The relationships and directions between electricity consumption and economic growth for four regions in China

XIAOQING MA [1] , RONG LI [2] , K L LO [2]

[1]School of Economics and Management, Shanghai University of Electric Power, No.2103, Ping Liang Road, Shanghai, China

[2] Department of Electronic and Electrical Engineering, University of Strathclyde, 204 George Street, Glasgow, G1 1XW, UK

Abstract

We investigate the relationship between electricity consumption and economic growth for four regions in China. The empirical results show that there are cointegration relationships and short-run bidirectional causality for the four regions. Over the long-run, there is bidirectional in the west, there is unidirectional causality running from economic growth to electricity consumption for the coastal region, whilst there is unidirectional causality running from electricity consumption to economic growth for the northeast and central area. The panel FMOLS estimates also support these results. This can provide a policy-making of demand forecasts and investment orientation in the short and long term.

Keywords: electricity consumption, economic growth, relationship and directions.

1. Introduction

1.1 Background

In the past two decades, China has achieved rapid economic growth in the world. The installed generation capacity in China amounted to more than 870GW and electricity consumption is more than 3600TWH. The coordination of electricity consumption and economy is crucial to sustain economic growth. Because of the differences of economic growth and industrial developments in different areas of China, this paper is attempted to investigate the relationship and causality between electricity consumption and economic growth in China by panel-based methods.

1.2 Literature review

Yang (2000), Narayan and Smyth (2005) , Ho and Siu (2007), Hu and Lin (2008) Odhiambo (2009) and Akinlo (2009)used standard Granger causality test to support that there was bidirectional causality between electricity consumption and growth in different countries.Narayan and Smyth (2009) employed panel methods on 6 Middle Eastern countries and they found bidirectional causality existed between electricity consumption and growth.

Shiu and Lam (2004) ,Yuan et al. (2008) asserted that there was a unidirectional causality running from electricity consumption to economic growth in China. Zhang and Cheng (2009) did not support the above opinion. Li et al. (2010) classified 30 China provinces into two parts, Wu et al. (2008) divided China into three parts (east, central and west parts) to investigate the relationship between energy consumption and economic growth.

1.3 Methodology

Firstly, in order to avoid spurious correction between LnEC and LnGDP, the paper uses panel unit root test to identify the order of each panel. Secondly, the paper tests the cointegration between these two variables in each panel by employing the heterogeneous panel cointegration test developed by Pedroni (1999). Then, the paper applies the panel vector error correction model to investigate the direction of the causal relation between the variables after establishing the cointegration relationship. Finally, to estimate panel long-run elasticity, the paper applies the fully modified and dynamic OLS techniques.

2. Definition of variable and classification of data

2.1 Definition of variable

This paper uses logarithmic electricity consumption ($\ln EC_{it}$) and logarithmic real GDP ($\ln GDP_{it}$, based on 1978's price) to stand for electricity consumption and economic growth of each province respectively for the 1985-2009 period (28 provinces excluding CHONGQIN, HAINAN and TIBET). The real GDP are converted by the nominal GDP. The nominal GDP data and GDP deflators are all from China Statistical Yearbooks (2010).

2.2classification of data

In order to reflect the difference in economic growth and electricity industry development in each province, 28 provinces are classified as four panels, which include 3 North-eastern provinces (Liaoning, Jilin and Heilongjiang), 7 better-developed provinces (Shanghai, Beijing, Tianjin, Zhejiang, Jiangsu, Guangdong and Shandong), 9 less-developed provinces (Fujian, Hebei, Hubei, Shaanxi, Shanxi, Sichuan, Henan, Hunan and Jiangxi) and 9 under-developed provinces (Neimenggu, Xinjiang, Qinghai, Ningxia, Anhui, Guangxi, Yunnan, Gansu and Guizhou). The classification of 28 provinces is based on GDP per head, industry production per head and industrial structure.

3.Empirical results and analysis

3. 1. Panel unit root test results

The results of panel unit root tests with and without time trend term for LnGDP and LnEC for four areas of China respectively. It can be inferred that the unit root hypothesis cannot be rejected when the variables are taken in levels. However, when first differences are used, the hypothesis of unit-root non-stationary is rejected at the 1%, 5% or 10% level of significance. Therefore, obviously, LnGDP and LnEC are I(1) process in each panel.

3.2. Panel cointegration test results

Table1. Panel cointegration test results

Within demension	Northeast	Coastal	Central	West
Panel v-Statistic	0.813	0.648	2.201**	1.798**
Panel rho-Statistic	-1.134	0.038	-1.438	-1.364*
Panel PP-Statistic	-1.896**	-0.059	-1.678**	-1.799**
Panel ADF Statistic	-1.849**	-1.269	-3.075***	-2.451***
Between dimension				
Group PP-Statistic	-0.208	0.293	0.044	-0.129
Group rho-Statistic	-1.492*	-0.175	-0.841	-0.948
Group ADF-Statistic	-1.478*	-2.085**	-3.536***	-2.453

Note: ***, ** and * indicates statistical significance at the 1%, 5% and 10% level, respectively.

3.3. Panel FMOLS results

For the different regions, a 1% increase in log electricity consumption leads to 1.83%, 1.22%, 1.26% and 0.97% increase in log GDP in the northeast, coastal, central and west regions, respectively. The significant high FMOLS values of northeast provinces indicate the need for separating this region.

Table2. FMOLS results(West)

	FMOLS	t-stat
Neimenggu	0.92 ***	27.51 ***
Xinjiang	0.88 ***	56.12 ***
Qinghai	0.76 ***	14.82 ***
Ningxia	0.78 ***	26.46 ***
Anhui	1.25 ***	15.64 ***
Guangxi	1.08 ***	78.56 ***
Yuanan	0.92 ***	29.59 ***
Gansu	1.30 ***	24.51 ***
Guizhou	0.85 ***	32.43 ***
Group-mean	0.97 ***	101.88 ***

Table3. FMOLS results(Coastal)

	FMOLS	t-stat
shanghai	1.38 ***	58.40 ***
beijing	1.35 ***	59.42 ***
tianjin	1.47 ***	37.47 ***
zhejiang	0.99 ***	24.63 ***
jiangsu	1.15 ***	17.08 ***
Guangdong	1.00 ***	47.95 ***
Shandong	1.23 ***	20.89 ***
Group-mean	1.22 ***	100.47 ***

Table4. FMOLS results(Northeast)

	FMOLS	t-stat
Liaoning	1.61 ***	28.54 ***
Jilin	1.98 ***	21.44 ***
Heilongjiang	1.88 ***	14.50 ***
Group-mean	1.83 ***	37.23 ***

Table5. FMOLS results(Central)

	FMOLS	t-stat
fujian	1.09 ***	31.13 ***
hebei	1.20 ***	21.14 ***
hubei	1.43 ***	24.46 ***
shanxi2	1.32 ***	34.25 ***
shanxi	1.10 ***	32.74 ***
Sichuan	1.50 ***	12.47 ***
Henan	1.16 ***	30.48 ***
Hunan	1.26 ***	24.47 ***
Jiangxi	1.27 ***	15.73 ***
Group-mean	1.26 ***	75.62 ***

Note: *** indicates statistical significance at the 1% level.

4. Conclusion and policy implications

4.1 Conclusion

We applies the panel data for log electricity consumption and log GDP for 28 provinces from 1985 to 2009. The results show that there are bidirectional causalities between electricity consumption and growth for each panel in the short-run. Over the long term, there are bidirectional causality for the west. For coastal provinces, the direction is running from economic growth to electricity consumption, while in the northeast and central provinces the opposite is true. Northeast and central provinces have higher long-run elasticity of electricity consumption to GDP than other provinces, and it also means their electricity efficiency is higher than other provinces.

4.2 Policy suggestions

Firstly, the electricity investment strategy-making should take account of the electricity elasticity and causality direction of different regions. In Northeast the government needs to encourage investment in power industry as a priority. The coastal region need to development irregular power generation. Central and west regions have bidirectional causality between electricity consumption and economic growth. Hence the government ought to promote the coordinated development of economy and electrical industry while they step up investment on power industry.

Secondly, consideration of the bottleneck of power supply, the industry option of these provinces should more incline to some low electricity and energy cost industries. The coastal region should quicken industrial structure update and adjustment, focus on the development of the third industry, the high electricity and energy consumption industries could be transferred to the central and west regions.

Thirdly, ultra-high-voltage (UHV) electric transmission can be treated as a feasible scheme to remit electricity surplus or deficit problem in different regions. With regard to these relatively developed provinces, the problem of lack of electricity always exists. Therefore, through constructing cross-regional ultra-high-voltage electric transmission network to remit electricity supply and demand imbalance among different regions is worth consideration.

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Corresponding author:

XIAOQING MA
Telephone: 15921299348
Mail:maxqing95@hotmail.com

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