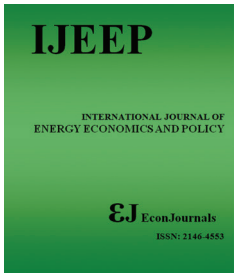

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Financial Markets and Electricity Consumption Nexus in Russia

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ABSTRACT

This paper investigates the nexus between development of financial markets and electricity consumption in case of Russia. According to the hypothesis, we assume that financial markets development gives birth to an increased level of electricity consumption. Also we incorporate economic growth and urbanization as important variables for model's specification. The hypothesis is tested on example of Russia for the period 1990–2016. The results confirm the hypothesis. We found that economic growth, urbanization and financial markets development positively affect the electricity consumption both in the long and short run.

Keywords: Financial Market, Electricity Consumption, Urbanization, Economic Growth
JEL Classifications: D53, Q41, P25, O47

1. INTRODUCTION

Nowadays, the status of the resource economy is not sufficient to ensure high rates of economic growth. In a context of global diversification, it is no longer sufficient to have only a large resource base. In such circumstances, diversification becomes a necessity for achieving set goals and rates of economic growth. In this regard, use of many macroeconomic indicators, as well as various tools, could assist in achieving macroeconomic stability and high rates of economic growth, as well as the overall economic well-being of the national economy.

Otherwise, if these macroeconomic indicators, as well as macroeconomic factors, remain undervalued, the achievement of the goal is unlikely. Most developed and developing countries need to maintain high productivity across different sectors of their national economies in order to sustain economic growth. In the context of the transition from the agrarian to industrial model of the national economy or to the post-industrial model, ensuring high productivity is the primary necessity. High productivity of the service sector is a key to ensuring sustainable and high rates of economic growth in the national economy. This issue is particularly acute in developing countries, which are also net exporters. The Russian Federation is no exception in this case.

One of the main factors that have a significant impact on the development of services' sector is the financial market. As financial markets develop, the needs of other sectors of the national economy increase. The growing volume of trading on the stock exchange, the increase in the number of approved loan applications from households, the increase in the need for working capital and investment needs on the part of economic entities, leads to the development of national financial markets. The growth of financial markets thus spurs the growth of the national economy, which in turn leads to an increase in electricity consumption by various economic agents.

Thus, the increasing growth rates of the national economy provide more opportunities for further growth, the growing financial markets in the national economy provide more resources for investment and industrial development. This in turn, leads to the development of stock markets, but also has an impact on the migration processes within the country. Internal labor migration, caused by the development of the financial sector, leads to an increase in the rate of economic growth in certain regions or cities of the country, which inevitably leads to an increase in electricity consumption. This, in turn, leads to the multiplication of economic growth rates.

Thus, on the one hand, the development of financial markets contributes to the strengthening of economic growth, both directly

and indirectly. Thus, the growth of financial markets leads through various channels to an increase in consumption and investment and employment, which in turn causes an increase in electricity consumption on the one hand and also affects migration processes on the other. Thus, migration can have a significant impact on the consumption of electrical energy, which in turn can have an impact on economic growth.

In this regard, the study of the relationship between the development of financial markets, economic growth, internal migration and electricity consumption seems relevant. Thus, this study is devoted to the comparative analysis, as well as the search for the relationship between the development of financial markets and electricity consumption in Russia. The main goal of this study lies in an attempt to find the relationship between the development of the financial market and electricity demand of economic agents. The practical significance of this study lies in the formation of proposals for public authorities in the strategic and tactical planning of the development of energy sectors of the national economy, taking into account the objectives and current trends in the development of economic and financial sectors. Taking into account the development of financial markets and domestic migration processes, the importance of assessing demand and the possibility of its satisfaction by large cities cannot be overestimated.

2. LITERATURE REVIEW

In the relevant literature review, Ozturk (2010) examines the relationship between energy, electricity consumption and national income in the light of the results of previous studies. According to the results of his research, in the academic environment on this issue there is no unambiguous point of view in connection with the existence of ambivalent and heterogeneous results of the studies dedicated to the research of the relationship between income, growth and energy consumption. Moreover, Ozturk (2010) proposes to improve methodological aspects of ongoing research on this issue, as well as to improve the methods and tools of analysis. This applies both to the selection of control variables and to econometric tests used to test hypotheses (see also following recent studies: Al-Mulali et al., 2015a; Rafindadi and Ozturk, 2016; Al-Mulali et al., 2015b; Nasreen et al., 2017).

For example, in the study by Adom (2011), the relationship between electricity consumption and economic growth rates in Ghana for the period 1971–2008 was tested. As a result of the study, he concludes that economic growth has a positive impact on the consumption of electricity, not vice versa. Acaravci and Ozturk (2012) using the data for Turkey for the period 1968–2006 confirmed the fact that electricity consumption increases economic growth and the reverse relationship can be considered statistically insignificant. Adebola (2011) in his study on the example of Botswana for the period 1980–2008 comes to the conclusion about the existence of this relationship, adding capital as the third control variable. According to the results of the study, electricity consumption supports economic growth, strengthens it. At the same time, the opposite effect-that is, the impact of economic growth on electricity consumption-is statistically insignificant. Moreover, capital has a significant impact on economic growth. Ali et al. (2015), using quarterly time series for the period 1971–2011 on the example of Nigeria, concludes that the development of financial markets has a positive but insignificant impact on the consumption of electricity in the long term, along with a negative but statistically significant effect of economic growth on electricity consumption. Moreover, electricity prices also have a positive impact on electricity consumption.

Using data for the period 1970–2012, Solarin et al. (2016) explores the relationship between urbanization and electricity consumption and economic growth on the example of Angola. As a result of research, they conclude that economic growth, urbanization and trade have a significant impact on economic growth in the long term. However, they also conclude that economic growth is strengthened by the growth in consumption of electric energy, urbanization, migration and trade. Khobai et al. (2017) explores the production function using electricity supply, trade and electricity prices as additional variables on the example of South Africa for the period 1985–2014. As a result of research, they conclude that the price of electricity and capital have a significant impact on the supply of electricity. Moreover, income, trade and electricity prices have a significant impact on employment.

Acaravci et al (2015) explores the relationship between the variables on the example of Turkey for the period 1974–2013. As a result of the study, they conclude that electricity has a significant impact on economic growth, but the opposite effect is not statistically significant. Moreover, they have found a link between trade and foreign investment. At the same time, trade has an impact on foreign investment. Liaquat and Mahmood (2017) in the study presented an augmented model of electricity consumption and growth, by adding the debt cycle, accounting the problem in the energy electric sector of Pakistan. The study was conducted for the period 2005–2015. As a result of their research, they came to the conclusion that the circulation of debt and economic growth causes energy consumption. In this way, the use of electricity is enhanced by increasing economic growth in Pakistan. Moreover, circular debt and electricity consumption are also a cause of economic growth. Thus, this study presents the result of the bidirectional relationship between economic growth, energy consumption and changes in the debt burden.

Rahimi and Rad (2017) in their study on the relationship between electricity consumption and economic growth added an additional variable in the form of Internet usage. The study was conducted on the example of 8 developing countries for the period 1990–2013. The result of their study shows that the use of the Internet and economic growth have a significant impact on electricity consumption in the long run, while, national income has a positive impact on energy consumption only in the short term. They came to the conclusion that electricity consumption affects Internet usage and the last has an impact on the level of income. Al-Mulali and Ozturk (2015) investigated events that led to environmental degradation in the Middle East and North Africa regions. To achieve the goal of the study, a panel model was used, in which environmental footprint was used to reflect environmental degradation, as the best indicator. The study was conducted for the period 1996–2012 and consisted of 14 MENA countries. The

results of the Pedroni cointegration test revealed that ecological footprint, energy consumption, urbanization, trade openness, industrial development and political stability are cointegrated. Moreover, the results of fully modified ordinary least square showed that, energy consumption, urbanization, trade openness and industrial development increase environmental damage, while political stability reduces it in the long run. Shahbaz et al. (2014) explored the relationship between economic growth, electricity consumption, environmental degradation and urbanization on the example of the United Arab Emirates over the period 1975–2011. The study concluded that an inverted U-shaped relationship between economic growth and CO2 emissions exist, i.e., economic growth raises energy emissions initially and after achieving a threshold point of income per capita it declines (EKC exists). Electricity consumption declines CO2 emissions. The relationship between urbanization and CO2 emissions was found to be positive.

In the case of Saudi Arabia, Alkhateeb et al. (2017a) and Alkhateeb et al. (2017b) found out that the energy sector has a positive significant impact on employment. Mahmood and Alkhateeb (2017) came to the conclusion that trade has a negative impact on pollution emissions. Economic growth positively affects the level of pollution emissions.

However, even taking into account such a large amount of research on this issue, unfortunately the number of studies devoted to the relationship between the consumption of electricity and the development of financial market is limited. Moreover, there is no study on the search for these relationships on the example of Russia. In this regard, the study seems relevant and timely.

3. MATERIALS AND METHODS

Financial markets can have a significant impact, as well as support and reinforce economic activity through various channels and directions. For example, financial markets can enhance economic growth by meeting the demand for credit. These credit resources can be directed to both the economic entities and households, thereby meeting their temporary capital needs. Thus, the expansion or growth of economic activity or of economic entities implies the increasing need for energy consumption, and in particular in the consumption of electricity.

In addition, urbanization can also increase the demand for electricity, both from households and from economic entities. Thus, electricity consumption may grow due to the growth of urbanization in the country. Moreover, income, as well as its changes, can have a significant impact on the level of energy consumption. Given the difficulty of inter linkages of this specification, we follow Senan et al. (2018) and model the impact of the development of financial markets, urbanization and national income on the consumption of electricity of the following type:

$$lEC_t = f(lGDP_t, lFM_t, lURB_t) \quad (1)$$

t is showing a time period 1990–2016. The l is for logarithm. Most of economic relationships are not linear in nature. Therefore, we are supposing a log-linear relationship. ECt, GDPt, URBt, and FMt are for EC and GDP per capita (a proxy of economic income growth), urbanization (a proportion of population in city area) and financial market development (proxy by private credit as proportion to GDP) respectively. All series for Russia are collected from World Development Indicators for a period 1990–2016.

Financial markets allow to extend the budget constraint of the households, thereby increasing the demand for goods and services. In this regard, we expect that the development of financial markets should lead to an increase in demand for electricity from households and economic entities. Therefore, it is assumed that financial markets should have a positive impact on economic growth. Also, urbanization, as a manifestation of internal migration in the national economy, should also lead to an increase in demand for electricity, due to the fact that the urban residents need more electricity for their production function. Thus, urbanization can have a positive impact on economic growth. National income reflects total economic activity in national economies, and electricity is one of the main factors of production and consumption in order to ensure the continuity of the production or life cycle of an economic agent.

Thus, growing income in the national economy may require greater consumption of electricity for both consumption and production purposes. In this regard, we expect that all sampled variables should have a positive impact on economic growth.

For time series analysis, the first step is to determine the stationarity of the sampled variables. In this regard, we use the unit root test to determine the stationarity or nonstationary of time series. Therefore, augmented Dickey-Fuller (ADF) test might be used. The ADF equation is following:

$$\Delta z_t = y_0 + y_1 z_{t-1} \sum_{i=0}^{k} y_{2i} \Delta z_{t-i} + \omega_t \quad (2)$$

z_t can utilize all of our proposed variables one by one in the Equation 2 to test the unit root. The negative and significant γ_1 can be claimed for a stationary series. Then, we can proceed to cointegration analysis once we verify the series to be stationary. For the further analyses, we are employing auto-regressive distributive lag (ARDL) with the following equation:

$$\begin{aligned}\Delta lEC_t = {} & \alpha_0 + \alpha_1 lEC_{t-1} + \alpha_2 lFM_{t-1} + \alpha_3 lGDP_{t-1} + \alpha_4 lURB_{t-1} \\ & + \sum_{j=1}^{p} \varphi_{1j} \Delta lEC_{t-j} + \sum_{j=0}^{q} \varphi_{2j} \Delta lFM_{t-j} + \\ & \sum_{j=0}^{q} \varphi_{3j} \Delta lGDP_{t-i} + \sum_{j=0}^{q} \varphi_{4j} \Delta lURB_{t-j} + \theta_t \end{aligned} \quad (3)$$

As the first step, the null hypothesis of no cointegration should be tested (H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$). Then, long run effects can be calculated through normalizing. After that, we can proceed to estimation of the short run effects by the following error correction model:

$$\begin{aligned}\Delta lEC_t = {} & \sum_{j=1}^{p} \delta_{1j} \Delta lEC_{t-j} + \sum_{j=0}^{q} \delta_{2j} \Delta lFM_{t-j} + \\ & \sum_{j=0}^{q} \delta_{3j} \Delta lGDP_{t-i} + \sum_{j=0}^{q} \delta_{4j} \Delta lURB_{t-j} + k\theta_{t-1} + \varepsilon_t \end{aligned} \quad (4)$$

The short term effects can be calculated by the estimated if k is negative and significant.

4. RESULTS AND DISCUSSION

The results of the study, presented in Table 1, show that l (GDP) fulfill the stationarity requirement at level. However, other variables, which include l(EC), l(FM) and l(URB)are not stationary at level, but become stationary after being first differenced. The results of the unit root test allow to assume heterogeneous order of integration. Based on these results, for cointegration analyses we proceed to using ARDL.

Table 2 presents ARDL results of our electricity consumption model. Results of the bound test show that F-statistics (F=35.9831) is larger than the critical upper bound value at 1% significance level. Given these results we can reject the H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$ of Equation 3 and accept alternative hypothesis (H1), according to which cointegration is present in our model.

Results of the long-run estimates show that financial markets development (l(FM)) has a positive and statistically significant effect on the electricity consumption in Russia with elasticity of 0.0976. Results show that a 1% increase in financial markets development leads to a 9.76% increase in electricity consumption. Growing financial sector requires more sophisticated and developed technologies, which leads to an increased energy demand. Urbanization also has a positive and statistically significant effect on electricity consumption with elasticity of 0.0184. Given the fact, that urbanization processes also take place in Russia, yet a 1% increase in urbanization leads only to a 1.84% rise in electricity consumption. Such results show that urbanization is not of the great importance for electricity consumption issue. GDP also has a positive and statistically significant effect on electricity consumption in Russia with elasticity level of 8.95%. As GDP stands as a proxy for economic growth and level of the national income, rising GDP, ceteris paribus, may be related to rising electricity and energy needs. The long-run relation between GDP and EC confirm our hypothesis.

Table 2 also shows results of short run estimates of our EC model. The negative in sign and statistically significant θt-1 corroborates our assumption of the short-run relations between the sampled variables. So, the speed of adjustment of the variables toward equilibrium is 43.73% per year. As we can also see from Table 2, short run effect of financial markets development, urbanization and national income growth are positive in nature and statistically significant at 1% level. Yet, the effect of the variables on electricity consumption in the short-run is not great in scale. E.g., a 1% increase in financial markets development leads to 7.52% rise in electricity consumption.

5. CONCLUSION

In this study, we set ourselves a task of testing the hypothesis of the relationship between the development of financial markets and electricity consumption on the example of Russia for the period 1990–2016. In particular, sampled variables include national income, urbanization, development of financial markets and electricity consumption. The base period for the sample variables is 1 year.

Table 1: Results of ADF test

Variable	C	C and T
l (EC)	1.4508 (2)	−3.1345 (1)
l (FM)	−0.3581 (0)	−2.0879 (0)
l (GDP)	−3.9749 (1)**	−3.8631 (1)*
l (URB)	−2.8832 (1)	−2.9012 (1)
Δl (EC)	−3.0974 (2)*	−3.4216 (1)**
Δl (FM)	−6.5408 (0)***	−5.8347 (0)***
Δl (URB)	−4.2105 (0)***	−8.1289 (0)***
Δl (GDP)	−3.1984 (0)***	−3.4871 (0)***

*.**.***Denote stationarity of time series at 10%, 5% and 1% respectively.
ADF: Augmented Dickey-Fuller

Table 2: EC model statistics

Variable	Parameters	SE	t-statistic	P-value
Long-run estimates				
l (FM)	0.0976	0.1814	2.8843	0.0112
l (GDP)	0.0895	0.0639	4.0012	0.0006
l (URB)	0.0184	0.0035	5.9804	0.0000
C	0.6942	0.2753	2.9032	0.0283
Short-run estimates				
Δl (FM)	0.0752	0.0738	3.8953	0.0027
Δl (URB)	0.0814	0.0194	3.3094	0.0021
Δl (GDP)	0.0304	0.0037	2.9906	0.0075
θ_{t-1}	−0.4373	0.1405	−6.2301	0.0000
Bound test	Estimated F-value=35.9831			
Critical bound	Lower		Upper	
F-value (%)				
5	3.23		4.35	
1	4.29		5.61	

We have found a mixed integration level and also corroborated cointegration in our hypothesized model. The results of the study confirmed the hypothesis as a whole. For example, in the long run, we have found a statistically significant positive impact of income, urbanization and the development of financial markets on the consumption of electricity in Russia. Similar statistically significant positive effects were found in the short run.

Thus, we can assume that the development of financial markets has a positive impact on energy consumption, in terms of electricity consumption in Russia. In other words, we can assume that the development of financial markets leads to an increase in electricity consumption.

The results of the study can be useful in forecasting the consumption of electricity in light of the growth of national income and internal migration processes as well as the development of financial markets. Taking into account, albeit slow, development of financial markets and internal migration processes in Russia, it is recommended to take into account the potential impact of these areas of the national economy on the energy sector. Taking into account the obtained results is important in forecasting the need for electricity on the one hand, as well as in determining the strategy for the development of energy security of the national economy on the other.

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