,10	0,11	0,12	0,25	0,38	0,25	-0,12	-0,14
12	-0,29	0,03	0,16	0,17	0,26	0,44	0,23	-0,08	-0,17
13	-0,32	0,00	0,23	0,24	0,32	0,47	0,27	-0,08	-0,10
14	-0,29	-0,02	0,19	0,19	0,29	0,44	0,26	-0,08	-0,18
15	-0,32	0,05	0,16	0,17	0,26	0,44	0,24	-0,09	-0,16
16	-0,23	0,02	0,17	0,17	0,26	0,41	0,26	-0,04	-0,14
17	-0,27	0,06	0,11	0,12	0,25	0,38	0,24	-0,09	-0,19
18	-0,27	0,02	0,17	0,18	0,28	0,44	0,32	-0,01	-0,07
19	-0,20	0,15	0,08	0,09	0,18	0,33	0,19	-0,10	-0,15
20	-0,25	0,09	0,11	0,12	0,21	0,39	0,29	-0,13	-0,15
21	-0,24	0,07	0,06	0,07	0,22	0,37	0,21	-0,12	-0,13
22	-0,19	0,06	0,08	0,09	0,19	0,38	0,23	-0,18	-0,20
23	-0,15	0,11	0,05	0,06	0,17	0,39	0,21	-0,14	-0,16
24	-0,28	0,16	0,07	0,16	0,30	0,43	0,28	-0,15	-0,10
25	-0,23	0,03	0,08	0,08	0,22	0,35	0,28	-0,20	-0,21
26	-0,13	0,11	0,15	0,15	0,23	0,44	0,33	-0,14	-0,19
27	-0,23	0,04	0,13	0,13	0,28	0,46	0,27	-0,08	-0,04
28	-0,15	0,08	0,06	0,06	0,20	0,44	0,30	-0,15	-0,13
29	-0,22	0,14	0,04	0,05	0,19	0,36	0,22	-0,29	-0,19
30	-0,25	0,07	0,14	0,10	0,19	0,38	0,24	-0,23	-0,19
Av	-0,20	0,06	0,12	0,13	0,22	0,36	0,22	-0,09	-0,11
1-30 Δ	580%	-415%	15%	-18%	49%	275%	119%	-332%	-349%

Table A.3.10: Gaussian Copula Estimations of Turkish Market Indicators for Post-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,02	-0,01	0,26	0,26	0,28	0,27	0,18	0,13	0,21
2	-0,11	-0,04	0,29	0,30	0,33	0,31	0,23	0,15	0,22
3	-0,18	-0,04	0,32	0,34	0,39	0,34	0,25	0,20	0,22
4	-0,32	-0,04	0,31	0,33	0,38	0,36	0,28	0,17	0,21
5	-0,24	0,00	0,25	0,27	0,34	0,33	0,23	0,16	0,22
6	-0,25	-0,03	0,24	0,25	0,31	0,30	0,20	0,14	0,18
7	-0,19	-0,04	0,20	0,24	0,32	0,31	0,20	0,10	0,12
8	-0,24	-0,07	0,21	0,20	0,29	0,28	0,17	0,10	0,18
9	-0,22	-0,02	0,14	0,16	0,26	0,29	0,14	0,05	0,12
10	-0,28	-0,10	0,17	0,19	0,29	0,28	0,14	0,13	0,16
11	-0,22	-0,08	0,10	0,13	0,22	0,21	0,15	0,07	0,09
12	-0,28	-0,06	0,18	0,21	0,28	0,26	0,25	0,09	0,13
13	-0,33	-0,03	0,12	0,14	0,24	0,23	0,18	0,09	0,09
14	-0,34	-0,09	0,19	0,19	0,31	0,37	0,26	0,11	0,13
15	-0,35	-0,07	0,14	0,16	0,27	0,27	0,24	0,13	0,14
16	-0,24	-0,05	0,10	0,13	0,18	0,20	0,13	0,11	0,06
17	-0,27	-0,08	0,18	0,21	0,28	0,28	0,24	0,08	0,11
18	-0,30	-0,07	0,29	0,27	0,35	0,38	0,30	0,21	0,19
19	-0,29	-0,10	0,22	0,21	0,25	0,22	0,26	0,19	0,10
20	-0,34	-0,05	0,31	0,33	0,38	0,39	0,33	0,33	0,20
21	-0,33	-0,08	0,23	0,25	0,37	0,35	0,35	0,30	0,09
22	-0,29	0,07	0,24	0,27	0,34	0,29	0,25	0,33	0,09
23	-0,43	-0,06	0,37	0,38	0,37	0,43	0,37	0,33	0,20
24	-0,35	-0,03	0,25	0,28	0,35	0,37	0,39	0,24	0,21
25	-0,35	-0,03	0,36	0,37	0,44	0,46	0,33	0,29	0,05
26	-0,46	-0,13	0,43	0,45	0,51	0,53	0,45	0,36	0,22
27	-0,33	-0,12	0,38	0,41	0,38	0,49	0,49	0,29	0,21
28	-0,43	-0,02	0,32	0,35	0,38	0,48	0,41	0,21	0,21
29	-0,34	0,07	0,28	0,30	0,35	0,44	0,32	0,23	0,11
30	-0,40	-0,05	0,29	0,32	0,49	0,44	0,48	0,27	0,21
Av	-0,29	-0,05	0,25	0,26	0,33	0,34	0,27	0,19	0,16
1-30 Δ	-1866%	248%	11%	22%	73%	65%	169%	99%	2%

Table A.3.11: Students's t-Copula Estimations of Turkish Market Indicators for Pre-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,04	-0,02	0,13	0,14	0,14	0,11	0,11	0,11	0,08
2	-0,10	-0,05	0,12	0,12	0,15	0,15	0,11	0,03	0,04
3	-0,14	0,00	0,14	0,14	0,14	0,19	0,15	0,00	0,02
4	-0,09	0,07	0,18	0,18	0,20	0,27	0,11	0,01	0,02
5	-0,09	0,14	0,16	0,16	0,17	0,33	0,15	-0,07	-0,05
6	-0,07	0,12	0,23	0,23	0,27	0,38	0,17	-0,06	-0,02
7	-0,21	0,07	0,22	0,21	0,33	0,42	0,27	-0,07	-0,10
8	-0,24	0,06	0,20	0,21	0,25	0,45	0,28	-0,06	-0,09
9	-0,24	0,06	0,14	0,14	0,26	0,49	0,28	-0,19	-0,17
10	-0,29	0,09	0,10	0,12	0,22	0,43	0,25	-0,14	-0,16
11	-0,27	0,12	0,15	0,17	0,32	0,45	0,32	-0,08	-0,19
12	-0,35	0,04	0,22	0,23	0,34	0,51	0,30	-0,18	-0,24
13	-0,38	-0,01	0,29	0,29	0,39	0,53	0,34	0,09	-0,13
14	-0,35	-0,03	0,26	0,27	0,38	0,54	0,35	-0,10	-0,26
15	-0,42	0,07	0,24	0,24	0,35	0,54	0,33	-0,11	-0,23
16	-0,30	0,03	0,25	0,26	0,37	0,51	0,36	0,00	-0,20
17	-0,34	0,10	0,17	0,18	0,33	0,48	0,32	-0,03	-0,27
18	-0,35	0,03	0,23	0,25	0,37	0,53	0,41	-0,05	-0,09
19	-0,24	0,21	0,11	0,11	0,23	0,40	0,25	-0,13	-0,21
20	-0,32	0,13	0,18	0,18	0,30	0,50	0,39	-0,11	-0,23
21	-0,32	0,17	0,09	0,10	0,31	0,46	0,30	-0,13	-0,20
22	-0,26	0,17	0,13	0,14	0,29	0,48	0,35	-0,25	-0,28
23	-0,21	0,22	0,08	0,10	0,21	0,51	0,29	-0,28	-0,25
24	-0,37	0,25	0,09	0,25	0,40	0,53	0,39	-0,18	-0,10
25	-0,31	0,04	0,13	0,13	0,34	0,52	0,37	-0,16	-0,29
26	-0,19	0,19	0,21	0,22	0,34	0,58	0,46	-0,20	-0,24
27	-0,30	0,11	0,20	0,21	0,40	0,58	0,38	-0,14	-0,06
28	-0,21	0,16	0,11	0,11	0,31	0,55	0,44	-0,24	-0,11
29	-0,31	0,24	0,08	0,09	0,29	0,50	0,37	-0,37	-0,29
30	-0,33	0,09	0,24	0,14	0,27	0,48	0,34	-0,33	-0,15
Av	-0,25	0,10	0,17	0,18	0,29	0,45	0,30	-0,12	-0,15
1-30 Δ	734%	-471%	81%	6%	90%	341%	195%	-412%	-291%

Table A.3.12: Students' t-Copula Estimations of Turkish Market Indicators for Post-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,01	0,01	0,25	0,26	0,28	0,27	0,18	0,13	0,19
2	-0,14	-0,03	0,28	0,29	0,33	0,33	0,22	0,16	0,22
3	-0,21	-0,04	0,33	0,35	0,41	0,38	0,25	0,22	0,24
4	-0,36	-0,03	0,34	0,36	0,42	0,39	0,28	0,18	0,23
5	-0,27	-0,01	0,26	0,28	0,37	0,36	0,25	0,16	0,24
6	-0,28	-0,01	0,21	0,22	0,29	0,31	0,19	0,12	0,19
7	-0,18	-0,01	0,20	0,25	0,35	0,34	0,22	0,12	0,13
8	-0,22	-0,03	0,21	0,22	0,32	0,31	0,19	0,07	0,22
9	-0,24	0,00	0,15	0,17	0,29	0,31	0,15	0,05	0,14
10	-0,31	-0,10	0,20	0,23	0,32	0,32	0,16	0,14	0,19
11	-0,17	-0,04	0,08	0,11	0,22	0,22	0,16	0,04	0,08
12	-0,27	0,01	0,17	0,19	0,27	0,24	0,24	0,05	0,15
13	-0,31	-0,01	0,17	0,19	0,28	0,27	0,21	0,06	0,11
14	-0,34	-0,04	0,22	0,23	0,33	0,41	0,30	0,12	0,15
15	-0,40	-0,06	0,16	0,19	0,31	0,32	0,26	0,12	0,18
16	-0,16	0,01	0,12	0,15	0,20	0,24	0,16	0,10	0,12
17	-0,29	-0,06	0,19	0,20	0,35	0,34	0,29	0,02	0,13
18	-0,30	-0,03	0,34	0,33	0,42	0,43	0,34	0,22	0,23
19	-0,33	-0,08	0,26	0,23	0,31	0,27	0,31	0,18	0,13
20	-0,40	0,02	0,37	0,39	0,45	0,47	0,40	0,41	0,27
21	-0,38	-0,05	0,29	0,31	0,43	0,41	0,41	0,35	0,17
22	-0,33	0,10	0,30	0,33	0,40	0,34	0,28	0,39	0,16
23	-0,50	-0,04	0,41	0,42	0,43	0,49	0,43	0,32	0,21
24	-0,41	-0,01	0,29	0,32	0,42	0,44	0,42	0,26	0,25
25	-0,35	-0,01	0,40	0,42	0,51	0,53	0,39	0,29	0,13
26	-0,55	-0,11	0,48	0,51	0,58	0,59	0,48	0,26	0,29
27	-0,39	-0,08	0,41	0,43	0,46	0,56	0,55	0,37	0,27
28	-0,52	0,00	0,40	0,42	0,48	0,55	0,50	0,29	0,29
29	-0,41	0,11	0,32	0,35	0,45	0,53	0,39	0,31	0,19
30	-0,48	-0,06	0,34	0,38	0,55	0,53	0,55	0,34	0,32
Av	-0,32	-0,02	0,27	0,29	0,37	0,38	0,31	0,20	0,19
1-30 Δ	-3299%	-1185%	35%	49%	94%	92%	210%	162%	66%

Table A.3.13: Clayton Copula Estimations of Turkish Market Indicators for Pre-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,00	0,00	0,16	0,17	0,16	0,14	0,15	0,11	0,09
2	0,00	0,00	0,12	0,13	0,16	0,16	0,12	0,05	0,03
3	0,00	0,00	0,12	0,13	0,16	0,21	0,25	0,02	0,05
4	0,00	0,09	0,19	0,19	0,20	0,27	0,18	0,05	0,02
5	0,00	0,12	0,11	0,12	0,16	0,31	0,22	0,01	0,00
6	0,00	0,18	0,17	0,17	0,21	0,34	0,18	0,00	0,00
7	0,00	0,11	0,17	0,15	0,30	0,46	0,31	0,00	0,00
8	0,00	0,04	0,17	0,17	0,23	0,47	0,31	0,00	0,00
9	0,00	0,05	0,14	0,15	0,24	0,57	0,36	0,00	0,00
10	0,00	0,13	0,10	0,13	0,25	0,52	0,31	0,00	0,00
11	0,00	0,19	0,16	0,18	0,35	0,57	0,38	0,00	0,00
12	0,00	0,00	0,22	0,23	0,37	0,67	0,34	0,00	0,00
13	0,00	0,00	0,27	0,28	0,42	0,70	0,46	0,00	0,00
14	0,00	0,00	0,27	0,28	0,44	0,78	0,46	0,00	0,00
15	0,00	0,14	0,18	0,19	0,35	0,68	0,40	0,00	0,00
16	0,00	0,06	0,25	0,27	0,43	0,73	0,42	0,00	0,00
17	0,00	0,11	0,10	0,12	0,32	0,61	0,35	0,00	0,00
18	0,00	0,09	0,12	0,15	0,33	0,59	0,55	0,00	0,00
19	0,00	0,20	0,00	0,00	0,18	0,50	0,25	0,00	0,00
20	0,00	0,13	0,03	0,05	0,28	0,69	0,46	0,00	0,00
21	0,00	0,03	0,00	0,02	0,28	0,57	0,32	0,00	0,00
22	0,00	0,00	0,09	0,10	0,29	0,62	0,41	0,00	0,00
23	0,00	0,14	0,00	0,02	0,26	0,61	0,37	0,00	0,00
24	0,00	0,31	0,11	0,12	0,39	0,72	0,28	0,00	0,00
25	0,00	0,00	0,00	0,00	0,33	0,71	0,36	0,00	0,00
26	0,00	0,13	0,00	0,03	0,27	0,75	0,40	0,00	0,00
27	0,00	0,00	0,05	0,07	0,35	0,76	0,27	0,00	0,00
28	0,00	0,01	0,00	0,00	0,30	0,70	0,41	0,00	0,00
29	0,00	0,29	0,00	0,00	0,26	0,59	0,32	0,00	0,00
30	0,00	0,20	0,21	0,12	0,26	0,69	0,27	0,00	0,00
Av	0,00	0,09	0,12	0,12	0,28	0,56	0,33	0,01	0,01
1-30 Δ	0%	4257%	32%	-29%	56%	391%	78%	-100%	-100%

Table A.3.14: Clayton Copula Estimations of Turkish Market Indicators for Post-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,06	0,05	0,38	0,38	0,42	0,38	0,27	0,20	0,28
2	0,00	0,03	0,42	0,44	0,51	0,48	0,34	0,24	0,33
3	0,00	0,03	0,46	0,49	0,59	0,54	0,34	0,33	0,33
4	0,00	0,00	0,55	0,57	0,65	0,60	0,44	0,30	0,33
5	0,00	0,02	0,41	0,43	0,51	0,53	0,35	0,25	0,37
6	0,00	0,00	0,40	0,43	0,53	0,47	0,38	0,33	0,27
7	0,00	0,01	0,42	0,46	0,56	0,55	0,41	0,27	0,20
8	0,00	0,00	0,45	0,45	0,56	0,56	0,37	0,27	0,32
9	0,00	0,02	0,30	0,33	0,53	0,56	0,33	0,18	0,24
10	0,00	0,00	0,37	0,39	0,58	0,56	0,35	0,30	0,25
11	0,00	0,03	0,27	0,30	0,42	0,45	0,33	0,15	0,22
12	0,00	0,00	0,45	0,49	0,59	0,55	0,64	0,25	0,27
13	0,00	0,00	0,33	0,34	0,45	0,41	0,40	0,25	0,19
14	0,00	0,00	0,57	0,56	0,77	0,79	0,68	0,28	0,35
15	0,00	0,02	0,35	0,39	0,54	0,49	0,58	0,30	0,35
16	0,00	0,00	0,37	0,41	0,47	0,45	0,46	0,36	0,24
17	0,00	0,00	0,59	0,54	0,60	0,54	0,57	0,31	0,40
18	0,00	0,00	0,48	0,47	0,56	0,55	0,54	0,39	0,35
19	0,00	0,00	0,57	0,48	0,49	0,44	0,68	0,47	0,29
20	0,00	0,10	0,66	0,69	0,71	0,67	0,75	0,54	0,37
21	0,00	0,01	0,60	0,63	0,67	0,58	0,83	0,60	0,30
22	0,00	0,20	0,55	0,59	0,56	0,40	0,58	0,49	0,20
23	0,00	0,01	0,81	0,83	0,66	0,92	1,03	0,72	0,55
24	0,00	0,06	0,64	0,68	0,69	0,72	0,95	0,55	0,44
25	0,00	0,06	0,76	0,78	0,88	0,97	0,73	0,60	0,18
26	0,00	0,00	0,99	1,00	1,01	1,21	1,07	0,80	0,38
27	0,00	0,05	0,65	0,65	0,55	0,74	0,86	0,60	0,44
28	0,00	0,06	0,65	0,67	0,67	0,79	0,96	0,41	0,46
29	0,00	0,24	0,56	0,60	0,67	0,75	0,58	0,39	0,27
30	0,00	0,05	0,76	0,82	1,35	1,03	1,46	0,55	0,57
Av	0,00	0,03	0,52	0,54	0,63	0,62	0,61	0,39	0,33
1-30 Δ	-100%	1%	102%	114%	221%	168%	433%	175%	106%

Table A.3.15: Frank Copula Estimations of Turkish Market Indicators for Pre-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,27	-0,13	0,73	0,76	0,75	0,50	0,58	0,53	0,45
2	-0,51	-0,17	0,70	0,71	0,78	0,76	0,61	0,24	0,19
3	-0,70	0,09	0,77	0,76	0,73	1,04	0,93	0,02	0,07
4	-0,50	0,44	0,85	0,89	1,04	1,55	0,66	-0,03	0,05
5	-0,41	0,91	0,62	0,61	0,79	1,76	0,66	-0,48	-0,36
6	-0,37	0,68	1,19	1,17	1,40	2,15	0,77	-0,26	-0,13
7	-1,07	0,49	1,19	1,15	1,77	2,71	1,28	-0,40	-0,59
8	-1,34	0,40	1,10	1,16	1,41	2,89	1,48	-0,26	-0,56
9	-1,17	0,44	0,71	0,72	1,26	3,28	1,25	-1,10	-1,04
10	-1,56	0,45	0,40	0,44	0,96	2,41	0,99	-0,82	-0,85
11	-1,60	0,45	0,84	0,91	1,83	2,99	1,57	-0,57	-1,03
12	-1,80	0,40	0,98	1,03	1,68	3,04	1,57	-0,92	-1,21
13	-2,18	0,03	1,46	1,49	2,22	3,64	1,81	0,01	-0,61
14	-1,95	-0,04	1,16	1,20	1,93	3,22	1,61	-0,67	-1,46
15	-2,40	0,23	1,22	1,25	1,92	3,21	1,49	-0,71	-1,18
16	-1,78	0,13	1,22	1,24	2,01	3,05	1,90	-0,30	-1,04
17	-1,82	0,50	0,81	0,86	1,81	2,84	1,69	-0,44	-1,29
18	-1,94	0,41	1,03	1,11	2,00	3,11	2,34	-0,32	-0,53
19	-1,19	1,11	0,39	0,43	1,14	2,05	1,23	-0,51	-1,02
20	-1,80	0,56	0,96	0,98	1,68	3,09	2,33	-0,82	-0,89
21	-1,74	0,90	0,34	0,40	1,64	2,56	1,30	-0,95	-0,94
22	-1,35	0,79	0,56	0,61	1,52	2,99	1,96	-1,68	-1,59
23	-0,96	1,22	0,22	0,25	1,18	2,61	1,69	-1,64	-1,37
24	-2,07	1,20	0,56	1,11	2,22	3,13	1,81	-1,25	-0,65
25	-1,63	0,31	0,66	0,71	1,67	2,84	2,17	-1,28	-1,68
26	-0,76	1,21	0,81	0,88	1,76	3,39	2,41	-1,08	-1,55
27	-1,75	0,68	0,77	0,84	2,05	3,41	2,03	-0,81	-0,29
28	-1,09	0,92	0,36	0,38	1,49	3,28	2,44	-1,38	-0,89
29	-1,77	1,35	0,31	0,32	1,35	2,52	1,70	-2,31	-1,47
30	-2,21	0,49	1,02	0,64	1,24	2,93	2,07	-1,92	-1,15
Av	-1,39	0,55	0,80	0,83	1,51	2,63	1,54	-0,74	-0,82
1-30 Δ	717%	-482%	39%	-16%	66%	481%	254%	-464%	-356%

Table A.3.16: Frank Copula Estimations of Turkish Market Indicators for Post-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,13	0,07	1,55	1,57	1,73	1,68	1,05	0,76	1,16
2	-0,86	-0,15	1,73	1,81	2,08	2,05	1,32	0,92	1,33
3	-1,31	-0,24	2,10	2,23	2,78	2,60	1,58	1,35	1,47
4	-2,33	-0,19	2,13	2,27	2,79	2,59	1,73	1,09	1,42
5	-1,68	0,03	1,58	1,71	2,35	2,29	1,51	0,89	1,41
6	-1,69	-0,01	1,18	1,30	1,74	1,83	1,15	0,62	1,08
7	-0,99	0,01	1,10	1,40	2,16	2,06	1,30	0,68	0,81
8	-1,44	-0,07	1,24	1,21	1,86	1,89	1,05	0,36	1,36
9	-1,46	0,04	0,66	0,82	1,75	1,84	0,67	0,25	0,80
10	-1,81	-0,57	1,19	1,33	1,86	1,96	0,88	0,74	1,15
11	-1,04	-0,29	0,42	0,56	1,24	1,28	0,71	0,12	0,49
12	-1,57	0,08	0,95	1,12	1,56	1,48	1,33	0,27	0,76
13	-1,95	0,00	0,91	1,06	1,58	1,38	1,18	0,42	0,65
14	-2,25	-0,16	1,23	1,25	1,93	2,37	1,73	0,70	0,99
15	-1,89	-0,27	0,87	1,05	1,71	1,79	1,46	0,67	1,23
16	-1,06	0,05	0,62	0,78	1,10	1,27	0,90	0,55	0,61
17	-1,75	-0,25	1,14	1,18	1,75	1,66	1,49	0,16	0,91
18	-1,57	-0,08	1,86	1,76	2,49	2,50	2,10	1,19	1,35
19	-1,73	-0,30	1,46	1,08	1,41	1,02	1,50	1,10	0,82
20	-1,92	0,13	2,33	2,46	2,81	2,83	2,36	2,19	1,56
21	-1,81	-0,24	1,70	1,79	2,67	2,46	2,15	1,98	0,85
22	-1,95	0,69	1,67	1,86	2,29	1,90	1,53	1,87	0,89
23	-2,45	-0,16	2,52	2,58	2,62	2,73	2,62	2,09	1,42
24	-2,08	-0,03	1,78	1,97	2,40	2,65	2,57	1,40	1,55
25	-2,16	0,04	2,33	2,50	3,44	3,57	2,56	1,51	0,68
26	-3,28	-0,62	3,26	3,46	4,06	3,89	3,30	2,20	1,72
27	-2,47	-0,70	2,73	2,86	2,96	3,17	3,80	1,95	1,48
28	-2,77	0,00	2,40	2,57	2,71	2,92	3,02	1,35	1,49
29	-1,94	0,65	1,85	2,05	2,54	2,82	2,00	1,61	0,91
30	-2,82	-0,31	2,04	2,33	3,65	3,03	3,68	1,78	1,82
Av	-1,80	-0,10	1,62	1,73	2,27	2,25	1,81	1,09	1,14
1-30 Δ	-2331%	-560%	32%	49%	110%	80%	250%	133%	56%

Table A.3.17: Gumbel Copula Estimations of Turkish Market Indicators for Pre-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	1,00	1,00	1,06	1,06	1,07	1,04	1,04	1,05	1,03
2	1,00	1,00	1,04	1,04	1,07	1,07	1,05	1,00	1,00
3	1,00	1,00	1,08	1,08	1,08	1,11	1,07	1,00	1,00
4	1,00	1,02	1,09	1,09	1,13	1,19	1,04	1,00	1,01
5	1,00	1,07	1,11	1,12	1,13	1,25	1,07	1,00	1,00
6	1,00	1,03	1,17	1,17	1,20	1,30	1,08	1,00	1,02
7	1,00	1,01	1,16	1,16	1,25	1,37	1,17	1,00	1,00
8	1,00	1,03	1,13	1,13	1,15	1,43	1,17	1,02	1,00
9	1,00	1,01	1,07	1,07	1,15	1,48	1,13	1,00	1,00
10	1,00	1,01	1,06	1,07	1,11	1,34	1,14	1,00	1,00
11	1,00	1,09	1,10	1,11	1,26	1,40	1,17	1,00	1,00
12	1,00	1,04	1,14	1,14	1,25	1,45	1,20	1,01	1,00
13	1,00	1,01	1,18	1,19	1,28	1,50	1,23	1,05	1,00
14	1,00	1,00	1,17	1,18	1,30	1,49	1,23	1,01	1,00
15	1,00	1,03	1,17	1,18	1,29	1,52	1,22	1,05	1,00
16	1,00	1,04	1,18	1,18	1,33	1,49	1,28	1,07	1,00
17	1,00	1,07	1,12	1,13	1,28	1,44	1,21	1,01	1,00
18	1,00	1,00	1,17	1,18	1,33	1,54	1,36	1,09	1,00
19	1,00	1,16	1,07	1,07	1,16	1,28	1,17	1,00	1,00
20	1,00	1,08	1,21	1,21	1,27	1,46	1,37	1,00	1,00
21	1,00	1,12	1,07	1,08	1,25	1,38	1,19	1,03	1,00
22	1,00	1,12	1,10	1,11	1,26	1,46	1,30	1,00	1,00
23	1,00	1,15	1,10	1,11	1,24	1,48	1,26	1,01	1,00
24	1,00	1,19	1,09	1,24	1,36	1,45	1,35	1,00	1,02
25	1,00	1,07	1,14	1,14	1,30	1,50	1,41	1,00	1,00
26	1,00	1,12	1,17	1,18	1,33	1,63	1,45	1,00	1,00
27	1,00	1,08	1,16	1,17	1,37	1,58	1,34	1,05	1,07
28	1,00	1,11	1,13	1,12	1,25	1,52	1,40	1,00	1,03
29	1,00	1,17	1,09	1,08	1,21	1,42	1,35	1,00	1,00
30	1,00	1,08	1,16	1,05	1,14	1,39	1,33	1,00	1,00
Av	1,00	1,06	1,12	1,13	1,23	1,40	1,23	1,01	1,01
1-30 Δ	0%	8%	10%	0%	7%	34%	28%	-4%	-3%

Table A.3.18: Gumbel Copula Estimations of Turkish Market Indicators for Post-Crisis
Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,13	0,07	1,55	1,57	1,73	1,68	1,05	0,76	1,16
2	-0,86	-0,15	1,73	1,81	2,08	2,05	1,32	0,92	1,33
3	-1,31	-0,24	2,10	2,23	2,78	2,60	1,58	1,35	1,47
4	-2,33	-0,19	2,13	2,27	2,79	2,59	1,73	1,09	1,42
5	-1,68	0,03	1,58	1,71	2,35	2,29	1,51	0,89	1,41
6	-1,69	-0,01	1,18	1,30	1,74	1,83	1,15	0,62	1,08
7	-0,99	0,01	1,10	1,40	2,16	2,06	1,30	0,68	0,81
8	-1,44	-0,07	1,24	1,21	1,86	1,89	1,05	0,36	1,36
9	-1,46	0,04	0,66	0,82	1,75	1,84	0,67	0,25	0,80
10	-1,81	-0,57	1,19	1,33	1,86	1,96	0,88	0,74	1,15
11	-1,04	-0,29	0,42	0,56	1,24	1,28	0,71	0,12	0,49
12	-1,57	0,08	0,95	1,12	1,56	1,48	1,33	0,27	0,76
13	-1,95	0,00	0,91	1,06	1,58	1,38	1,18	0,42	0,65
14	-2,25	-0,16	1,23	1,25	1,93	2,37	1,73	0,70	0,99
15	-1,89	-0,27	0,87	1,05	1,71	1,79	1,46	0,67	1,23
16	-1,06	0,05	0,62	0,78	1,10	1,27	0,90	0,55	0,61
17	-1,75	-0,25	1,14	1,18	1,75	1,66	1,49	0,16	0,91
18	-1,57	-0,08	1,86	1,76	2,49	2,50	2,10	1,19	1,35
19	-1,73	-0,30	1,46	1,08	1,41	1,02	1,50	1,10	0,82
20	-1,92	0,13	2,33	2,46	2,81	2,83	2,36	2,19	1,56
21	-1,81	-0,24	1,70	1,79	2,67	2,46	2,15	1,98	0,85
22	-1,95	0,69	1,67	1,86	2,29	1,90	1,53	1,87	0,89
23	-2,45	-0,16	2,52	2,58	2,62	2,73	2,62	2,09	1,42
24	-2,08	-0,03	1,78	1,97	2,40	2,65	2,57	1,40	1,55
25	-2,16	0,04	2,33	2,50	3,44	3,57	2,56	1,51	0,68
26	-3,28	-0,62	3,26	3,46	4,06	3,89	3,30	2,20	1,72
27	-2,47	-0,70	2,73	2,86	2,96	3,17	3,80	1,95	1,48
28	-2,77	0,00	2,40	2,57	2,71	2,92	3,02	1,35	1,49
29	-1,94	0,65	1,85	2,05	2,54	2,82	2,00	1,61	0,91
30	-2,82	-0,31	2,04	2,33	3,65	3,03	3,68	1,78	1,82
Av	-1,80	-0,10	1,62	1,73	2,27	2,25	1,81	1,09	1,14
1-30 Δ	-2331%	-560%	32%	49%	110%	80%	250%	133%	56%

Table A.3.19: Pearson Correlation Estimations of Turkish Market Indicators for Pre-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,03	-0,02	0,12	0,13	0,14	0,11	0,11	0,10	0,07
2	-0,09	-0,04	0,12	0,12	0,15	0,15	0,11	0,02	0,03
3	-0,11	-0,01	0,12	0,12	0,15	0,20	0,12	-0,02	0,01
4	-0,08	0,07	0,17	0,17	0,20	0,26	0,13	-0,01	0,00
5	-0,07	0,08	0,16	0,16	0,20	0,28	0,15	-0,04	-0,04
6	-0,11	0,04	0,19	0,20	0,25	0,35	0,20	-0,04	-0,04
7	-0,16	0,03	0,21	0,22	0,27	0,35	0,23	0,01	-0,07
8	-0,17	0,00	0,21	0,22	0,27	0,38	0,25	-0,02	-0,07
9	-0,19	0,00	0,19	0,19	0,26	0,41	0,24	-0,04	-0,10
10	-0,19	0,01	0,18	0,18	0,26	0,40	0,23	-0,04	-0,12
11	-0,21	0,02	0,18	0,18	0,27	0,39	0,25	-0,06	-0,13
12	-0,22	0,01	0,17	0,18	0,27	0,43	0,24	-0,07	-0,17
13	-0,25	-0,03	0,24	0,24	0,33	0,47	0,28	-0,02	-0,06
14	-0,23	-0,02	0,19	0,20	0,30	0,45	0,25	-0,07	-0,14
15	-0,24	0,00	0,16	0,17	0,27	0,44	0,25	-0,12	-0,17
16	-0,21	0,01	0,18	0,18	0,27	0,41	0,26	-0,05	-0,08
17	-0,21	0,01	0,12	0,13	0,26	0,39	0,25	-0,09	-0,17
18	-0,21	0,02	0,16	0,17	0,28	0,43	0,30	-0,05	-0,09
19	-0,17	0,08	0,10	0,10	0,19	0,34	0,19	-0,15	-0,16
20	-0,20	0,04	0,10	0,11	0,21	0,41	0,30	-0,16	-0,16
21	-0,20	0,03	0,05	0,06	0,21	0,37	0,22	-0,15	-0,16
22	-0,20	0,03	0,08	0,09	0,21	0,40	0,28	-0,19	-0,19
23	-0,13	0,07	0,05	0,05	0,19	0,41	0,20	-0,17	-0,18
24	-0,20	0,05	0,16	0,16	0,27	0,45	0,25	-0,16	-0,12
25	-0,17	0,05	0,05	0,06	0,18	0,34	0,26	-0,21	-0,22
26	-0,15	0,08	0,12	0,12	0,21	0,44	0,30	-0,18	-0,23
27	-0,17	0,02	0,12	0,12	0,26	0,47	0,26	-0,10	-0,07
28	-0,17	0,04	0,08	0,09	0,21	0,43	0,26	-0,16	-0,14
29	-0,16	0,08	0,05	0,05	0,16	0,34	0,20	-0,29	-0,19
30	-0,16	0,04	0,02	0,03	0,18	0,35	0,21	-0,22	-0,17
Av	-0,17	0,03	0,14	0,14	0,23	0,37	0,23	-0,09	-0,11
1-30 Δ	463%	-296%	-80%	-73%	29%	209%	89%	-318%	-326%

Table A.3.20: Pearson Correlation Estimations of Turkish Market Indicators for Post-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,00	-0,06	0,29	0,29	0,30	0,27	0,20	0,15	0,24
2	-0,10	-0,07	0,32	0,33	0,37	0,32	0,26	0,15	0,26
3	-0,21	-0,07	0,31	0,33	0,39	0,34	0,25	0,18	0,25
4	-0,27	-0,09	0,30	0,32	0,39	0,35	0,26	0,15	0,23
5	-0,28	-0,08	0,29	0,31	0,41	0,38	0,27	0,18	0,21
6	-0,30	-0,09	0,27	0,29	0,40	0,37	0,25	0,16	0,19
7	-0,35	-0,10	0,29	0,32	0,45	0,43	0,32	0,18	0,15
8	-0,36	-0,13	0,29	0,32	0,43	0,41	0,30	0,19	0,20
9	-0,35	-0,07	0,24	0,28	0,44	0,41	0,28	0,17	0,10
10	-0,38	-0,13	0,25	0,29	0,47	0,43	0,32	0,18	0,10
11	-0,35	-0,11	0,24	0,28	0,44	0,41	0,32	0,20	0,08
12	-0,39	-0,13	0,28	0,33	0,49	0,45	0,38	0,22	0,11
13	-0,38	-0,09	0,26	0,31	0,48	0,46	0,40	0,20	0,07
14	-0,43	-0,10	0,30	0,35	0,53	0,52	0,41	0,26	0,08
15	-0,46	-0,15	0,30	0,35	0,53	0,50	0,46	0,27	0,09
16	-0,38	-0,11	0,28	0,33	0,51	0,49	0,40	0,23	0,03
17	-0,44	-0,12	0,31	0,37	0,55	0,52	0,47	0,24	0,05
18	-0,47	-0,15	0,37	0,42	0,59	0,58	0,50	0,32	0,09
19	-0,46	-0,14	0,35	0,40	0,57	0,54	0,50	0,31	0,05
20	-0,47	-0,14	0,38	0,43	0,59	0,57	0,50	0,34	0,12
21	-0,48	-0,16	0,36	0,42	0,60	0,58	0,52	0,29	0,04
22	-0,44	-0,07	0,35	0,41	0,61	0,58	0,49	0,32	0,04
23	-0,55	-0,19	0,43	0,48	0,64	0,62	0,54	0,35	0,11
24	-0,50	-0,19	0,42	0,47	0,65	0,63	0,58	0,34	0,12
25	-0,54	-0,15	0,44	0,49	0,66	0,65	0,55	0,37	0,03
26	-0,57	-0,21	0,47	0,52	0,68	0,66	0,58	0,40	0,10
27	-0,55	-0,22	0,44	0,50	0,68	0,66	0,61	0,40	0,09
28	-0,52	-0,17	0,43	0,49	0,67	0,65	0,59	0,33	0,08
29	-0,51	-0,14	0,41	0,47	0,65	0,64	0,54	0,34	0,03
30	-0,59	-0,22	0,46	0,52	0,68	0,65	0,60	0,37	0,09
Av	-0,40	-0,13	0,34	0,38	0,53	0,50	0,42	0,26	0,11
1-30 Δ	-32392%	287%	59%	77%	130%	138%	197%	148%	-64%

Table A.3.21: Spearman Correlation Estimations of Turkish Market Indicators for Pre-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,04	-0,02	0,12	0,12	0,12	0,08	0,09	0,08	0,07
2	-0,08	-0,02	0,12	0,12	0,13	0,13	0,11	0,03	0,03
3	-0,09	0,02	0,13	0,12	0,12	0,17	0,13	-0,01	0,01
4	-0,09	0,08	0,17	0,17	0,19	0,26	0,14	-0,02	0,00
5	-0,07	0,09	0,12	0,12	0,15	0,26	0,11	-0,08	-0,06
6	-0,14	0,05	0,18	0,18	0,24	0,35	0,17	-0,02	-0,05
7	-0,21	0,05	0,23	0,23	0,28	0,39	0,19	0,00	-0,09
8	-0,21	0,04	0,22	0,22	0,28	0,40	0,23	-0,01	-0,08
9	-0,24	0,02	0,19	0,19	0,27	0,45	0,21	-0,05	-0,12
10	-0,24	0,02	0,15	0,15	0,23	0,40	0,17	-0,04	-0,12
11	-0,22	0,01	0,16	0,16	0,27	0,41	0,24	-0,04	-0,15
12	-0,27	0,05	0,13	0,14	0,23	0,42	0,23	-0,13	-0,19
13	-0,32	-0,04	0,24	0,25	0,35	0,51	0,29	0,04	-0,06
14	-0,26	0,02	0,19	0,18	0,28	0,46	0,22	-0,09	-0,19
15	-0,32	0,03	0,18	0,19	0,29	0,45	0,22	-0,08	-0,17
16	-0,28	0,07	0,19	0,20	0,30	0,43	0,28	-0,01	-0,13
17	-0,24	0,04	0,11	0,12	0,26	0,42	0,27	-0,07	-0,17
18	-0,28	0,08	0,12	0,14	0,27	0,39	0,31	-0,05	-0,07
19	-0,21	0,19	0,05	0,05	0,16	0,33	0,18	-0,19	-0,14
20	-0,26	0,07	0,12	0,11	0,21	0,40	0,33	-0,10	-0,12
21	-0,25	0,07	0,06	0,09	0,27	0,37	0,18	-0,13	-0,15
22	-0,24	0,07	0,07	0,08	0,17	0,41	0,35	-0,21	-0,22
23	-0,11	0,17	0,01	0,03	0,13	0,30	0,23	-0,18	-0,20
24	-0,25	0,08	0,10	0,12	0,27	0,41	0,21	-0,11	-0,09
25	-0,25	0,10	0,11	0,09	0,20	0,32	0,26	-0,19	-0,21
26	-0,22	0,08	0,15	0,15	0,27	0,37	0,36	-0,12	-0,17
27	-0,25	0,05	0,11	0,12	0,34	0,43	0,33	-0,11	-0,04
28	-0,22	0,03	0,01	0,00	0,22	0,41	0,33	-0,17	-0,14
29	-0,30	0,13	0,00	0,01	0,19	0,30	0,23	-0,32	-0,14
30	-0,30	-0,05	0,04	0,04	0,13	0,39	0,26	-0,22	-0,08
Av	-0,22	0,05	0,13	0,13	0,23	0,36	0,23	-0,09	-0,11
1-30 Δ	642%	182%	-66%	-66%	6%	386%	177%	-363%	-205%

Table A.3.22: Spearman Correlation Estimations of Turkish Market Indicators for Post-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,02	0,01	0,23	0,23	0,25	0,24	0,16	0,11	0,17
2	-0,14	-0,02	0,25	0,26	0,30	0,32	0,19	0,14	0,20
3	-0,20	-0,01	0,28	0,29	0,36	0,35	0,21	0,15	0,22
4	-0,25	0,02	0,27	0,28	0,35	0,35	0,22	0,11	0,22
5	-0,23	0,04	0,22	0,24	0,33	0,33	0,22	0,08	0,23
6	-0,22	0,04	0,16	0,18	0,27	0,27	0,20	0,05	0,16
7	-0,20	0,04	0,18	0,21	0,34	0,33	0,24	0,06	0,16
8	-0,21	0,06	0,19	0,20	0,30	0,29	0,20	0,07	0,22
9	-0,22	0,04	0,12	0,16	0,30	0,29	0,20	0,03	0,12
10	-0,23	-0,01	0,19	0,22	0,36	0,35	0,25	0,11	0,13
11	-0,15	0,08	0,10	0,13	0,26	0,25	0,20	0,03	0,09
12	-0,22	0,03	0,14	0,16	0,29	0,29	0,25	0,06	0,13
13	-0,24	0,07	0,20	0,23	0,33	0,31	0,29	0,07	0,12
14	-0,31	0,04	0,25	0,28	0,39	0,41	0,33	0,15	0,14
15	-0,33	0,02	0,21	0,25	0,35	0,34	0,35	0,11	0,13
16	-0,26	0,01	0,22	0,25	0,35	0,33	0,27	0,14	0,11
17	-0,31	0,06	0,23	0,25	0,35	0,33	0,29	0,09	0,09
18	-0,30	-0,01	0,28	0,31	0,40	0,42	0,35	0,16	0,16
19	-0,34	0,01	0,25	0,29	0,39	0,36	0,36	0,17	0,13
20	-0,29	0,01	0,28	0,30	0,38	0,38	0,37	0,18	0,18
21	-0,28	-0,04	0,25	0,29	0,38	0,37	0,36	0,15	0,07
22	-0,31	0,09	0,24	0,28	0,39	0,37	0,33	0,19	0,07
23	-0,40	-0,06	0,30	0,32	0,44	0,44	0,38	0,21	0,14
24	-0,36	-0,06	0,26	0,28	0,44	0,45	0,41	0,20	0,15
25	-0,33	0,02	0,24	0,29	0,39	0,37	0,35	0,20	0,07
26	-0,42	-0,04	0,31	0,33	0,48	0,47	0,42	0,23	0,17
27	-0,37	0,00	0,21	0,25	0,46	0,43	0,43	0,28	0,10
28	-0,40	-0,04	0,27	0,32	0,51	0,48	0,46	0,22	0,12
29	-0,35	-0,01	0,29	0,31	0,47	0,47	0,39	0,31	0,11
30	-0,49	-0,10	0,35	0,38	0,49	0,46	0,48	0,29	0,16
Av	-0,28	0,01	0,23	0,26	0,37	0,36	0,31	0,15	0,14
1-30 Δ	-2552%	-1017%	52%	68%	98%	92%	211%	158%	-8%

Table A.3.23: Kendall Correlation Estimations of Turkish Market Indicators for Pre-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	-0,03	-0,01	0,08	0,08	0,08	0,05	0,06	0,06	0,05
2	-0,06	-0,01	0,08	0,08	0,09	0,08	0,07	0,02	0,02
3	-0,06	0,01	0,09	0,09	0,08	0,12	0,09	-0,01	0,01
4	-0,06	0,06	0,11	0,11	0,13	0,17	0,09	-0,01	0,00
5	-0,05	0,05	0,08	0,08	0,10	0,18	0,08	-0,05	-0,04
6	-0,09	0,03	0,12	0,12	0,17	0,24	0,11	-0,01	-0,03
7	-0,13	0,03	0,15	0,16	0,19	0,27	0,12	0,00	-0,05
8	-0,14	0,03	0,15	0,15	0,19	0,28	0,16	0,01	-0,05
9	-0,15	0,02	0,12	0,13	0,18	0,31	0,14	-0,03	-0,07
10	-0,16	0,01	0,10	0,11	0,16	0,27	0,12	-0,02	-0,08
11	-0,13	0,00	0,11	0,11	0,18	0,29	0,17	-0,02	-0,10
12	-0,18	0,03	0,09	0,09	0,15	0,28	0,15	-0,10	-0,13
13	-0,22	-0,03	0,16	0,17	0,22	0,34	0,19	0,03	-0,04
14	-0,17	0,01	0,12	0,11	0,19	0,30	0,16	-0,06	-0,12
15	-0,21	0,01	0,11	0,11	0,19	0,29	0,16	-0,06	-0,12
16	-0,20	0,05	0,14	0,13	0,19	0,29	0,18	0,00	-0,08
17	-0,16	0,02	0,07	0,08	0,16	0,28	0,18	-0,04	-0,12
18	-0,17	0,05	0,07	0,08	0,18	0,27	0,21	-0,04	-0,04
19	-0,13	0,12	0,04	0,04	0,12	0,24	0,11	-0,13	-0,10
20	-0,19	0,04	0,10	0,09	0,15	0,26	0,24	-0,07	-0,07
21	-0,16	0,04	0,04	0,07	0,18	0,24	0,12	-0,09	-0,11
22	-0,15	0,07	0,05	0,06	0,14	0,28	0,23	-0,16	-0,15
23	-0,10	0,11	0,02	0,03	0,09	0,20	0,17	-0,14	-0,12
24	-0,16	0,04	0,05	0,07	0,18	0,27	0,14	-0,06	-0,06
25	-0,18	0,06	0,07	0,07	0,13	0,21	0,18	-0,12	-0,16
26	-0,16	0,05	0,11	0,09	0,19	0,23	0,26	-0,09	-0,13
27	-0,17	0,05	0,08	0,10	0,21	0,29	0,21	-0,10	-0,02
28	-0,17	0,03	0,01	0,00	0,13	0,27	0,19	-0,12	-0,11
29	-0,22	0,09	0,00	0,00	0,09	0,18	0,17	-0,22	-0,10
30	-0,25	-0,03	0,02	0,02	0,05	0,26	0,17	-0,16	-0,10
Av	-0,15	0,03	0,09	0,09	0,15	0,24	0,16	-0,06	-0,07
1-30 Δ	827%	151%	-68%	-76%	-32%	384%	175%	-378%	-296%

Table A.3.24: Kendall Correlation Estimations of Turkish Market Indicators for Post-Crisis Period

Day	USD	EUR	XU30	XU100	XUSIN	XKMYA	XELKT	XULAS	XILTM
1	0,01	0,01	0,16	0,16	0,17	0,17	0,11	0,08	0,12
2	-0,10	-0,01	0,17	0,18	0,21	0,22	0,13	0,10	0,14
3	-0,14	-0,01	0,19	0,20	0,25	0,25	0,14	0,10	0,15
4	-0,17	0,02	0,19	0,20	0,25	0,25	0,16	0,08	0,15
5	-0,16	0,03	0,15	0,16	0,23	0,23	0,16	0,05	0,16
6	-0,16	0,03	0,11	0,12	0,19	0,19	0,13	0,04	0,11
7	-0,14	0,03	0,13	0,15	0,24	0,23	0,16	0,05	0,11
8	-0,15	0,04	0,13	0,14	0,21	0,21	0,14	0,05	0,15
9	-0,15	0,03	0,08	0,10	0,20	0,20	0,13	0,02	0,08
10	-0,16	-0,01	0,13	0,15	0,25	0,24	0,17	0,08	0,09
11	-0,10	0,06	0,07	0,09	0,18	0,17	0,14	0,02	0,07
12	-0,15	0,02	0,10	0,11	0,20	0,20	0,17	0,04	0,09
13	-0,17	0,05	0,14	0,16	0,23	0,22	0,20	0,04	0,09
14	-0,22	0,02	0,18	0,20	0,27	0,29	0,23	0,11	0,10
15	-0,24	0,02	0,15	0,18	0,25	0,25	0,24	0,08	0,09
16	-0,18	0,01	0,15	0,17	0,24	0,24	0,18	0,09	0,08
17	-0,22	0,05	0,16	0,17	0,24	0,24	0,20	0,07	0,06
18	-0,20	0,00	0,18	0,21	0,28	0,28	0,24	0,11	0,12
19	-0,23	0,02	0,19	0,22	0,28	0,25	0,25	0,12	0,09
20	-0,20	0,01	0,20	0,21	0,28	0,28	0,26	0,12	0,12
21	-0,20	-0,03	0,17	0,20	0,26	0,25	0,26	0,10	0,05
22	-0,22	0,06	0,17	0,20	0,28	0,26	0,24	0,14	0,06
23	-0,28	-0,05	0,21	0,23	0,32	0,31	0,27	0,14	0,11
24	-0,25	-0,04	0,19	0,20	0,31	0,32	0,28	0,14	0,12
25	-0,23	0,02	0,16	0,19	0,26	0,24	0,24	0,13	0,06
26	-0,29	-0,03	0,22	0,24	0,35	0,34	0,31	0,16	0,12
27	-0,28	-0,01	0,14	0,17	0,33	0,31	0,33	0,19	0,08
28	-0,28	-0,02	0,20	0,23	0,37	0,34	0,33	0,16	0,09
29	-0,25	0,02	0,21	0,22	0,33	0,35	0,28	0,21	0,08
30	-0,34	-0,05	0,22	0,26	0,35	0,31	0,34	0,20	0,11
Av	-0,20	0,01	0,16	0,18	0,26	0,25	0,21	0,10	0,10
1-30 Δ	-2565%	-811%	42%	65%	102%	88%	221%	167%	-6%

APPENDIX B

MATLAB CODE

```
clear all;

data =xlsread('DataTR_1-30_returns', 'data_period2', 'B2:K1396');

N1 = 0; N2 =0;
N1=size(data,1);
N2=size(data,2);

MeanMats = zeros(N1,N2,30);
Rho_Mats=zeros(5,N2,30);
Returns =zeros(N1-1,N2,30);

for i = 1:30

    div = floor(N1/i);
    ReturnMats = zeros(div-1,N2);
    ARMA_ResMats = zeros(div-1,N2);
    GARCH_ResMats = zeros(div-1,N2);

    for j = 1:div
        for k=1:N2
            MeanMats(j,k,i) = mean(data((j-1)*i+1:j*i,k));
        end
    end

    % STEP - 1 : Return Calculations

    for j = 1:div-1
        for k=1:N2
            ReturnMats(j,k) = log(MeanMats(j+1,k,i) ./ MeanMats(j,k,i));
            Returns(j,k,i) = ReturnMats(j,k);
        end
    end

    acf_all = zeros(5,N2); pacf_all = zeros(5,N2);
```

```

s = zeros(1,N2);

for k=1:N2

    datas=nonzeros(ReturnMats(:,k));
    dof=length(datas)-1; %degrees of freedom of each series
    tdist = struct('Name','t','DoF',dof);

    %STEP-2 : Choosing White Noise Series
    [acf,lags,bounds_acf] = autocorr(ReturnMats(:,k));
    [pacf,lags,bounds_pacf] = parcorr(ReturnMats(:,k));

    acf_all(:,k) = acf(2:6);
    pacf_all(:,k) = pacf(2:6);

    p=0 ; q=0;

    for n=1:5
        if (abs(acf_all(n,k)) >= bounds_acf(1)*1.25)
            p=1;
            %p_den(k) = 1;
            break;
        end
    end

    for n=1:5
        if (abs(pacf_all(n,k)) >= bounds_pacf(1)*1.25)
            q=1;
            %q_den(k) = 1;
            break;
        end
    end

    if (p==0 && q==0)
        % White Noise Filtering
        ARMA_ResMats(:,k) = ReturnMats(:,k);
    else
        % ARMA Modelling
        nperformance = zeros(3,3); tperformance = zeros(3,3);
        ARMA_success = 0;
        for p=1:3
            for q=1:3
                try
                    ARMA=arima('ARLags',p, 'MALags',q);

```

```

[~,~,logL]=estimate(ARMA,ReturnMats(:,k));
nperformance(p,q)=aicbic(logL,dof);

ARMAT=arima('ARLags',p,'MALags',q,'Distribution',tdist);
[~,~,logL]=estimate(ARMAT,ReturnMats(:,k));
tperformance(p,q)=aicbic(logL,dof);
ARMA_success = 1;
catch
nperformance(p,q)=10e5;
tperformance(p,q)=10e5;
end
end
end
if (ARMA_success==0)
ARMA_ResMats(:,k) = ReturnMats(:,k);
else
if min(nperformance)<min(tperformance)
[op,oq]=find(nperformance==min(nperformance(:)));
ARMA=arima('ARLags',op,'MALags',oq);
E=estimate(ARMA,ReturnMats(:,k));
[ARMA_ResMats(:,k),~,~]=infer(E,ReturnMats(:,k));
else
[op,oq]=find(tperformance==min(tperformance(:)));
ARMAT=arima('ARLags',op,'MALags',oq,'Distribution',tdist);
E=estimate(ARMAT,ReturnMats(:,k));
[ARMA_ResMats(:,k),~,~]=infer(E,ReturnMats(:,k));
end
end

end

% STEP-2 : Choosing White Noise Series
ARMA_ResMats_Sqr = power(ARMA_ResMats(:,k),2);

[~, p_val]=lbqtest(ARMA_ResMats_Sqr, 'lags', [1:20]);
for n=1:20
if(p_val(n)<=0.05)
s(k)= s(k)+1;
end;
end

if (s(k) > 16)
GARCH_ResMats(:,k) = ARMA_ResMats(:,k);

```

```

else
    nperformance = zeros(2,2); tperformance = zeros(2,2);

    GARCH_success = 0;
    for p=1:2
        for q=1:2
            try
                GARCH=garch('GARCHLags',p,'ARCHLags',q);
                [~,~,logL,~]=estimate(GARCH,ARMA_ResMats(:,k));
                nperformance(p,q)=aicbic(logL,dof);

                TGARCH=garch('GARCHLags',p,'ARCHLags',q,'Distribution',tdist);
                [~,~,logL,~]=estimate(TGARCH,ARMA_ResMats(:,k));
                tperformance(p,q)=aicbic(logL,dof);
                GARCH_success=1;
            catch
                nperformance(p,q)=10e5;
                tperformance(p,q)=10e5;
            end
        end
    end
end

if (GARCH_success==0)
    GARCH_ResMats(:,k) = ARMA_ResMats(:,k);
else
    E=zeros(div-1,1);
    if min(nperformance)<min(tperformance)
        [op,oq]=find(nperformance==min(nperformance(:)));
        GARCH=garch('GARCHLags',op,'ARCHLags',oq);
        E=estimate(GARCH,ARMA_ResMats(:,k));
        [V,~]=infer(E,ARMA_ResMats(:,k));
        GARCH_ResMats(:,k)=(ARMA_ResMats(:,k)-E.Offset)./sqrt(V);
    else
        [op,oq]=find(tperformance==min(tperformance(:)));
        TGARCH=garch('GARCHLags',op,'ARCHLags',oq,'Distribution',tdist);
        E=estimate(TGARCH,ARMA_ResMats(:,k));
        [V,~]=infer(E,ARMA_ResMats(:,k));
        GARCH_ResMats(:,k)=(ARMA_ResMats(:,k)-E.Offset)./sqrt(V);
    end
end

end

end

```



```

end

%Copula Modelling
uniform=zeros(div-1,N2);
for k=1:N2

uniform(:,k)=ksdensity(GARCH_ResMats(:,k),GARCH_ResMats(:,k),'function','cdf');
    try
        temp =copulafit('Gaussian',[uniform(:,1),uniform(:,k)]);
        Rho_Mats(1,k,i) = temp(1,2);
    catch
        Rho_Mats(1,k,i) = NaN;
    end

    try
        temp =copulafit('t',[uniform(:,1),uniform(:,k)]);
        Rho_Mats(2,k,i) = temp(1,2);
    catch
        Rho_Mats(2,k,i) = NaN;
    end

    try
        Rho_Mats(3,k,i)=copulafit('Clayton',[uniform(:,1),uniform(:,k)]);
    catch
        Rho_Mats(3,k,i) = NaN;
    end

    try
        Rho_Mats(4,k,i)=copulafit('Frank',[uniform(:,1),uniform(:,k)]);
    catch
        Rho_Mats(4,k,i) = NaN;
    end

    try
        Rho_Mats(5,k,i)=copulafit('Gumbel',[uniform(:,1),uniform(:,k)]);
    catch
        Rho_Mats(5,k,i) = NaN;
    end
end

end

%%
Op_Rho_Mats = zeros(30,N2);

```

```

for i=1:30
    Op_Rho_Mats(i,:)=Rho_Mats(5, :, i);
end

i=1:30;
figure;
title('CAPUERAS');
plot(i,Op_Rho_Mats(i,:));

%% Correlation Calculations
CorrMats = zeros(30,N2,2,3);
for i=1:30
    div = floor(N1/i);
    for k=1:N2
        [CorrMats(i,k,1,1),CorrMats(i,k,2,1)] = corr>Returns(1:div-1,1,i),Returns(1:div-1,k,i));
        [CorrMats(i,k,1,2),CorrMats(i,k,2,2)] = corr>Returns(1:div-1,1,i),Returns(1:div-1,k,i),'type', 'Spearman');
        [CorrMats(i,k,1,3),CorrMats(i,k,2,3)] = corr>Returns(1:div-1,1,i),Returns(1:div-1,k,i),'type', 'Kendall');
    end
end
figure;
i=1:30;
%CorrMats(1:29, :, 1, 1)=0;
title('Correlations');
plot(i,CorrMats(i, :, 1, 1));

```