An Analysis of the Relationships between Financial Indicators and Energy Prices among the OECD Countries*

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Abstract

In this study, short and long term relationships between energy prices and market indicators of 24 OECD countries were investigated. The study was realized in the period of June 2001 – March 2009 and cointegration and causality tests were applied and the data were analyzed for each of the countries and the findings were evaluated. In conclusion, it is shown in this study that there are extensive and multidirectional relationships both among energy prices and financial indicators. For the moment, these findings don't sufficiently support researches claiming that energy markets in the world and in Europe start to integrate. And for the moment, existing relationships can only be explained through individual countries' factors regarding their energy markets and resources.

Keywords: Energy Prices, Market Indicators, Cointegration, Causality, OECD

1.Introduction

One of the most important production factors is energy prices and these prices vary considerably depending on types of energy such as coal, natural gas, electricity, oil, etc. Given the facts that energy resources are dependent on each other, that they are complementary to each other, technological characteristics and geographical differences, the relation among the prices of these resources may be very different from time to time and their connection with each other becomes very complicated. Nuclear technology and resources of renewable energy which are developed during the recent years as well as energy security, environmental, political and ideological factors are also influential on this relation. On the other hand, as countries develop, they inevitabily use more energy for production of goods and services. Advanced industrialized societies use more energy per unit of economic output and far more energy per capita than developing societies. The linkages among energy, other inputs, and economic activity clearly change significantly as an economy moves through different stages of development (Barnes and Floor, 1996). In many of these researches (Wolde-Rufael, 2004; Yuan, Kang, Zhao and Hu, 2008), it is observed that energy consumption has an effect on economic growth, and in some others, it is revealed that the cause and effect relation is a result of economic growth (Jinke, Hualing and Dianming, 2008). In the literature, there isn't a general consensus.

On the other hand, this relation is reflected inevitably on market indicators. The more the national economy is developed, the more such basic financial factors as interests and stock index can be influenced by these developments and sometimes financial markets can influence economic activities. Being the most used financial indicators in our time, stock indexes and interest rates have a quite complex relation with various energy prices. In recent years, many researchers have been interested in this subject (Sadorsky, 1999; Park and Ratti, 2008; Miller and Ratti, 2009). The most important financial indicator is stock indexes. Equity markets are the indicators of economic growth and welfare and reflect the trust of enterprises and clients to the economy. When the confidence towards the economic development increases, the demand for goods requiring high levels of energy increases also and this situation directly causes energy demand (Sadorsky, 2010). Stock indexes are not only the indicator of economic performance but they can also show development of the financial sector of a country.

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The relationship between economic activities and the development level of financial sector is not unidirectional. According to researches, there are different hypotheses about the direction of the variation relation between financial indicators and energy price indexes. The relation of interest rates both with the financial development level and economic growth has also a quite complicated structure (Gregorio and Guidotti, 1995). However, during recent years, many researchers examined the relationship between nominal interest rates and energy prices and detected mutual relationships between these indicators (Sadorsky, 1999; Papapetrau, 2001; Milani, 2009; Du, He and Wai, 2010; Reicher, 2010). What makes this matter more interesting is that the relationship between financial indicators and energy price indexes as well as their relationships within themselves vary according to economic growth level of countries, their dependency to energy resources, their economic regime structures and other factors. If we could understand the relationship between energy prices and financial indicators in countries having different characteristics in relation with their energy dependencies, their energy resources and development levels, this will help us understand energy markets that are developing more and more during recent years thanks to the determination of whether certain characteristics of countries are important for understanding these relationships better or not. The small number of researches carried out within this field indicates that a new study to be made within this framework can contribute to the literature.

The principal hypothesis of this study suggests that there are short and long-term relationships between financial variables and energy prices both in a mutual way and within themselves, and that this relation can be explained with basic characteristics of countries' energy markets. Given the fact that a considerable majority of examined countries is located in Europe, this research will also be able to give us a clue regarding the efficiency of integration efforts of energy markets which is started to be applied particularly in Europe in recent years. The research gathered data from 24 OECD countries on a 3 month-basis between June 2001 and March 2009, a period when the global economy developed rapidly. Energy variables used in the study are crude oil price index, electricity price index, natural gas price index and coal price index and financial variables are stock index and interest rate. The most important side of our study which makes it different from other studies is that the variables that have an impact on financial development and economic growth; energy prices, stock indexes and interest rates are examined as a whole and that the relationship among them is tried to be explained with the characteristics of countries' energy markets. And particularly, the detailed analysis of the energy factor in terms of sub-resources and prices as well as the demonstration of relationships in this line are the superior side of this study. For that matter, another superior side of this study is that it isn't carried out based on total data regarding OECD countries but that each country is analyzed individually so that results can be more detailed and more accurate and that it can be possible to categorize countries according to obtained results.

In this study, Augmented Dickey-Fuller (ADF-1979) and Philips-Perron (PP-1988) tests, which are used the most frequently in similar studies, were used. Presence and direction of the relationship were investigated with Johansen-Juselius (1990) cointegration test and Granger (1969). In the second part of our study, findings regarding empirical studies, which can be found in the literature in relation with concerned variables, are presented. In the third part, our findings from carried out analyses are presented. There will be evaluations made in the light of obtained findings in the last part.

2.Background

The economic growth is based on two major sectors. One of them is the real sector, and the other is the financial sector. As for real sector, one of the most important sources of the real sector is energy factor and it has important impacts on real sector mechanism and thus influences the economic growth process. Interest rates and stock indexes created within the financial sector have an impact on countries' economies in different ways. Although the impacts of energy prices or energy consumption and economic growth on each other are accepted by economists to a large extent, and it is caused by the direction of causality on which this relationship is based. This issue is explained by "Ecological and Neoclassical" approaches which are contrary to each other. The main idea of Neoclassical approach is to evaluate the economic structure as a closed system. Created products are produced through capital and workforce and the products are exchanged between enterprises and clients (Ockwell, 2008). Neoclassical growth theory takes the energy factor into consideration and this kind of approach is mainly influenced by developed intrinsic growth models, public spending (Barro, 1988), human capital (Lucas, 1988) and the studies of Neoclassical economists, Hamilton (1983) and Burbridge and Harrison (1984) (Aytac, 2010). Ecologist economists criticize the ideas presented by neoclassical approach.

Ecological point of view asserts that the closed system adopted by the neoclassical approach isn't realistic and that the economic system should be taken into consideration as an open global system (Ockwell, 2008). Studies carried out on this issue are summarized **(inserted in Table 1)**. As it can be seen from the table, there is a strong relationship between energy prices or consumption of both developed and developing countries and their national income. Wolde-Rufael (2004), Yuan, Kang, Zhao and Hu (2008) and Hu and Lin (2008) revealed that energy consumption effects GDP in a unidirectional way while Jinge, Hualing and Dianming (2008) assert that in China, the causality relationship is rather from domestic product to coal production to the contrary of other countries. Studies of Kapusuzoglu and Karan (2010) support also the idea that the causality starts from national income. Yang (2000), Yoo (2006) as well as Apergis and Payne (2010) claim that the relationship between energy consumption and national income is bidirectional while Payne (2009) claims that there isn't a mutual bidirectional relationship between these two factors. However, in the studies carried out in this field, countries' energy market characteristics aren't taken into consideration generally during the explanation of causality relationships.

The relationship between financial development and economic growth is categorized in the literature according to four basic relationship hypotheses (Apergis et. al, 2007). First two of these hypotheses are supply-side hypothesis and demand-side hypothesis (Berthelemy and Varoudakis, 1996; Robinson, 1952). The third hypothesis asserts that there is a mutual relationship between financial development and economic growth. Findings of studies carried out by Demetriades and Hussein (1996) as well as by Greenwood and Smith (1997) seem to support this hypothesis. And the fourth hypothesis indicates that there isn't any significant relationship between financial development and economic growth (Lucas, 1988; Chandavarkar, 1992). Within this context, even though there are different results regarding the direction of the relationship between financial development and economic growth, what is more predominant among studies is that the direction of this relationship starts from economic growth. According to Jung (1986), Demetriades and Hussien (1996), Arestis and Demetriades (1997), Biswas (2008) and Chakraborty (2008), there is causality relationship from economic growth towards financial development in developed countries and this relationship is from financial development towards economic growth in developing countries.

However, certain researches obtained serious findings showing that the relationship between financial development and economic growth is bidirectional. Boulila and Trabelsi (2004) reached the conclusion that in majority of countries, the causality relationship is from economic growth to financial development while in some other countries this relationship is bidirectional. Abu-Bader and Abu-Qarn (2008), Wolde-Rufael (2009) and Hassan, Sanchez and Yu (2010) obtained similar results, too. Nevertheless, in studies of Hayo (1998), no relationship was found between these two factors to the contrary of previous studies while Kar, Nazlioglu and Agir (2010) couldn't reach to a conclusion regarding the direction of this relationship. Most of the studies concentrated on the relationship between energy prices and financial indicators have been carried out in the course of last 10 years. In most of the studies of which summaries are given **(inserted in Table 2)**. It is seen that variations in energy prices have an impact both on stock exchange markets and countries' monetary policies through interest rates. However, there are certain findings showing that this impact may differ according to oil dependencies of countries. For example, oil prices influence industries of such countries as Australia and Norway in a positive way while they have negative impacts of many European countries' exchange markets.

3. Data and Methodology

Data set used in this study is the data gathered on a 3 month-basis during the period June 2001 – March 2009 from 24 OECD countries (United States, Germany, Austria, United Kingdom, Czech Republic, Denmark, Finland, France, Netherlands, Ireland, Spain, Sweden, Switzerland, Italy, Canada, Korea, Luxembourg, Hungary, Norway, Poland, Portugal, Turkey, New Zealand and Greece), and the data regarding energy variables (crude oil price index, electricity price index, natural gas price index and coal price index) on which the study is based are obtained from the International Energy Agency (IEA) World's Energy Prices and Tax Statistics Book (2009) while financial variables (stock exchange index and interest rate) are obtained from the Trade Economics (http://www.tradingeconomics.com) database. Since there isn't any data regarding other countries within OECD, they haven't been taken into consideration during the study. The main limitation of the study is fewness of present data. This situation is caused by the fact that this study is extensively comprehensive in terms of sampling and variables. For analyzing the data, Eviews 5.1 software is used. The methodology used in this study is parallel to those used in similar studies. Firstly, natural logarithm of the variables are calculated. Before carrying out the analysis with time series data, these series need to be searched whether they are stationary or not.

Stationary test is also called unit root test. Accordingly, stationary analysis is applied on data regarding variables to be used in the study. Parametric tests namely Augmented Dickey-Fuller (ADF-1979) test and Philips-Perron (PP-1988) tests which evaluate possible structural breaking and trend in time series. The presence of a long-term relationship between time series is investigated by applying cointegration test developed by Johansen and Juselius (1990). Finally, Granger (1969) Causality Test is used to measure the relationship between the variables. If a cointegration relationship (cointegration vector) is detected, showing that there is a long-term relationship among variables, causality relationships need to be analyzed based on error correction model of causality relationships (Vector Error Correction Model, VECM). Within this context, Granger Causality Test is used.

4. Empirical Findings

4.1 Unit Root Tests

Unit root test is used in order to investigate the stationary of data. At first stage, it is investigated whether variables are I(0) stationary or not by using unit root tests. Following the standard approach, both ADF and PP tests are applied based on 3 different models; constant, constant-trend and without constant-trend. PP test is applied in order to verify ADF test. Delay numbers applied during the realization of ADF unit root test are delay values determined according to Schwarz information criterion (SIC). And in PP test, dependent variables in sufficient number to correct autocorrelation aren't included in delayed model and instead they are adjusted with Newey-West estimator.

According to the results of unit root analysis carried out, variables of crude oil in US, crude oil in Germany, crude oil in Austria, crude oil in Denmark, crude oil and electricity in Finland, crude oil in France, crude oil in Netherlands, crude oil in UK, crude oil and electricity in Ireland, crude oil in Spain, crude oil in Sweden, crude oil in Italy, natural gas in Korea, interest rate in Hungary, crude oil and natural gas in Turkey, and crude oil, electricity and coal in New Zealand are stationary even though other variables taken into consideration aren't stationary. However, it is accepted that findings obtained as a result of ADF test are stationary either since they aren't verified by PP test. On the other hand, variables of interest rate in Czech Republic, natural gas in Netherlands, electricity and interest rate in Switzerland, electricity and natural gas in Canada, crude oil and electricity in Norway, interest rate in Poland, interest rate in Turkey and natural gas in New Zealand are found to be stationary according to ADF test and this findings is verified with PP test. And for this reason, related variables are left out of analysis and others are included in analyses.

If all variables taken into consideration aren't stationary according to unit root tests, related variables are deducted and rendered stationary. In this direction, first difference is deducted and I(1) ADF and PP unit root tests are reapplied in order to render the variables stationary. When results of related tests are examined, interest rate variable in Denmark, UK, Canada and New Zealand can't be rendered stationary even when the first difference is deducted. And in this direction, interest rate variable in concerned countries isn't taken into consideration and analysis is carried out with other variables. We have reached the conclusion that there may be a cointegrated relationship among variables of indicated countries since these variables becoming stationary after that their first degree difference I(1) is deducted are integrated in first degree I(1) even though they aren't stationary at their own level I(0). Consequently, it will be possible for us to investigate if there is a long-term relationship (cointegration) among them since these variables are integrated at the same level.

4.2 Johansen Cointegration Test

Results of Johansen Cointegration test which was applied in order to investigate the presence of a long-term relationship among variables of countries taken into consideration during analysis are presented **(inserted in Table 3-6).** Delay number to be considered during the application of cointegration test is included in models based on Schwarz (SIC), Akaike (AIC), and Hannan-Quinn (HQ) information criteria. As a result of carried out analyses, eigen, trace and max-eigen statistical values are obtained in relation with Johansen cointegration test. The presence of the cointegration vector, in other words; the presence of a long-term relationship is investigated by comparing these obtained statistical values and critical values of 1%, 5% and 10%. When obtained analysis findings are examined, almost in all countries, the presence of cointegration relationship among variables is encountered, in other words, findings show that there is a long-term relationship among variables. Only in New Zealand, no cointegration relationship was found among variables and in this direction, it is concluded that there isn't a long-term relationship among variables. According to these results, trace and max-eigen statistical results are in conformance with each other.

The absence hypothesis stating that there isn't cointegration relationship can be rejected based on either the result of trace statistical value or maximum value statistics. Therefore, both trace and maximum value (eigen) values show that there is a long-term relationship (cointegration) among variables of countries taken into consideration.

4.3 Granger Causality Test

According to Granger (1988), presence of a cointegration among series indicates that there is at least unidirectional causality relationship. In case of cointegration, causality relationships need to be analyzed with error correction model (Vector Error Correction Model, VECM). In this direction, vector error correction model is applied due to the presence of cointegration among variables included within the analysis and the causality relationship among them is tested with Block Exogeneity Wald test as VEC Granger, and obtained findings are presented **(inserted in Table 7-8).** As a result of applied analyses, three relationships encountered the most on the basis of countries are unidirectional causality relationships from crude oil variable to electricity variable (12 countries), from crude oil variable to natural gas variable (11 countries) and from exchange market variable to coal variable (9 countries). Three relationships encountered the least on the basis of countries are unidirectional causality relationship from interest rate variable to crude oil variable (1 country), from coal variable to electricity variable (2 countries) and from natural gas variable to interest rate variable (3 countries). As for New Zealand, no causality relationship was encountered among variables.

In Table 9, causality relationships are summarized on the basis of countries. In the first column of the table, the direction of causality relationship is given while in other columns, the names of overdeveloped countries, developed countries and developing countries are indicated respectively. According to analysis findings, the relationship encountered the most on basis of all countries is unidirectional causality relationship from crude oil variable to electricity variable. In other words, in 12 countries where this relationship is detected, crude oil price has a role on variations of electricity prices as an effective explanatory variable. When the concerned countries are examined, it is seen that these are mostly developed and developing countries. Among countries where this kind of relationship is seen, US is in third place of world ranking regarding crude oil production (8.3%) and in the first place regarding its importation (26,9%) while France (4%), Germany (5%), Italy (4.2%), Spain (3%) and Korea (5.6%) are also in the first ten in world ranking regarding crude oil importation. Concerning electricity resource, US is in the first place in world ranking of electricity production (21.5%) and in the third place regarding its importation while France is in the first place in electricity exportation (17.9%) and in the first ten regarding electricity production. Other countries making it to first ten in the world ranking are Germany for electricity production (3.1%) and exportation (7.4%), Portugal (3.4%), Finland (4.9%), Italy (15%), Czech Republic (4.1%) for its exportation and Korea (2.2%) for its production. Taking into consideration this powerful condition of countries, obtained findings conform to expectations.

According to analysis findings, the second relationship encountered the most among all countries is unidirectional causality relationship from crude oil variable to natural gas variable. In other words, in 11 countries where this relationship is detected, crude oil price has a role on changes of natural gas prices as an effective explanatory variable. When concerned countries are examined, it is seen that these are mostly important countries. Among countries where this kind of relationship is seen, France (4%), Italy (4.2%) and Spain (3%) are in the first ten regarding crude oil importation. Austria, Denmark, France, Ireland, Sweden, Switzerland, Luxembourg regarding natural gas resource; concerning its importation Italy is in the fourth place (9.2%) while France in fifth place (6%), Spain in eight place (4.5%) and UK in tenth place (3.8%). As it can be seen from the table, crude oil has an impact on exchange market index in 8 countries and on interest rate in 7 countries.

As it is expected, there are crude oil prices behind the movement of energy prices and consequently of financial indicators in the world. Even though financial indicators are also important, none of financial indicators is as powerful as crude oil regarding their impacts. In line with analysis findings, the third relationship encountered the most among all countries is unidirectional causality relationship from exchange market index variable to coal variable. This finding supports studies detecting a relationship between financial expansion and economic growth. In other words, in 9 countries where this relationship is detected, exchange market index has a role on variations of coal prices as an effective explanatory variable. When concerned countries are examined, it is seen that these are overdeveloped (Germany, France, UK) countries, developed countries (Denmark, Korea, Ireland, Norway) and a developing country (Turkey). Among countries where this kind of relationship is seen, Korea is in the third place (12.6%), German in the sixth place (4.6%), UK in the seventh place (4.6%) and Turkey in eighth place (2.4%) regarding coal importation.

Mutual relations between exchange market index and interest rate are detected rather in developed countries of Europe as well as in Korea. Obtained findings show that relations among variables are quite complicated. It is understood that it is difficult to make a generalization based on these results and that it isn't possible to reach a conclusion by categorizing either European countries or other countries. However, it is possible to comment the relationships among variables if characteristics of individual countries are taken into consideration.

5. Conclusion

In this study, mutual and cross relationships between such two variables as energy prices and exchange market index and interest of OECD countries are investigated. As it was the case for previous studies too, these relationships are found to be quite complicated and they have different causality relationships. Moreover, countries' energy securities, their distance from raw material sources, energy production capacities and differences in their energy markets have roles on these complicated relationships. It is difficult to reach a common relational conclusion even among European Union countries which are willing to form a unique Market nearly since ten years. However when findings are examined closely, it can be seen that it is possible to make certain generalizations and comments on individual conditions of countries. As it is expected, the most powerful variable among those that are used in the analysis is crude oil. Crude oil has an extensive impact on both electricity and natural gas prices. Crude oil influences also exchange market indexes in general. As it is known, exchange market indexes are leading economic variables. This finding supports the idea which has also been revealed by previous studies, that is crude oil prices have an impact on GDP. In countries where crude oil prices impact exchange market indexes, crude oil prices also impact natural gas and electricity prices.

Among financial variables, it is more important regarding its influencing power over exchange market indexes and it has an impact on coal prices in an extensive way (9 countries). This importance of influence is followed by interest (8 countries) and electricity and natural gas prices (5 countries each). In developed countries, exchange market and interest variables influence each other. However, interest rate is variable which is in interaction with other variables the least in general. Among overdeveloped countries, in US market, coal also has an extensive influencing power on energy prices along with crude oil. There is also a bidirectional relationship between coal and interest rates. In UK where gas market is developed the most, there is bidirectional relationship between gas prices and crude oil prices, and in UK known for its highly rich coal reserves, coal prices are influenced by exchange market index while they may influence natural gas market. It is observed that Ireland has similar trends as UK to a great extent. It is very common in France and Germany that energy prices and financial indicators influence each other. It is thought that this situation is caused by powerful status in the continental Europe and multidirectional relations of these two countries. While there is no relationship among variables in New Zealand, in Canada, there is only a bidirectional relationship between coal and oil.

Being a European country without oil dependency, Norway is independent from the interaction of energy prices to a great extent. In this country, such financial variables as exchange market and interest have relationship among themselves and they influence coal prices. No similar trends can't be detected among North Pool countries. So, it isn't possible to categorize these countries in the same class. Similarly, there isn't any significant similarity among three developing countries; Turkey, Hungary and Poland. However, these countries show important relations regarding only exchange market index among all financial indicators. In conclusion, it is shown in this study that there are extensive and multidirectional relationships both among energy prices and financial indicators. For the moment, these findings don't sufficiently support researches claiming that energy markets in the world and in Europe start to unify. And for the moment, existing relationships can only be explained through individual countries' factors regarding their energy markets and resources.

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TABLES

Table 1: Findings related to the Relation between Energy and Economic Growth

Author	Data Set	Methodology	Findings
Yang (2000)	**Coverage:**Taiwan **Variables:**Energy Consumption and GDP	Granger Causality Test	It is detected that GDP has a bidirectional causality relationship with total energy consumption, coal consumption and electricity consumption, and a unidirectional causality relationship with natural gas consumption and oil consumption.
Wolde-Rufael (2004)	**Coverage:**Shanghai **Variables:**Industrial Energy Consumption and GDP	Toda-Yamamoto Causality Test	A unidirectional causality relationship is detected from coal, coke, electricity and total energy consumption towards GDP. However no causality relationship is detected between oil consumption and GDP.
Yoo (2006)	**Coverage:**Korea **Variables:**Coal Consumption and GDP	Johansen Cointegration and Granger Causality Tests	It is detected that there is a bidirectional causality relationship between coal consumption and economical development.
Jinge, Hualing and Dianming (2008)	**Coverage:**OECD and Non-OECD Contries **Variables:**Coal Consumption and GDP	Engle-Granger Cointegration and Granger Causality Tests	While a unidirectional causality relationship is detected in China from GDP towards coal consumption, no relationship is detected in India. It is also detected that South Korea and South Africa isn't cointegrated with US and that there is a unidirectional causality relationship in Japan from GDP towards coal consumption.
Hu and Lin (2008)	**Coverage:**Taiwan **Variables:**Energy Consumption and GDP	Threshold Cointegration Analysis and VECM	According to the findings, there is an important balance relationship between energy consumption and GDP and energy consumption increases the growth of GDP.
Yuan, Kang, Zhao and Hu (2008)	**Coverage:**China **Variables:**Energy Consumption, GDP, Capital and Labor	Johansen Cointegration Test, VECM and Granger Causality Test	Short-term causality relationship is revealed from electricity and oil consumption towards GDP and from GDP towards total energy consumption, coal and oil consumption. Moreover, no causality relationship is detected from coal and total energy consumption towards GDP and from GDP towards electricity consumption.
Payne (2009)	**Coverage:**US **Variables:** Energy Consumption, GDP, Gross Fixed Capital Formation and Total Civilian Employment	Toda-Yamamoto Causality Test	No causality relationship is found between renewable and nonrenewable energy resources and GDP.
Apergis and Payne (2010b)	**Coverage:**OECD Countries **Variables:**Coal Consumption, GDP, Gross Fixed Capital Formation and Labour Force	Panel Cointegration and Causality Tests	Bidirectional causality relationship is found between coal consumption and economical development both in short (negative) and long (positive) terms.
Wolde-Rufael (2010)	**Coverage:**China, India, Japan, S.Korea, S.Africa and US **Variables:**Coal Consumption and GDP	Toda-Yamamoto Causality Test	It is detected that there is a unidirectional causality relationship from coal consumption to GDP in Japan and India, a unidirectional causality relationship from GDP to coal consumption in Korea and China, and a bidirectional causality relationship between these variables in US and South Africa.
Apergis and Payne (2010a)	**Coverage:**15 Countries (Developing) **Variables:**Coal Consumption, GDP, Gross Fixed Capital Formation ve Labour Force	Panel Cointegration and Causality Tests	It is put forth that in long-term, there is a relationship between variables, that gross fixed capital formation and total labor force have significant positive effect on GDP and a negative effect on coal consumption, and that in both short and long-terms, there is a bidirectional causality relationship between coal production and GDP.
Kapusuzoglu and Karan (2010)	**Coverage:**Turkey **Variables:**Electricity Consumption and GDP	Johansen Cointegration Test, VECM and Granger Causality Test	It is detected that there is a long-term relationship between related variables and that there is a unidirectional causality relationship from electricity consumption towards GDP.

Table 2: Findings related to the Relation between Energy and Financial Development

Author	Data Set	Methodology	Findings
Sadorsky (1999)	**Coverage:**US **Variables:**Oil Price, Interest Rate and Industrial Output	VAR and GARCH Analysis	It is revealed that oil prices and variations in oil prices have an important role on share earnings, and that sudden variations in oil prices have an asymmetrical impact on the economy.
Faff and Brailsford (1999)	**Coverage:**Avustralya **Variables:**Oil Price and Stock Returns (24 Sectors)	Multi Regression Analysis and Wald Test	It is observed that majority of industries has a positive sensitivity to oil price, but that paper, packaging and transportation industries have a negative sensitivity towards this variable.
Papapetrau (2001)	**Coverage:**Greece **Variables:**Oil Price, Stock Price, Interest Rate and Labor Force	VAR Analysis	It is detected that variations in oil prices influence real economy activities and that the oil price is an important factor for examining exchange market price movements.
Park and Ratti (2008)	**Coverage:US** and 13 European Countries **Variables:**Oil Price and Stock Return	Johansen CointegrationTest and VAR Analysis	It is detected that sudden price variations on a general basis have an impact on stock exchange earnings, that increases in oil prices in Norway increase also stock exchange earnings, and that in many European countries except US, increase of oil price variations has a negative impact on stock exchange earnings.
Cong, Wei, Jiao and Fan (2008)	**Coverage:**China **Variables:**Oil Price and Stock Return	VAR Analysis	It is understood that sudden variations in oil prices don't have significant impact on share earnings and that some important sudden variations have negative impact on oil company shares.
Oberndorfer (2009)	**Coverage:**Eurozone **Variables:**Energy Prices and Energy Stocks Return	ARCH and GARCH Analysis	It is put forth that increases in oil prices have an impact on share earnings in Europe in a negative way, that variations in coal prices have also an impact on share earnings, but that this impact isn't as significant as the one of oil prices, and that the price of natural gas doesn't have a role on energy share prices.
Miller and Rati (2009)	**Coverage:**OECD Countries **Variables:**Oil Price and Stock Exchange	Structural Stability, Cointergration Test and ECM.	It is seen that in general there is a long-term relationship among variables and that in long-term the stock exchange market responds to increases in oil prices in a negative way.
Milani (2009)	**Coverage:**US **Variables:**Oil Price, Inflation, GDP and Interest Rate	VAR Analysis	It is seen that output level of oil prices has a very important explanatory impact on economical growth level, monetary policies (interest rate) and inflation.
Du, He and Wei (2010)	**Coverage:**China **Variables:**Oil Price, GDP, Interest Rate, Inflation	VAR Analysis	It is observed that oil prices have an impact on economical development and inflation.
Filis (2010)	**Coverage:**Greece **Variables:**Oil Price, Stock Price, Consumer Price Index and Industrial Production	Johansen CointegrationTest and VECM	It is detected that in long-term, oil prices and stock exchange index have a positive effect on client price index, that oil prices have a negative impact on exchange market and that oil prices don't have any effect on industrial production. Accordingly, no relationship is detected between exchange market and industrial production.

Table 3: Johansen Cointegration Test Results

Hypothesis - Countries						**Austria**	**Canada**	**Czech Republic**	**Denmark**	**Finland**	**France**	**Germany**	**1% CV**	**5% CV**	**10% CV**
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Trace Statistics**									
$r = 0$	$r > 1$	-	-	-	-	154.313***	-	-	-	-	201.711***	228.858***	104.961	95.753	91.110
$r \leq 1$	$r > 2$	$r = 0$	$r > 1$	-	-	106.852***	-	145.301***	173.034***	202.616***	134.706***	118.688***	77.818	69.818	65.819
$r \leq 2$	$r > 3$	$r \leq 1$	$r > 2$	-	-	60.203***	-	79.852***	66.416***	100.938***	82.533***	65.606***	54.681	47.856	44.493
$r \leq 3$	$r > 4$	$r \leq 2$	$r > 3$	$r = 0$	$r > 1$	36.723***	59.316***	36.809***	36.545***	52.088***	48.332***	31.578**	35.458	29.797	27.066
$r \leq 4$	$r > 5$	$r \leq 3$	$r > 4$	$r \leq 1$	$r > 2$	15.017*	14.822*	14.167*	15.117*	22.088***	22.781***	10.785	19.937	15.494	13.428
$r \leq 5$	$r > 6$	$r \leq 4$	$r > 5$	$r \leq 2$	$r > 3$	3.474*	0.048	5.361*	6.126*	0.323	10.397***	0.002	6.634	3.841	2.705
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Maximum-Eigenvalue Statistics**									
$r = 0$	$r = 1$	-	-	-	-	47.460***	-	-	-	-	67.004***	110.169***	45.869	40.077	37.277
$r \leq 1$	$r = 2$	$r = 0$	$r = 1$	-	-	46.649***	-	65.448***	106.617***	101.677***	52.172***	53.082***	39.370	33.876	31.239
$r \leq 2$	$r = 3$	$r \leq 1$	$r = 2$	-	-	23.479	-	43.042***	29.871**	48.850***	34.201***	34.027***	32.715	27.584	25.124
$r \leq 3$	$r = 4$	$r \leq 2$	$r = 3$	$r = 0$	$r = 1$	21.705*	44.493***	22.641**	21.428**	30.000***	25.550**	20.793*	25.861	21.131	18.892
$r \leq 4$	$r = 5$	$r \leq 3$	$r = 4$	$r \leq 1$	$r = 2$	11.542	14.773**	8.806	8.990	21.765***	12.383*	10.783	18.520	14.264	12.296
$r \leq 5$	$r = 6$	$r \leq 4$	$r = 5$	$r \leq 2$	$r = 3$	3.474*	0.048	5.361**	6.126**	0.323	10.397***	0.002	6.634	3.841	2.705

,**, represent the statistical significance levels of %10, %5 and %1 respectively. CV: Critical Value**

Table 4: Johansen Cointegration Test Results

Hypothesis - Countries						**Greece**	**Holland**	**Hungary**	**Ireland**	**Italy**	**Korea**	**1% CV**	**5% CV**	**10 % CV**
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Trace Statistics**								
r=0	r>1	-	-	-	-	277.672***	-	158.494***	159.942***	-	220.252***	104.961	95.753	91.110
r≤1	r>2	r=0	r>1	-	-	163.236***	-	94.039***	109.628***	131.924***	114.116***	77.818	69.818	65.819
r≤2	r>3	r≤1	r>2	r=0	r>1	71.613***	159.593***	55.640***	63.939***	72.603***	69.473***	54.681	47.856	44.493
r≤3	r>4	r≤2	r>3	r≤1	r>2	45.029***	83.154***	28.285*	33.809**	42.009***	42.980***	35.458	29.797	27.066
r≤4	r>5	r≤3	r>4	r≤2	r>3	24.756***	35.545***	7.773	13.884*	21.266***	19.012**	19.937	15.494	13.428
r≤5	r>6	r≤4	r>5	r≤3	r>4	11.155***	8.866***	1.516	1.122	6.165**	0.986	6.634	3.841	2.705
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Maximum-Eigenvalue Statistics**								
r=0	r=1	-	-	-	-	114.436***	-	64.454***	50.673***	-	106.135***	45.869	40.077	37.277
r≤1	r=2	r=0	r=1	-	-	91.632***	-	38.398**	45.328***	59.321***	44.643***	39.370	33.876	31.239
r≤2	r=3	r≤1	r=2	r=0	r=1	26.583*	76.439***	27.355*	30.129**	30.593**	26.492*	32.715	27.584	25.124
r≤3	r=4	r≤2	r=3	r≤1	r=2	20.273*	50.608***	20.512*	19.925*	20.742*	23.967**	25.861	21.131	18.892
r≤4	r=5	r≤3	r=4	r≤2	r=3	13.600*	23.679***	6.256	12.601*	15.101**	18.025**	18.520	14.264	12.296
r≤5	r=6	r≤4	r=5	r≤3	r=4	11.155***	8.866***	1.516	1.282	61.165**	0.986	6.634	3.841	2.705

,**, represent the statistical significance levels of %10, %5 and %1 respectively. CV: Critical Value**

Table 5: Johansen Cointegration Test Results

Hypothesis - Countries								**Luxembourg**	**New Zealand**	**Norway**	**Poland**	**Portugal**	**Spain**	**1% CV**	**5% CV**	**10% CV**
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Trace Statistics**								
$r=0$	$r>1$	-	-	-	-	-	-	199.160***	-	-	-	119.802***	-	104.961	95.753	91.110
$r\leq 1$	$r>2$	$r=0$	$r>1$	-	-	-	-	110.464***	-	-	132.621***	72.869**	118.586***	77.818	69.818	65.819
$r\leq 2$	$r>3$	$r\leq 1$	$r>2$	$r=0$	$r>1$	-	-	73.945***	34.331	-	78.837***	41.604	62.634***	54.681	47.856	44.493
$r\leq 3$	$r>4$	$r\leq 2$	$r>3$	$r\leq 1$	$r>2$	$r=0$	$r>1$	42.071***	17.865	31.885**	37.651***	19.553	33.441**	35.458	29.797	27.066
$r\leq 4$	$r>5$	$r\leq 3$	$r>4$	$r\leq 2$	$r>3$	$r\leq 1$	$r>2$	13.540*	5.171	9.546	10.181	8.313	11.282	19.937	15.494	13.428
$r\leq 5$	$r>6$	$r\leq 4$	$r>5$	$r\leq 3$	$r>4$	$r\leq 2$	$r>3$	1.618	1.874	0.487	0.001	0.207	0.648	6.634	3.841	2.705
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Maximum-Eigenvalue Statistics**								
$r=0$	$r=1$							88.696***	-	-	-	46.933***	-	45.869	40.077	37.277
$r\leq 1$	$r=2$	$r=0$	$r=1$					36.518**	-	-	53.783***	31.265*	55.952***	39.370	33.876	31.239
$r\leq 2$	$r=3$	$r\leq 1$	$r=2$	$r=0$	$r=1$			31.873**	16.465	-	41.185***	22.050	29.193**	32.715	27.584	25.124
$r\leq 3$	$r=4$	$r\leq 2$	$r=3$	$r\leq 1$	$r=2$	$r=0$	$r=1$	28.531***	12.694	22.339**	27.469***	11.240	22.158**	25.861	21.131	18.892
$r\leq 4$	$r=5$	$r\leq 3$	$r=4$	$r\leq 2$	$r=3$	$r\leq 1$	$r=2$	11.922	3.297	9.058	10.180	8.106	10.633	18.520	14.264	12.296
$r\leq 5$	$r=6$	$r\leq 4$	$r=5$	$r\leq 3$	$r=4$	$r\leq 2$	$r=3$	1.618	1.874	0.487	0.001	0.207	0.648	6.634	3.841	2.705

,**, represent the statistical significance levels of %10, %5 and %1 respectively. CV: Critical Value**

Table 6: Johansen Cointegration Test Results

Hypothesis - Countries						**Sweden**	**Switzerland**	**Turkey**	**United Kingdom(UK)**	**United States(US)**	**1% CV**	**5% CV**	**10% CV**
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Trace Statistics**							
r=0	r>1	-	-	-	-	-	-	-	-	132.173***	104.961	95.753	91.110
r≤1	r>2	r=0	r>1	-	-	171.939***	-	170.574***	144.926***	94.294***	77.818	69.818	65.819
r≤2	r>3	r≤1	r>2	r=0	r>1	89.170***	156.215***	95.740***	78.340***	64.378***	54.681	47.856	44.493
r≤3	r>4	r≤2	r>3	r≤1	r>2	48.404***	89.558***	45.721***	41.874***	39.604***	35.458	29.797	27.066
r≤4	r>5	r≤3	r>4	r≤2	r>3	19.254**	40.713***	17.880**	11.722	18.294**	19.937	15.494	13.428
r≤5	r>6	r≤4	r>5	r≤3	r>4	0.033	2.279	5.005**	2.039	0.368	6.634	3.841	2.705
H_0	**H_1**	**H_0**	**H_1**	**H_0**	**H_1**	**Maximum-Eigenvalue Statistics**							
r=0	r=1	-	-	-	-	-	-	-	-	37.879*	45.869	40.077	37.277
r≤1	r=2	r=0	r=1	-	-	82.769***	-	74.834***	66.586***	29.915	39.370	33.876	31.239
r≤2	r=3	r≤1	r=2	r=0	r=1	40.765***	66.657***	50.018***	36.465***	24.774	32.715	27.584	25.124
r≤3	r=4	r≤2	r=3	r≤1	r=2	29.150***	48.844***	27.841***	30.151***	21.309**	25.861	21.131	18.892
r≤4	r=5	r≤3	r=4	r≤2	r=3	19.220***	38.434***	12.874*	9.683	17.296**	18.520	14.264	12.296
r≤5	r=6	r≤4	r=5	r≤3	r=4	0.033	2.279	5.005**	2.039	0.368	6.634	3.841	2.705

,**, represent the statistical significance levels of %10, %5 and %1 respectively. CV: Critical Value**

Table 7: Granger Causality Test Results

Independent Value – Dependent Value	CO - E	CO - NG	CO - C	CO - SE	CO - IR	E - CO	E - NG	E - C	E - SE	E - IR	NG - CO	NG - E	NG - C	NG - SE	NG - IR
Austria	3.876	5.688*	0.498	1.405	0.068	0.021	1.135	2.580	4.732*	0.165	0.119	0.289	1.304	2.739	1.298
Canada	-	-	9.658**	2.328	-	-	-	-	-	-	-	-	-	-	-
Czech Republic	7.860**	2.000	0.232	0.738	-	1.698	2.441	3.778	1.194	-	3.148	5.637	2.611	2.035	-
Denmark	2.606	56.918***	13.947***	1.574	-	11.552***	33.168***	21.764***	0.533	-	7.450*	0.381	15.786***	3.085	-
Finland	6.573*	-	5.321	12.240***	1.440	2.597	-	4.203	5.514	0.237	-	-	-	-	-
France	5.483*	4.775*	0.062	3.171	5.220*	0.212	2.359	1.255	2.543	5.526*	3.384	3.875	1.649	0.658	6.546**
Germany	3.796	1.004	19.453***	0.788	1.207	2.167	9.459***	9.169**	5.741*	0.633	7.785**	1.772	24.230***	2.667	1.047
Greece	5.016*	3.833	0.336	9.663***	0.470	2.307	6.325***	1.480	13.768***	8.100**	2.677	1.071	1.480	2.271	1.290
Holland	10.443**	-	-	2.984	9.388*	18.559***	-	-	7.550	37.366***	-	-	-	-	-
Hungary	1.178	0.473	0.573	2.997	4.717*	6.530**	2.216	1.052	3.693	0.824	2.605	0.052	3.106	2.321	3.889
Ireland	0.419	15.061***	6.179**	3.495	0.654	6.577**	2.532	0.342	0.154	0.536	3.673	0.306	1.011	1.837	0.654
Italy	8.754**	34.659***	-	10.031**	1.076	5.588	3.432	-	4.410	0.410	12.223*	2.590	-	8.829*	2.191
Korea	7.946**	1.343	0.993	2.138	1.792	0.379	0.481	1.672	3.657	0.561	4.067	3.745	7.162**	7.112**	0.426
Luxembourg	0.848	7.684**	1.059	5.649*	18.141***	2.190	3.409	0.223	4.525	13.663***	1.738	2.835	0.696	3.947	19.169***
New Zealand	0.244	-	1.583	1.156	-	1.151	-	0.019	0.030	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Poland	1.552	3.351	1.941	1.044	-	9.513**	4.606	1.567	3.138	-	10.085**	4.159	0.112	3.494	-
Portugal	3.147*	4.840**	0.351	0.073	9.443***	0.145	1.813	0.369	0.371	1.967	2.570	0.260	2.836*	2.262	4.116**
Spain	10.701**	9.768**	-	7.466*	4.293	6.880*	5.892	-	21.957***	9.956**	5.170	9.593**	-	33.658***	2.354
Sweden	15.788***	19.434***	-	10.764**	9.323**	11.491***	2.082	-	12.592***	1.903	0.449	20.723***	-	11.276**	1.573
Switzerland	-	11.154**	15.0181**	12.457**	-	-	-	-	-	-	6.754	-	23.730***	2.268	-
Turkey	8.806**	2.174	0.811	17.974***	-	3.934	7.375*	5.958	8.316**	-	3.511	8.499**	0.648	12.568***	-
United Kingdom(UK)	4.589	6.792*	2.619	1.193	-	6.849*	4.515	9.233**	4.069	-	9.512**	3.108	3.298	2.942	-
United States(US)	10.866***	0.907	1.884	1.811	1.371	1.615	0.973	7.589**	2.998	2.738	2.236	8.554*	2.345	0.616	0.144

,**, represent the statistical significance levels of %10, %5 and %1 respectively. (Chi-Square Values)**
CO: Crude Oil – E:Electricity – NG: Natural Gas – C: Coal – SE: Stock Exchange – IR: Interest Rate

Table 8: Granger Causality Test Results

Independent Value – Dependent Value	C - CO	C - E	C - NG	C - SE	C - IR	SE - CO	SE - E	SE - NG	SE - C	SE - IR	IR - CO	IR - E	IR - NG	IR - C	IR - SE
Austria	1.018	0.299	1.167	3.278	3.574	0.324	1.489	7.136**	1.287	2.544	0.098	3.064	4.529	0.409	6.380**
Canada	10.329**	-	-	2.074	-	6.256	-	-	4.914	-	-	-	-	-	-
Czech Republic	5.070	19.785***	3.157	1.070	-	3.830	8.312**	8.003**	0.772	-	-	-	-	-	-
Denmark	9.410*	0.637	13.193***	1.998	-	8.285**	1.513	12.957***	9.852**	-	-	-	-	-	-
Finland	0.886	4.036	-	3.353	5.685	2.775	3.617	-	0.904	7.138*	3.154	6.832*	-	1.373	15.247***
France	0.082	16.626***	1.848	2.992	8.230**	0.241	8.295**	7.070**	6.768**	6.875**	1.636	0.894	16.794***	7.386*	2.517
Germany	3.275	3.918	8.078*	5.207*	3.897	3.383	3.732	0.389	7.404*	8.305**	6.648**	4.210	2.291	19.533***	3.137
Greece	1.605	2.437	10.176***	1.882	0.659	2.584	10.467***	4.585	0.685	4.153	1.913	4.326	7.039**	3.310	1.161
Holland	-	-	-	-	-	5.564	3.903	-	-	8.056*	3.688	5.550	-	-	9.178*
Hungary	2.528	2.821	2.683	2.171	0.308	1.957	2.637	2.692	2.078	1.404	4.502	2.318	4.101	3.173	0.589
Ireland	12.262***	4.202	0.459	0.278	9.737***	1.854	3.436	1.170	4.973*	5.104*	0.820	2.788	4.601	4.541	0.237
Italy	-	-	-	-	-	2.678	2.890	7.879**	-	1.539	5.754	2.178	7.624*	-	8.964**
Korea	1.576	4.013	0.425	7.599**	4.289	0.142	0.797	4.146	6.225**	1.891	1.484	1.986	0.439	1.090	13.184***
Luxembourg	0.965	0.794	0.705	2.391	9.621***	0.017	0.348	1.148	0.919	14.523***	1.413	1.318	6.497**	0.892	1.891
New Zealand	0.617	0.961	-	1.638	-	1.215	1.965	-	0.077	-	-	-	-	-	-
Norway	-	-	-	0.538	0.034	-	-	-	4.146**	4.080**	-	-	-	7.701***	0.275
Poland	29.321***	2.467	0.919	7.217*	-	29.280***	0.899	2.859	0.065	-	-	-	-	-	-
Portugal	3.582*	0.061	0.130	1.298	3.764*	2.249	2.088	0.269	2.195	16.280***	0.943	0.059	0.057	0.113	0.987
Spain	-	-	-	-	-	1.898	6.483*	4.594	-	4.641	4.446	10.132**	3.960	-	51.413***
Sweden	-	-	-	-	-	2.600	33.198***	1.956	-	1.203	2.869	10.228**	25.475***	-	17.285***
Switzerland	5.825	-	4.129	13.493***	-	13.848***	-	3.254	13.739***	-	-	-	-	-	-
Turkey	4.757	5.484	7.543*	18.870***	-	9.174**	2.220	3.638	10.538**	-	-	-	-	-	-
United Kingdom(UK)	3.638	5.869	7.004*	1.744	-	0.990	5.220	5.910	4.324	-	-	-	-	-	-
United States(US)	10.160***	3.887	6.038**	0.992	4.789*	0.537	0.880	0.624	14.118***	0.199	0.453	11.606***	1.178	6.750**	3.355

,**, represent the statistical significance levels of %10, %5 and %1 respectively. (Chi-Square Values)**
CO: Crude Oil – E:Electricity – NG: Natural Gas – C: Coal – SE: Stock Exchange – IR: Interest Rate

Table 9: Causality Relations among Variables by the Countries

X-Y (from X to Y causality)	Very Developed Countries (G8)	Developed Countries	Developing Countries
Crude Oil-Electricity (12)	US, Germany, France, Italy	Czech Republic, Finland, Korea, Spain, Sweden, Portugal, Greece	Turkey
Crude Oil-Natural Gas (11)	France, Italy, UK	Austria, Denmark, Ireland, Spain, Sweden, Switzerland, Luxembourg, Portugal	
Stock Exchange-Coal (9)	Germany, France, UK	Denmark, Korea, Ireland, Switzeland, Norway	Turkey
Crude Oil-Stock Exchange (8)	Italy	Finland, Spain, Sweden, Switzerland, Luxembourg, Greece	Turkey
Electricity-Crude Oil (8)	UK	Denmark, Holland, Ireland, Spain, Sweden	Hungary, Poland
Stock Exchange-Interest Rate (8)	Germany, France	Finland, Holland, Ireland, Luxembourg, Norway, Portugal	
Interest Rate-Stock Exchange (7)	Italy	Austria, Finland, Korea, Holland, Spain, Sweden	
Crude Oil-Interest Rate (6)	France	Holland, Sweden, Luxembourg, Portugal	Hungary
Electricity-Stock Exchange (6)	Germany	Austria, Spain, Sweden, Greece	Turkey
Coal-Crude Oil (6)	US, Canada	Denmark, Ireland, Portugal	Poland
Coal-Natural Gas (6)	US, Germany, UK	Denmark, Greece	Turkey
Crude Oil-Coal (5)	Germany, Canada	Denmark, Ireland, Switzerland	
Electricity-Interest Rate (5)	France	Holland, Spain, Luxembourg, Greece	
Natural Gas-Crude Oil (5)	Germany, Italy, UK	Denmark	Poland
Natural Gas-Coal (5)	Germany	Denmark, Korea, Switzerland, Portugal	
Natural Gas-Stock Exchange (5)	Italy	Korea, Spain, Sweden	Turkey
Coal-Stock Exchange (5)	Germany	Korea, Switzerland	Poland, Turkey
Coal-Interest Rate (5)	US, France	Ireland, Luxembourg, Portugal	
Stock Exchange-Electricity (5)	France	Czech Republic, Spain, Sweden, Greece	
Stock Exchange-Natural Gas (5)	France, Italy	Austria, Czech Republic, Denmark	
Interest Rate-Natural Gas (5)	France, Italy	Sweden, Luxembourg, Greece	
Electricity-Natural Gas (4)	Germany	Denmark, Greece	Turkey
Electricity-Coal (4)	US, Germany, UK	Denmark	
Natural Gas-Electricity (4)	US	Spain, Sweden	Turkey
Stock Exchange-Crude Oil (4)	-	Denmark, Switzerland	Poland, Turkey
Interest Rate-Electricity (4)	US	Finland, Spain, Sweden	
Interest Rate-Coal (4)	US, Germany, France	Norway	
Natural Gas-Interest Rate (3)	France	Luxembourg, Portugal	
Coal-Electricity (2)	France	Czech Republic	
Interest Rate-Crude Oil (1)	Germany		

( ) total number of countries