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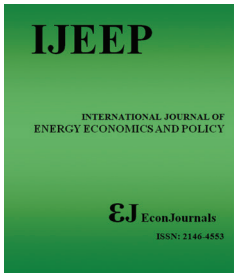

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Estimating the Impact of the Financial Development on Energy Consumption: A Co-integration Analysis

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ABSTRACT

This paper investigated the impact of financial development on energy consumption in Turkey. For this purpose, the annual data from 1961 to 2015 is examined using with Johansen cointegration test and fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) test. Test results indicate the existence of long run relationship between financial development, economic growth and energy consumption in Turkey. In addition The FMOLS and DOLS test results show that financial development and economic growth have a positive effect on energy consumption in Turkey. For this reason, policy makers should also take into account the impact of financial development on energy consumption while setting energy policies and setting targets.

Keywords: Financial Development, Energy Consumption, Economic Growth, Co-integration, Turkey
JEL Classifications: C32, Q43

1. INTRODUCTION

Since energy is one of the main economic growth sources of the country's economy, it is important for various reasons to reveal the determinants of energy consumption. Energy is used in the production of almost all goods and services in the economy, many developing economies are growing rapidly and as the economic growth increases, the energy demands of the countries are also increasing (Sadorsky, 2010. p. 2528). At the same time, the lack of balance between energy supply and demand due to excessive increases in energy consumption has adversely affected economic growth (Furuoka, 2015. p. 430). It is also important in terms of how to manage greenhouse gas emissions caused by energy consumption in the future and in terms of energy policies to be implemented (Sadorsky, 2010. p. 2528).

The financial system is a sector that uses productive resources to facilitate the formation of capital through the provision of a wide variety of financial instruments to meet the different requirements of lenders and borrowers. Therefore, the financial system plays an important role in the mobilization of savings and intermediation, and it ensures that these resources are efficiently allocated to productive sectors (Ang, 2008. p. 536). The development of the financial sector is expressed as developments in financial activities such as increases in banking sector activities, stock market activities and/or bond market activities (Pradhan et al., 2018. p. 6). Financial development contributes to the growth of economies by attracting foreign direct investment (FDI) to the country, and/or encouraging stock exchanges, banking activities and other financial intermediaries.(Mahalik et al., 2017. p. 1022-1024; Shahbaz et al., 2013. p. 10). Financial development also increases the availability of investment resources that lead to the growth of the industry and the expansion of the production base (Farhani and Solarin, 2017. p. 1030). Even in countries with limited financial resources, effective management of the financial system leads to more efficient use of financial resources. It also contributes to innovations that promote economic development and to creating a favorable socio-economic environment for technological progress (Furuoka, 2015. p. 430).

For the energy sector, too, financial development can provide the liquidity needed to stimulate energy projects. Financial development encourages industrial growth and helps create new infrastructure facilities; and for this reason it can affect energy consumption positively. In addition, a well-managed and developed financial sector helps to allocate sufficient financial resources to the energy sector and to provide a balance between energy supply and demand

(Farhani and Solarin, 2017. p. 1030). Financial development can have an impact on energy saving and carbon emission policies as it can affect energy demand as well as economic activities (Mahalik et al., 2017. p. 1022-1024; Sadorsky, 2010. p. 2528-2529). Therefore, there is a dynamic relationship between energy demand, financial development and economic growth.

The aim of this study was to determine the effect of financial development on energy consumption in Turkey. The remainder of the paper is organized as follows: Section 2 explains the theoretical literature between financial development and energy consumption Section 3 briefly reviews relevant literature on the relationship between financial development and energy consumption. Section 4 informs data set and methodology. Section 5 reports the findings. Section 6 concludes the study.

2. LITERATURE REVIEW

Financial development can impact energy consumption in the economy by reducing financial risk and credit costs, promoting transparency between borrowers and creditors, providing access to more financial capital, investment flows and advanced technologies (Sadorsky, 2011. p. 1000; Komal and Abbas, 2015. p. 216; Ouyang and Li, 2018. p. 239).

Financial development can affect energy consumption positively or negatively (Ali et al., 2015; Rafindadi and Ozturk, 2016; Shahbaz et al., 2017; Rafindadi and Ozturk, 2017; Nasreen et al., 2017; Gungor and Simon, 2017). The development of the financial sector may have a positive effect on energy consumption through various channels. Accordingly, financial development leads to economic growth by increasing investments through level and efficient effects. The level effect is expressed as facilitating the transfer of idle resources from non-profitable investments to profitable investments because the financial sector attracts both domestic and foreign investments. The efficient effect is related to the financial sector's facilitating the provision of more financial resources for highly productive investment. Thus, energy demand increases (Odusanya et al., 2016. p. 156). On the other hand, Sadorsky (2011) stated that financial development has an influence on energy consumption through direct, business and wealth effect channels (Sadorsky, 2011. p. 1000; Mahalik et al., 2017. p. 1025).

2.1. Direct Effect

An effective financial system allows consumers to buy more goods, supporting more lending to households and firms, leading to higher energy consumption (Furuoka, 2015. p. 430). Thanks to an advanced financial system, consumers spend their accumulated money in the banks or received loan buy expensive products that consume more energy, such as cars, homes, refrigerators, air conditioners and washing machines. Therefore, an effective financial system allows consumers to buy more goods, which leads to higher energy consumption (Sadorsky, 2011. p. 1000; Mahalik et al., 2017. p. 1025).

2.2. Business Effect

The business world also benefits from financial development. A well-managed financial system can provide adequate support for producers' efforts to expand their business activities (Furuoka, 2015. p. 430). Energy demands of business firms increase with the financial development of an economy. An advanced financial system provides appropriate interest rates to enhance firm investments and innovation activities. Financial development helps companies expand their existing businesses (such as establishment, worker recruitment and purchase of machinery equipment), but in business activities leads to more energy consumption by more use of establishment, machinery and workers, thus affecting the energy demand of the whole country (Sadorsky, 2011. p. 1000; Mahalik et al., 2017. p. 1025; Kahouli, 2017. p. 19-20).

2.3. Wealth Effect

Increased stock market activity is seen as a leading indicator of economic growth and prosperity, but it has a wealth effect in terms of affecting trust between consumers and businesses firms. In other words, increasing stock market activities have a positive effect on the trust of consumers and businesses, and thus create the wealth effect (Odusanya et al., 2016. p. 157). Both consumers and business firms benefit from debt financing as well as from equity financing, depending on the development of an economy's stock market. Because companies provide additional funding by issuing shares. As a result, equity financing increases economic activity and leads to an increase in the energy demand of the country (Sadorsky, 2011; 1000; Mahalik et al., 2017. p. 1025).

The development of the financial sector may have a negative effect on energy consumption due to technological effect (Shahbaz et al., 2017. p. 201). Enhanced financial institutions and capital markets can offer capital financing for renewable energy sector as well as providing and lending to the green renewable energy projects. Financial development makes it possible to offer loans for environmentally friendly projects with low financing costs. In addition, FDI could provide for the reduction of energy consumption by causing increases in investments made by new technologies by local firms (Chang, 2015. p. 28-29; Shahbaz et al., 2017. p. 199). In other words, financial development contributes to the reduction of energy consumption by leading to more modern and less energy consuming technologies (Shahbaz et al., 2017. p. 201). Hence, Mielnik (2002) concluded that there is an inverse relationship between FDI and energy intensity. This is explained by financial development helping the efficient use of energy (Islam et al., 2013. p. 437).

Thus, while financial development gives lenders capital to the energy sector (which also increases energy consumption), it can also serve as an incentive for increased energy substitution (reducing energy consumption). From these two different perspectives, it can be said that the effect of financial development on energy consumption is uncertain (Chang, 2015. p. 28-29). In this context, it is important to examine how financial development will affect energy consumption.

3. APPLIED LITERATURE

In the applied literature, the relationship between financial development and energy consumption has been analyzed by both time series and panel data methods. However, different results have

been obtained in studies. This may be due to the different econometric methods, variables and established models, as well as differences in the country's financial development status (their financial structure, degree of concentration of financial institutions, size of financial institutions and instruments, efficiency of financial intermediaries, volume of financial transactions and effectiveness of the financial regulatory framework) and energy consumption requirements (Ouyang and Li, 2018. p. 238; Keskingöz and İnançlı, 2016. p. 105).

Some of the results obtained in this field study are related to the fact that financial development will increase energy consumption. Mahalik et al. (2017) revealed the relationship between financial development and energy consumption in Saudi Arabia for the period 1971–2011 using time series methodology (ARDL approach). Their results show that unidirectional causality running from financial development to energy demand is found. Odusanya et al. (2016) examined the link between financial development and energy consumption in Nigeria both in the long run and the short run over the 1971-2014 using ARDL approach. Their results indicated that the development of the financial sector exerted positively and significantly on energy demand in the Nigerian economy. Komal and Abbas (2015) demonstrated the finance-growth-energy nexus for Pakistan over the 1972-2012 period using generalized method of moments (GMM). Their result indicate that financial development positively and significantly affects energy consumption through the economic growth channel. Al-mulali and Lee (2013) examined the impact of the financial development on energy use in the Gulf Cooperation Countries for the period 1980-2009 using panel data methodology. They found that financial development increases energy use in the short and lon-run. Ozturk and Acaravci (2013) examined the causal relationship between financial development, trade, economic growth, energy consumption and carbon emissions in Turkey for the period 1960-2007 using ARDL approach. Their result show that there is a unidirectional causality from financial development to energy consumption in the short-run but there is no relationship between the variables in the long run. Sadorsky (2011) explored the relationship between financial development and energy consumption in Central and Eastern European Frontier Economies for the period 1996-2006 using panel GMM analysis. This study indicate that financial development has a positive effect on energy consumption. Sadorsky (2010) investigated the impact of financial development on energy consumption in Emerging Economies for the period 1990-2016 using panel GMM. This study show that financial development has a positive effect on energy consumption. Zhang (2011) demonstrated the impact of financial development on carbon emissions in China for the periodusing time series analysis (Johansen cointegration and Granger causality). This study reported that China's financial development acts as an important driver for carbon emissions increase.

On the other hand, in applied literature, financial development will reduce energy consumption, so there are also studies suggesting that the technology impact is valid. Ouyang and Li (2018) explored relationships among financial development, energy consumption, and economic growth in China from 30 Chinese provinces for the period 1996Q1-2015Q4 using a GMM panel VAR approach. The study result show that financial development plays a negative role in both economic growth and energy consumption. Farhani and Solarin (2017) examined the relationship among financial development and energy demand in the United States for the period 1973Q1-2014Q4 using time series analysis (Bayer-hanckand ARDL cointegrationtest, Granger and asymmetric causality test). Their results indicate that financial development decreases energy demand in the U.S. Jalil and Feridun (2011) explored the relationship between financial development and CO_2 emissions in China for the period 1953-2006 using time series methodology (ARDL analysis). Their findings indicate that financial development lowers environmental pollution. Tamazian et al. (2009) examined the relationship between financial development, economic growth and CO_2 emissions in BRIC Countries for the period 1992-2004 using panel data analysis. This study found that higher degree of economic and financial development decreases the environmental degradation.

Some of the studies that deal with financial development and energy consumption in the literature show that there is a bi-directional relationship (feedback effect) between the relevant variables, i.e., both variables affect each other. Shahbaz and Lean (2012) investigated the relationship among financial development and energy consumption in Tunisia for the period 1971-2008 using time series methodology (ARDL, Johansen cointegration test and Granger causality test). They show that bidirectional causality between financial development and energy consumption. Shahbaz (2015) explored relationship among electricity consumption and economic growth in Pakistan by incorporating financial development within the neoclassical production function for the period 1972-2012 using ARDL approach This study found find that feedback effect between electricity consumption and economic growth, and financial development and electricity consumption.

4. DATA AND METHODOLOGY

The dataset in this study consists of three variables, that is, energy use (kg of oil equivalent per capita) which is used as a proxy for energy consumption, domestic credit to private sector as a percentage of gross domestic product (GDP) which is used as a proxy for financial development and per capita real GDP in constant 2010 US $ which is used as a proxy for economic growth. For the empirical analysis annual time series data are used for the Turkey over the period from 1961 to 2015. Annual data are collected from the World Bank's world development indicators database. For the purpose of examining the impact of financial development and economic growth on the energy consumption, the long-run equation of general empirical framework is given as follows:

$$EC = f(FD, GDP) \quad (1)$$

This paper utilizes data logarithmic processing, such that the time series can be reasonably analyzed and equation can be described as follows:

$$ln\ EC_t = \beta_0 + \beta_1 lnFD_t + \beta_2 lnGDP_t + \varepsilon_t \quad (2)$$

Where EC is energy consumption, FD is financial development and GDP is economic growth. β0, ε and β1 and β2 stand for the

constant term, the error term and the elasticities' impact of other variables on energy consumption, respectively. t is the time period.

Some of the procedures in time series econometrics are based on the assumption that they are treated with stationary series. However, this assumption can not always be fulfilled. For this reason, the application of some non-stationary series of econometric methods may lead to misinterpretation of the results. In the literature, the stationary of variables is tested by unit root tests. In this study, Augmented Dickey Fuller (ADF) (1981) and Phillips and Perron (PP) (1988) unit root tests will be applied as unit root test.

The basis of unit root tests is the Dickey Fuller (DF) (1979) test. However, the DF test is insufficient if the error terms are autocorreated. This situation is overcome by the Augmented Dickey Fuller (ADF) test. With the ADF test, the delayed values of the dependent variable are included as a independent variable. For reliability of the ADF test results, the series were also tested with the PP unit root test using a non-parametric approach (Aytaç, 2016. p. 49). The PP unit root test has been developed with the thought that autocorrelation may occur between error terms. In both stationarity tests, the hypothesis that the null hypothesis contains a unit root and the alternative hypothesis suggests that the series is stationary.

This study aims to examine cointegration relationship between energy consumption, financial development and economic growth. For this purpose, the three variables are tested by the cointegration methods of Johansen (1988) and Johansen ve Juselius (1990). In the Johansen cointegration test, all variables are acted on by the VAR model, which is internally accepted. With this method, the maximum likelihood method is used for estimating the vectors and the rank of the coefficient matrix is tried to be determined (Saatçi and Dumrul, 2013. p. 16). Also in this study Fully modified least square (FMOLS) by proposed Phillips and Hansen (1990) and dynamic ordinary least square (DOLS) cointegration methods by proposed Stock and Watson (1993) will be used to check the consistency and validity of the long-run dynamics. The FMOLS estimator uses a semi-parametric correction method to avoid estimation problems, which are caused by long-term correlation between co-integration equation and stochastic shocks. Consequently, the estimator is fully active and asymptotically unbiased, allowing standard Wald tests using the asymptotic χ^2 distribution. The DOLS estimation procedure is based on the independent variables lags and leads to the equation of cointegration (Berke, 2012. p. 251). Both the FMOLS and DOLS methods take account of the problem of autocorrelation between error terms as well as the relation endogeinity problem between independent variables and error terms.

5. FINDINGS AND DISCUSSIONS

Before modeling, the ADF and PP tests are applied to judge whether the three variables InEC, lnFD and lnGDP have the unit root or not. The results obtained regarding ADF and PP tests can be seen in Table 1.

As can be seen from Table 1, according to ADF and PP test results energy consumption, financial development and economic growth variables are not stationary at the level. The series become stationary when the first difference is received. In other words, the results show that all the variables are I(1).

After determining that the variables are integrated at the order (1), the next step is to calculate the long-run relationship between the variables. The optimal lag length should first be determined when the cointegration relationship is tested. Unrestricted VAR was used in this study and selected optimal lag length by choosing AIC criterion. Results for most of the criterion proposed optimal lag length 1. (VAR (P = 1).The results of Johansen cointegration has produced two statistics, trace and maximum eigenvalue statistics. The significance of trace statistic and eigenvalues statistic exhibits cointegration relation among variables of this study. Results of Johansen cointegration are presented in Table 2.

Table 1: Unit root test results

Variables	Augmented Dickey Fuller (ADF) test				Phillips-Perron (P-P) test			
	Level		First Diff.		Level		First Diff.	
	t-stat.	P-val	t-stat.	P-val	t-stat.	P-val	t-stat.	P-val
LEC	−1.35	0.59	−7.032	0.00	−1.43	0.56	−7.04	0.00
LFD	−0.55	0.98	−5.607	0.00	−0.32	0.97	−5.55	0.00
LGDP	−1.6	0.44	−7.771	0.00	−1.62	0.46	−7.77	0.00

Significant at 5%

Table 2: Results of Johansen test for cointegration

Unrestricted cointegration rank test (trace)					
Cointegration vector number hypothesis (H_0)	Alternative hypothesis (H_1)	Eigenvalue	Trace statistic	0.05 critical value	P
(r=0)*	(r=1)	0.341503	33.43418	29.79707	0.0182
(r≤0)	(r=2)	0.175907	12.12664	15.49471	0.1510
Unrestricted cointegration rank test (maximum eigenvalue)					
Cointegration Vector number hypothesis (H_0)	Alternative hypothesis (H_1)	Eigenvalue	Max-eigen statistic	0.05 critical value	P
(r=0)*	(r≥0)	0.341503	21.30754	21.13162	0.0472
(r≤0)	(r≥2)	0.175907	9.867075	14.26460	0.2208

Table 3: FMOLS and DOLS analysis

Variables	Dependent variable: lnEC					
	Fully modified least square (FMOLS)			Dynamic least square (DOLS)		
	Coefficient	t-stat.	P-value	Coefficient	t-stat.	P-value
LFD	0.883321	7.668444	0.0000	0.900457	5.834760	0.0000
LGDP	0.220343	5.053638	0.0000	0.216436	3.946943	0.0003
C	3.424627	8.112610	0.0000	3.391970	6.604859	0.0000

Johansen test statistics results (trace and maximum eigenvalue) reject the null hypothesis; that is, there is no cointegration relationship. Results in Table 2 reveal that there exist at least one cointegration relationships. Therefore, long-term cointegration relationships exist between lnEC, lnFD and lnGDP.

FMOLS and DOLS methods were used in order to determine and interpret the long-run coefficients after determining the cointegration relation between the variables studied in the study. The results of the analysis are shown in Table 3.

As can be seen from Table 3, according to the FMOLS results, 1% increase in financial growth increases energy consumption by 0.88% and 1% increase in economic growth increases energy consumption by 0.22%. According to the DOLS results, a 1% increase in the financial developments in Turkey's energy consumption by 0.90%, while 1% increase in economic growth increases by 0.21%. In summary, both FMOLS and DOLS test results show that financial development and economic growth have an impact on energy consumption in Turkey. Accordingly, financial development and economic growth increase energy consumption in Turkey. However, the coefficients for all variables are statistically significant. The close results of the two cointegration methods that give long-run coefficients increase confidence in the estimates of these tests.

6. CONCLUSION

In this study, the effect of financial development on energy consumption is examined both theoretically and practically. In the theoretical literature, there is the opinion that the financial development will influence energy consumption positively through different channels (such as direct, business and wealth), as well as the suggestion that it will affect the negative due to technology influence. There are also studies suggesting that there is a bi-directional relationship in the applied literature. Therefore, there is no consensus on the relationship in the literature.

This study focuses on the effect of financial development on energy consumption in Turkey. As a result of co-integration, FMOLS and DOLS tests using 1961-2015 period data, it is concluded that there is a long relationship between financial development and energy consumption and that financial development has a positive effect on energy consumption. It said that the policies aimed at improving the financial sector have a direct impact on Turkey's energy consumption. The results are consistent with the findings of Mahalik et al. (2017) for Saudi Arabia; Odusanya et al. (2016), Komal and Abbas (2015) for Pakistan; Al-mulali and Lee (2013) for Gulf Cooperation Countries; Sadorsky (2011) for Central and Eastern European Frontier Economies Sadorsky (2010) for Emerging Economies and Zhang (2011) for China.

At the same time, the study found that economic growth also increased energy consumption. Turkey is a country dependent on foreign energy, diversification of energy supply to meet the energy consumption, which will increase with the growth is important. Therefore, the increase in energy consumption due to the increase in financial development and economic growth should be considered in energy consumption planning for Turkey's economy.

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