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Financial Markets and Electricity Consumption Nexus in Saudi Arabia

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ABSTRACT

Financial market is growing at faster speed in Saudi Arabia with a policy of economic diversification. This may require the more electricity consumption (EC) in turn. This paper has investigated the EC and financial market development (FMD) nexus incorporating economic growth and urbanization in analyses by using a period 1970-2015 for Saudi Arabia. We have found positive effects of economic growth, urbanization and FMD on the EC in long and short run analyses. Based on results, we recommend the Saudi economy to increase the electricity production capacity through several energy resources especially renewable and clean sources to meet the demand from rising economic growth, urbanization and FMD.

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

1. INTRODUCTION

It is not enough to survive and grow in this diversified world being only a resource rich economy. However, diversification may majorly be required to sustain the targeted growth in any economy. Further, many determined macroeconomic indicators may contribute to economic growth and used as tool to measure economic prosperity. However, if the important main factors, which may contribute mostly to the concept of growth, remain underestimated then economy may work under-capacity. Most of world is transforming from primary and industries' sectors towards the service sector now a day due to higher expected productivity of this sector to achieve higher economic growth. Then, Saudi Arabia is not an exception and financial sector is growing at tremendous pace. With rising financial development along with its byproduct of economic growth, electricity is also required to meet the demand resulted from higher economic activities. Further, more growth may also provide more opportunities and resources for investment and industrial expansion which is causing people to migrate to location or project contributing again to consume more electricity and adding to economic growth resultantly. Therefore, urbanization may also significantly increase the demand for electricity. A country is escalating economic growth trigger to many factors. The same way our paper tries to relate economic growth, urbanization and financial development of Saudi Arabia with electricity consumption (EC) so that a contribution of major factors may be determined and accordingly a policy is devised keeping in view a fact that if usage of electricity is for productive purpose then it may contribute to economic growth in turn.

Financial sector assessment Programme took place during the aftermath of a major shock for the Saudi economy, whose repercussions were still being felt despite a decisive policy response. During 2015-16, the decline in oil prices led to a sharp fall in oil revenues. Government spending was cut and payments to some suppliers were delayed, adding to the contractionary effects on the economy. A sharp drop in oil prices in late 2014 caused the current account to swing from a surplus of about 10% of gross domestic product (GDP) in the same year (and even higher in earlier years) into a deficit of 8% of GDP in 2015, and nearly halved government oil revenue. In response to a surging fiscal deficit from 3.4% in 2014 to almost 16% of GDP in 2015, the government

took steps during 2015-16 to increase non-oil revenue and cut expenditures, while delaying some payments to suppliers, which dampened activity in the non-oil economy. Further, the government launched wide-ranging medium-term fiscal consolidation reforms, to help in financing the fiscal deficit, and raised a US$10 billion international syndicated loan in April 2016. It also issued US$17.5 billion in international bonds and US$9 billion of Islamic bonds (Sukuk) in April 2017. By these evidences, financial sector is also a great stakeholder in the government financing and economic activities of this sector is also growing at considerable rate which may increase energy consumption as a result.

Recognizing the above challenges, the government unveiled in 2016 an ambitious "Vision 2030" plan and a more detailed 5-years National Transformation Program focused on reducing the economy's reliance on oil; rationalizing and enhancing the efficiency of public spending; increasing non-oil revenues through new taxes and fees; encouraging the non-oil private sector contribution to GDP and employment, including through SME development and growth-enhancing structural reforms; increasing home ownership; and transforming Saudi Arabia into a regional trade and finance hub. Therefore, financial sector is expected to grow at faster rate than before and may increase the electricity demand with rising economic activities. For this purpose, Saudi government has also declared a long run plan related to clean electricity production through clean energy production mix in the NEOM project and expected 3.45 GW electricity production in 2020 and 9.5 GW in 2023.

Thus, conducting a comparative analysis of economic growth in the non-oil sector that has been impacted by financial sector development is crucial to enhance the kingdom's EC and making this study extremely relevant and significant. It is vital for policymakers to identify what type of economic growth (financial or non-financial) has been the most directly impacted on the EC to determine what policy changes can be made to enhance future economic growth by utilizing the energy in efficient way in Saudi Arabia. Our estimated results are useful in forecasting the EC with rising economic growth, urbanization and FMD. The financial market and urbanization are growing at faster rate in Saudi Arabia now days. Therefore, need of electricity cannot be ignored to support the economic activities due to above-mentioned reasons.

2. LITERATURE REVIEW

In a literature survey, Ozturk (2010) discusses the association in energy/EC and income in the past studies. He reports that literature has corroborated a mix kind of results in the relationship of mentioned variables. Further, he suggests to improve the methodological aspects of this issue i.e. choice of control variables and estimation strategies instead of choosing different countries or time sample. A limited literature has been discussed here to highlight the importance of this relationship in this paper. For example, Adom (2011) inspects the EC and growth relationship for Ghana using a period 1971-2008. He finds that economic growth is positively affecting to EC and not the vice versa. Acaravci and Ozturk (2012) utilize a period 1968-2006 for Turkey and confirm that EC is increasing the economic growth and reserve effect has been found insignificant.

Adebola (2011) utilize a period of 1980-2008 for Botswana to confirm this relationship using capital as third variable. He finds that electricity is supporting the economic growth and reserve effect is insignificant. Further, capital is also significantly affecting the economic growth. Ali et al. (2015) utilize a quarterly series of a period of 1971-2011 for Nigeria. They find that FMD is negatively impacting the energy consumption in short run along a negative effect of economic growth on energy consumption but energy prices have positively affected the EC. However, FMD is positively and insignificantly affecting the energy consumption in long run along a negatively significant effect of economic growth on energy consumption. Further energy prices are also positively affecting energy consumption. Using a period 1971-2012, Solarin et al. (2016) investigate the urbanization, EC and growth relationships for Angola. They find that growth, urbanization and trade variables are causing the EC in the long run. Further, growth is also caused by the EC, urbanization and trade variables. Khobai et al. (2017) explore a production function using electricity supply, trade and electricity price as additional variables for South Africa using a period 1985-2014. They find that price of electricity and capital are causing the electricity supply. Further, income, trade and electricity prices are causing to the employment.

Acaravci et al. (2015) investigate this issue for Turkey using a period 1974-2013. They report that electricity is affecting the economic growth but reverse effect is found insignificant. Further, they also find a one-way relation from trade to foreign investments. Liaquat and Mahmood (2017) augment a model of EC and growth by combining a real problem of circular debt in electricity sector of Pakistan using a period 2005-2015. They find that circular debt and growth are causing EC. Hence, electricity usage is increased by more economic growth in Pakistan. Further, circular debt and EC are also causing the economic growth. So, feedback effect is found in EC and growth. Rahimi and Rad (2017) reconnoiter the EC-growth relationship containing an interesting variable of internet usage for eight developing nations using period 1990-2013. They corroborate that internet usage and economic growth are increasingly affecting the electricity usage in long run and income is only positively contributing to the electricity usage in the short run. Further, they find that EC is causing to the internet usage and internet usage is causing to the income. Al-Mulali and Ozturk (2015) examine the events that caused the environmental degradation in the Middle East and North African (MENA) region. To achieve the goal of this study, a panel model that represents the environmental degradation utilizing ecological footprint as a better indicator is constructed taken the period 1996-2012 investigating 14 MENA countries. The results from 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 concluded that energy consumption, urbanization, trade openness and industrial development increases environmental damage while the political stability lessens it in the long run. Shahbaz et al. (2014) examine the relationship between economic growth, EC, urbanization and environmental degradation in United Arab Emirates over the period of 1975-2011. They found an inverted U-shaped relationship between economic growth and CO_2 emissions i.e. economic growth raises

energy emissions initially and declines it after a threshold point of income per capita (EKC exists). EC declines CO_2 emissions. The relationship between urbanization and CO_2 emissions is positive.

In case of Saudi Arabia, Alkhateeb et al. (2017a) and Alkhateeb et al. (2017b) find that energy sector is positively contributing to the employment level and Mahmood and Alkhateeb (2017) find that trade is negatively affecting the pollution emissions and economic growth is positively affecting the pollution emissions. However, still there is need to investigate an important issue of testing the effect of FMD and economic growth on EC. Therefore, present paper is achieving this goal by working on this topic.

3. METHODOLOGY

Financial market can have a supporting behavior to economic activities by providing loans to business sector. Therefore, increasing economic activities need the electricity for the energy needs. Further, urbanization augments the need of electricity for the domestic electrical appliances and business's EC. So, EC may increase with the more urbanization in a country. Further, income or GDP per capita can have direct demanding effect on the EC. Keeping these justifications, we are modeling the impact of FMD, urbanization and income on the EC in the following way:

$$lECPC_t = f(lGDPC_t, lFM_t, lURB_t) \quad (1)$$

t is showing a time period 1970-2015. The l is for logarithm. Most of economic relationships are not linear in nature. Therefore, we are supposing a log-linear relationship. $ECPC_t$, $GDPC_t$, URB_t, and FM_t 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 (FMD) (proxy by private credit as proportion to GDP) respectively. All series for Saudi Arabia are collected from World Development Indicators for a period 1970-2015. Financial market is monetizing the demand of consumable and producible and is expected to increase the demand for electricity as it empowered the domestic and commercial appliance to be worked. Therefore, FM_t would have a positive impact on the $ECPC_t$. Further, urbanization (a shift of rural population to the urban areas) may also increase the demand for electricity, as urban life requires more electrical appliances than that of rural one. Therefore, urbanization could have positive influence on the EC. Lastly, GDP/income per capita reflects the overall economic activities in a country and electricity is a major need to support the economic activities along with other energy demand. Therefore, a rising income of a country may require more of electricity for consumption and production purposes and a positive relationship between them can be supposed. Overall, we are supposing the positive impact of all of our independent variables on the EC.

For the time series analyses, unit root testing can be assumed as first step because of non-stationary macroeconomic series in nature. Therefore, Augmented Dickey Fuller (ADF) test might be utilized. The ADF equation can be displayed as:

$$\Delta z_t = \gamma_0 + \gamma_1 z_{t-1} + \sum_{i=0}^{k} \gamma_{2i} \Delta z_{t-i} + \omega_t \quad (2)$$

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. We can proceed for the cointegration analyses once we verify this. For the further analyses, we are employing auto-regressive distributive lag (ARDL) with the following equation.

$$\begin{aligned} \Delta lECPC_t = {} & \eta_0 + \eta_1 lECPC_{t-1} + \eta_2 lFM_{t-1} + \eta_3 lGDPC_{t-1} \\ & + \eta_4 lURB_{t-1} + \sum_{j=1}^{p} \phi_{1j} \Delta lECPC_{t-j} \\ & + \sum_{j=0}^{q} \phi_{2j} \Delta lFM_{t-j} + \sum_{j=0}^{q} \phi_{3j} \Delta lGDPC_{t-i} \\ & + \sum_{j=0}^{q} \phi_{4j} \Delta lURB_{t-j} + \xi_t \end{aligned} \quad (3)$$

At first, H_0: $\eta_1 = \eta_2 = \eta_3 = \eta_4 = 0$ of no-cointegration will be tested for an evidence of cointegration. Then, long run effects can be calculated through normalizing. After that, we can proceed for the short run effects by the following error correction model:

$$\begin{aligned} \Delta lECPC_t = {} & \sum_{j=1}^{p} \lambda_{1j} \Delta lECPC_{t-j} + \sum_{j=0}^{q} \lambda_{2j} \Delta lFM_{t-j} \\ & + \sum_{j=0}^{q} \lambda_{3j} \Delta lGDPC_{t-i} + \sum_{j=0}^{q} \lambda_{4j} \Delta lURB_{t-j} \\ & + \kappa \xi_{t-1} + e_t \end{aligned} \quad (4)$$

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

4. ESTIMATIONS

The results show in Table 1 that $lGDPC_t$ is stationary at level. Further, $lECPC_t$, lFM_t and $lURB_t$ are not stationary at levels but stationary after first differences. A mix order of integration can be claimed after the unit root analyses. But, it is sufficient for the further cointegration analyses as ARDL is valid technique in this case.

Table 2 displays the ARDL results of our EC model. At first, F = 30.6396 is larger than critical upper bound value at 1%. Therefore, we may reject the H_0: $\eta_1 = \eta_2 = \eta_3 = \eta_4 = 0$ in equation 3 and may claim for the existence of cointegration in our model. In the long run estimates, lFM_t has a positive effect on the EC with elasticity = 0.282. It shows that 1% increase in FMD could increase the 0.282% consumption of electricity. It also shows that FMD is significantly monetizing the economic activities which require the EC in response. Basically, the financial sector of Saudi Arabia is growing at faster face and augmenting the consumption and production by providing loans to the household and business sectors respectively. The increasing household and business activities require the electricity for the use of electrical appliances to support their activities. This result is corroborating the need of electricity with the FMD in the kingdom. Further, $lURB_t$ has a positive effect on the EC with elasticity = 0.0272. So, urbanization is also increasing significantly the demand for electricity. The life in rural areas is supposed as simple in the literature with a lesser population density and EC can be

Table 1: ADF test

Variable	C	C&T
$lECPC_t$	1.3308 (2)	−2.8635 (1)
lFM_t	−0.2425 (0)	−2.4617 (0)
$lGDPC_t$	−3.2383 (1)**	−3.2225 (1)*
$lURB_t$	−2.6921 (1)	−2.7348 (1)
$\Delta lECPC_t$	−2.9345 (2)*	−3.3156 (1)**
$\Delta lFMD_t$	−6.0560 (0)***	−5.1585 (0)***
$\Delta lURB_t$	−3.9259 (0)***	−6.4188 (0)***

*,** and ***for stationarity at 10%, 5% and 1%. ADF: Augmented Dickey Fuller

Table 2: EC model

Variable	Parameters	SE	t-statistic	P value
Long run estimates				
lFM_t	0.2820	0.1079	2.6137	0.0126
$lGDPC_t$	0.1621	0.0443	3.6566	0.0007
$lURB_t$	0.0272	0.0052	5.2328	0.0000
C	0.5456	0.2506	2.1774	0.0354
Short run estimates				
ΔlFM_t	0.1685	0.0541	3.1139	0.0034
$\Delta lGDPC_t$	0.0968	0.0299	3.2421	0.0024
$\Delta lURB_t$	0.0162	0.0054	3.0033	0.0046
ξ_{t-1}	−0.5974	0.1016	−5.8819	0.0000
Bound test	Estimated F-value=30.6396			
Critical bound F-value	Lower		Upper	
5%	3.23		4.35	
1%	4.29		5.61	

EC: Electricity consumption

lesser due to a simple life style. But, life in the urban areas is very modern in this age with a lot of electricity appliances in use and EC in urban areas is also more as compare to rural area due to the greater population density as well. Therefore, more EC is required to support the phenomena of urbanization. Lastly, $lGDPC_t$ has a positive effect on the EC with elasticity = 0.1621. GDP per capita is proxy of economic growth and income level and rising income may come up with more demand for the goods which may require electricity to worked. This result is corroborating the higher demand for EC with a rising income level in the kingdom. In large, our three hypothesized variables have positive and significant effects on the EC. The measured elasticity may help in forecasting the future demand for electricity in the long run with rising economic growth, urbanization and FMD.

Table 2 also displays the short run estimates of our model. The negative and significant ξ_{t-1} is corroborating the short run relationship in our model and also showing a 59.74% speed of convergence in a year. Further, the short run effects of income, urbanization and FMD are found positive and significant at 1%. However, the estimated elasticity of the mentioned variables has been declined in the short run. Though, our hypothesized independent variables have also significant effect on the EC in short run as well.

5. CONCLUSIONS

This paper has investigated the effects of income, urbanization and FMD on EC of Saudi Arabia by using a yearly series of 1970-2015. We have found a mixed integration level and also corroborated cointegration in our hypothesized model. In the long run estimates, we have found the expected positive impacts of income, urbanization and FMD on EC in Saudi Arabia. The same impacts have also been verified in the short run estimates. Therefore, we claim that FMD is increasing the EC along with urbanization and income growth.

Our estimated results are useful in forecasting the EC with rising income level, urbanization and FMD. The financial market and urbanization are growing at faster rate in Saudi Arabia now-a-days. Therefore, we are recommending to increase the production of electricity to meet the need of rising income, financial markets and urbanization. Our recommendations are aligned with the current project of Country's National Renewable Energy which is projected to generate the clean energy in mass production of energy mix which is expected to reach at 9.5 GW in 2023.

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