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The Impact of Urbanization on Energy Demand in the Middle East

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Abstract: This study examines the impact of urbanization on energy demand for a panel of eleven Middle Eastern countries over the period 1990-2012. To this end, panel cointegration and causality approaches are employed. Panel cointegration results indicate a co-movement between variables in the long-run. Cointegrating regression results show that a 1% increase in urbanization leads to a 0.49% increase in energy demand in the long-run. In terms of causality, results differ from short-term through long-term. While causality runs from energy demand to urbanization in the short-run; the direction turns out to run from urbanization to energy demand in the long-run.

Keywords: urbanization, energy consumption, Middle East.

JEL classification: R28, O13, C23.

1. Introduction

Pioneer studies in the field of energy economics were on the relationship between energy consumption and economic growth. However, it has been observed that energy consumption has increased rapidly along with economic development all over the world over the last a few decades. Urbanization, closely related to economic development and industrialization, has then started to become one of the driving forces of energy demand. With these developments, studies in the field have adopted some new variables into the model since 2010. One of the favorite variables in these augmented forms has definitely been urbanization.

Belloumi and Alshehry (2016) explain that the impact of urbanization on energy consumption may be positive or negative across the globe due to two opposite channels. Because urbanization leads to an expansion in the economy through pumping up aggregate demand, production and income, energy consumption may increase as a consequence. On the other hand, however, it may also generate economies of scale and lead to an increase in energy efficiency.

The aim of this paper is to investigate the relationship between urbanization and energy consumption in a panel of Middle Eastern countries. Although there are a good number of papers in the case of certain Middle Eastern countries and/or region itself in energy economics literature (see, for example: Sadorsky, 2011; Al-mulali, 2012; Ozcan, 2013; Aslan et al., 2014; among others), the number of the papers directly looking into the relationship between urbanization and energy consumption in the region is very limited. Al-mulali and Ozturk (2015) is the only paper, to the best of our knowledge, examining the impact of some set of variables including urbanization on energy consumption in the MENA region. Given the idea that measuring the impact of urbanization on energy consumption over a broader time period, the motivation of this paper is to focus merely on Middle Eastern countries and expand the literature in that way. By doing so, we will reflect of a unique picture of how this relationship looks like in the region and aim to contribute to the literature.

Rest of paper is organized as follows: section 2 reviews literature. Section 3 describes model and data. Section 4 presents methods and findings. Finally section 5 concludes.

2. Literature review

The number of the papers measuring impact that urbanization has on energy consumption and/or carbon emissions has grown steadily over the last a few years. Bulk of these studies have found that urbanization affects energy consumption/carbon emissions positively both for single country and for multi-country cases (see, for example: Karaca et al., 1995; Parikh and Shukla, 1995; Cole and Neumayer, 2004; Paumanyong ve Kaneko, 2010; Hossain, 2011; Al-mulali et al., 2012; Shahbaz et al., 2014; among others). Unlike the number of papers finding positive correlation, the number of papers that have found a negative impact (Sharma, 2011) is very limited. In addition to these studies, Sadorsky (2014) finds for a panel of emerging countries that the impact of urbanization on energy consumption is insignificant. Moreover, Martinez-Zarzoso and Maruotti (2011) report a curvilinear relationship between urbanization and energy consumption in developing countries. With the review herein, it is now apparent that majority of the studies have agreed on the finding that energy consumption increases with urbanization.

Once the topic is related to urbanization, energy economics literature conveniently offers a large number of single-country case studies on Chinese economy, in particular. Papers in the case of China, indeed, do not only use time-series to measure the impact in the economy as a whole (see, for example: Liu, 2009; Yuan et al., 2015; Zi et al., 2016; among others); but do also use panel data approaches to deal with provincial data (see, for example: Wang et al., 2016; Ji and Chen, 2015; Liu et al., 2015; Xu and Lin, 2015; among others).

Apart from regression analysis, there also exists some studies investigating this issue in terms of causality. Mishra et al. (2009) find a uni-directional causality from urbanization to energy consumption both in the short-run and in the long-run for a panel of Pacific Island countries. In the case of OECD countries, Salim ve Shafiei (2014) do not find a support of a causal running. Kasman and Duman (2015) report for the new EU members and candidate countries that causality runs from urbanization to energy consumption both in the short-run and in the long-run. Arvin et al. (2015) find a bi-directional causality between urbanization and carbon emissions in G-20 countries. In context of Tunisia, Shahbaz and Lean (2012) find a uni-directional causality running from energy consumption to urbanization in the short-run while there is no causality in the long-run.

3. Model and data

Consistent with empirical literature, energy consumption (e) is defined as a function of income (y) and urbanization (u) in existing paper.

$$e = f(y, u) \tag{1}$$

Equation (2) below augments panel data format of relationship presented in eq. (1)

$$e_{i,t} = \beta_{1i} y_{it} + \beta_{2i} u_{it} + \varepsilon_{it} \qquad (2)$$

where i signifies cross section (i=1,…..,N) and t signifies time dimension (t=1,….,T) of the model. Dataset consists of annual panel data observations spanning from 1990 to 2012. Ten Middle Eastern countries in the sample are Bahrain, Israel, Iran, Iraq, Jordan, Lebanon, Oman, Saudi Arabia, United Arab Emirates and Yemen. Due to data availability restrictions, cross section dimension is set out by including countries as many as possible. Likewise, time dimension is also limited with the period 1990-2012.

Energy consumption is measured as energy use in kg of oil equivalent per capita. Income variable s represented by GDP per capita measured in constant 2011 international $, PPP. Urbanization is represented by urban population measured as a share of total population. All data are gathered from World Bank (WB) World Development Indicators (WDI) database released by February 2016.

4. Empirical approach and findings

According to Granger and Newbold (1974), estimations with non-stationary variables may cause spurious regression and results based on those regressions might be biased. As a first step, therefore, one should determine whether the series have unit root before estimating any kind of empirical relationship.

Commonly used unit root tests in panel data econometrics are Levin, Lin and Chu (LLC hereinafter, 2002) and Im, Pesaran and Shin (IPS hereinafter, 2003) tests. Table 1 presents the results of LLC and IPS tests. In the light of these findings, null hypothesis stating series have unit root can not be rejected in the levels, but can be rejected in the first difference of all variables. Therefore, it can be concluded that series are integrated of I(1) with respect to both tests.

Table 1. Panel Unit Root Results

Variables	LLC	IPS
e	-0.594 [0.27]	2.276 [0.98]
y	-0.641 [0.26]	2.547 [0.99]
u	-1.103 [0.13]	3.813 [0.99]
Δe	-12.69 [0.00]	-13.42 [0.00]
Δy	-12.97 [0.00]	-11.12 [0.00]
Δu	-3.169 [0.00]	-7.493 [0.00]

Note: Tests are carried out with intercept. Δ represents lag operator.
Maxiumum lag length is chosen as 2 with regard to Schwarz Information Criteria (SIC).
Bandwidth is selected using Newey-West estimator considering Bartlett kernel in LLC test.
Values in brackets are probability values (p-values).

Having proved that all variables in the system are I(1), we can test cointegration among the variables in order to see if they move together in the long run. The most frequent analysis to test panel cointegration in panel data econometrics is Pedroni (1999) approach, which can be applied only if all the variables are integrated of the same order.

Table 2. Panel Cointegration Results

Dimension	Test	Value
Within group	Panel-v	-0.909 [0.81]
	Panel-rho	-1.884 [0.02]
	Panel-pp	-3.876 [0.00]
	Panel-adf	-4.156 [0.00]
Between group	Grup-rho	-0.481 [0.31]
	Grup-pp	-4.053 [0.00]
	Grup-adf	-4.288 [0.00]

Note: Test is carried out with intercept.
Maximum lag length is chosen as 2 with regard to SIC
Panel-v test is a right-tailed test while others are left-tailed.
Values in brackets are probability values (p-values).

Table 2 shows the results of Pedroni's (1999) cointegration test. Null hypothesis stating the no long-run relationship among variables is rejected for the majority of the tests. Therefore, it is proved that variables are cointegrated, which means energy consumption, income and urbanization move together in the long run. Once cointegration relationship is established, we can further estimate long term coefficients using Fully Modified Ordinary Least Squares (FMOLS, hereinafter). FMOLS regression results, reported in table 3, indicate that the impact of income and urbanization on energy consumption is positive, significant in the long-run. What is more interesting is that the magnitude is almost the same. A 1% increase in urbanization increases energy consumption by %0.493 while a 1% increase in come increases energy consumption by %0.491 in the long-run.

Table 3. Cointegrated Regression Results

Variable	*y*	*u*
Coefficient	0.491 [0.00]	0.493 [0.00]

Note: Values in brackets are probability values (p-values).

Following the estimation of long-run coefficients, it can be tested what is direction of causality between the variables under investigation. For this purpose, Vector Error Correction Model (VECM, hereinafter) seems as the appropriate technique in panel data framework based on Engle and Granger (1987) procedure.

Table 4. Causality Results

	Source of causation			
Dependent variables	*e*	*y*	*u*	*ect*
e		0.973 [0.32]	0.095 [0.75]	4.028 [0.04]
y	0.072 [0.78]		0.005 [0.94]	0.997 [0.31]
u	13.06 [0.00]	5.230 [0.02]		2.270 [0.13]

Note: Reported short-run statistics are F-Wald stats. Term "ect" denotes error correction term.
Values in brackets are probability values (p-values).

Table 4 reflects the short-run and long-run causality results based on VECM. In the lights of findings, although there is uni-directional causality both in the short-run and in the long-run, the direction of causality differs with respect over time period. While energy consumption and income Granger causes urbanization in the short-run; income and urbanization Granger causes energy consumption in the long-run.

5. Conclusion

This paper examines the relationship between urbanization and energy consumption in a panel of Middle Eastern countries. To this end, panel cointegration and causality techniques are employed based on annual observations ranging from 1990 to 2012. Panel cointegration results indicate a co-movement among the variables in the long-run. FMOLS results reveal that urbanization positively affects energy consumption in the long-run and a 1% increase in urbanization increases energy consumption by %0.49. Causality results, on the other hand, point out that causality runs from energy consumption to urbanization in the short-run. In the long-run, however, direction of causality is from urbanization to energy consumption.

Findings obtained from existing study are very consistent with those of previous studies. The positive impact of urbanization on energy consumption in the long-run is in line to the bulk of the literature, which points out that energy consumption rises as urbanization increases. In context of causality, the results are totally consistent with the results of Mishra et al. (2009) and Kasman and Duman (2015). In addition, while causality results are partially consistent with Arvin et al. (2015), they are completely contradictory with the results of Salim and Shafiei (2014) and Shahbaz and Lean (2012). As the focus of Shahbaz and Lean (2012) is merely on Tunisia, however, it does not seem likely that comparing two results could provide useful implications. Our results partially go in line with those provided by Al-mulali and Ozturk (2015) reporting a bi-directional causality between urbanization and energy consumption in MENA region. In addition, estimated long-run coefficient on urbanization variable in this paper is very close to those reported by Al-mulali and Ozturk (2015) whose estimated coefficient is 0,549 for the MENA region.

As policy guidance, policy makers in the region should consider urbanization as a significant determinant while targeting an energy conservation policy. They should keep in mind that energy saving policies would take a knock if perpetual increases are experienced in urbanization rate in the long-run. It is also useful to note that taking required measures related to urbanization could contribute to decrease region’s global gas emissions. And finally, as a future direction, following papers on this issue can estimate short-run parameters with the inclusion of more countries from the region. This attempt will definitely help policy makers in understanding what happens if unexpected sharp increases are experienced in urbanization rate in the short-run.

Endnotes:

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