Journal of Applied Sciences

ISSN 1812-5654

science alert

ANSInet
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Journal of Applied Sciences 13 (17): 3604-3607, 2013
ISSN 1812-5654 / DOI: 10.3923/jas.2013.3604.3607

China's Industrial Energy Intensity: Regional Differences and Influencing Factors

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Abstract: The sustainable development of China's economy has become a long-term strategy under the energy and environmental constraints. It is of significance to explore the changes and influencing factors of the industrial sector energy intensity for our energy reduction. By making use of 30 provinces and cities panel data, we conducted an empirical analysis of factors affecting industrial energy intensity. The results showed that the factors like firm size, institutional constraints, trade structure and economic development level have different impacts on the energy intensity in different regions.

Key words: Industry, energy intensity, energy consumption, influencing factors

INTRODUCTION

Under the background of that climate change has had a significant impact on the human environment and sustainable development, energy conservation has become a long-term implemented strategy in China (Yin and Shi, 2010). While China is faced with the dual contradiction of the development of economy and shortage of resources, it is an important part of energy saving and emission reduction to reverse the industrial department's image of high energy consumption but low efficiency. It is estimated that 1978-2000 China's energy consumption elasticity coefficient is less than 1 and the average growth rate of energy consumption is lower than the half of the average growth rate of GDP (Qv and Yuan, 2009). During the year 2000-2005, the average growth rate of national energy consumption is up to 12.4% which is much higher than the average growth rate of GDP by half. Where in 2005 the country's total energy consumption is 2.23319 billion tons of standard coal and the industrial energy consumption totaled 1.58058 billion tons of standard coal, the industrial energy consumption accounted for up to 70.8%. So, how to develop the analysis of industrial sectors energy efficiency and tell out the main influences of industrial energy consumption is vital to help China to establish effective policies and promote the emission goal achieved successfully.

Over the past years there has been an increase in the literature that deals with the energetic topic. The use of different angles and methodologies to study empirical questions is widely accepted in the literature. For instance, about the question that what makes China's energy intensity declined obviously these years, Sinton and Levine (1994) thought the change of energy efficiency as the main reason based on analyzing the 1980 to 1990 industrial sector data. Fisher-Vanden *et al.* (2004) and Zhang (2003) are all taken the that energy price, R and D input, industry structure or the less use of energy as the main reasons of the industrial energy intensity decreasing much. Miketa (2001) pointed out that the gross capital formation has important impacts on the energy intensity and having an increasing influence with the sectoral output increasing. Liao *et al.* (2007) viewed that the excess investment of some energy-intensive industrial had leaded to the conversion of industrial structure as the main reason. Hao (2011) used hierarchical clustering method, pointing out that the difference between China's high-energy intensity and low energy intensity industries sector's energy intensity was too large. By introducing the cost-benefit analysis he got that whether to further reduce costs or improve the main business revenue from principal operations were both able to effectively reducing the energy intensity of the industrial sector.

Domestic and foreign scholars had a lot research about a variety of factors which influenced the energy intensity by classifying the industrial sectors. The methods are mostly concentrated in the factor decomposition method, cluster analysis, the production function method or something which the scholars paid much attention on the industry level to analyze the internal energy intensity of the industry. In China, However, it is so vast a region with different resource endowments, economic structure and economic development level among different regions.

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INFLUENCING FACTORS: MODEL AND ANALYTICS

Variables and definition: In order to define each variable exactly, this study select 1650 samples of 30 provinces from year 2000-2010 as a panel date for observing which is based on other scholars studying. All the data come from the China Statistical Yearbook, New China 60 years material assembly, China areal statistics yearbook, China's industrial statistics yearbook and China Energy Statistical Yearbook.

Each variables defined as follows: $EI_{i,t}$ stands for industrial energy intensity, $EI_{i,t} = ENG_{i,t}/GDP_{it}$. $myjg_{it}$ for trade structure, $myjg_{it} = Ex_{it}/GDP_{i,t}$. $SYS_{i,t}$ for institutional factors, $SYS_{i,t} = Gy_{i,t}/GDP_{i,t}$ $ES_{i,t}$ for firm size and $Pergdp_{i,t}$ for economic development level, respectively $Es_{i,t} = GM_{i,t}/GY_{i,t}$ and $Pergdp_{i,t} = GDP_{i,t}/PN_{i,t}$.

Econometric model structure: Depart all the data of 30 provinces to three sectors according to the eastern, the central and the western regions. Then make use of the data group to establish a panel data model as follow:

$$EI_{j,it} = \alpha_0 + \alpha_{j1} myjg_{j,it} + \alpha_{j2} SYS_{j,it} + \alpha_{j3} ES_{j,it} + \alpha_{j4} Pergdp_{j,it} + \mu_{j,it} \quad (1)$$

Equation 1 j = 1, 2, 3, respectively represents the three regions and i is for provinces, t is for years. α_0 is for random area effects, $\mu_{j,it}$ is for random period effect, α_{j1}, α_{j2}, α_{j3}, α_{j4} stand for the changes of the IEI result from the alterations for trade structure, institutional factors, firm size and economic development level, respectively which reflects the influential degree of the industrial energy intensity clearly.

RESULTS AND DISCUSSION

According to Eviews 6.0, the sample data regression results are shown in Table 1.

Seeing from the tabular data in Table 1, it is of great difference for each factor to influence the regional industrial energy intensity. Reasonable r-squared R2 and adjustment r-squared R2 figures that the model we use functions well. The specific statistical analyses are listed as follows:

- The effects of Trade structure on every regional IEI show obvious difference. The higher proportion of the very industrial products export make up, the lower IEI of the eastern region will be, but it is just on the contrary to the central region. This situation may owe to the large scale adjustment and transfer of our country industry structure nearly 10 years. In fact, a lot of high energy consuming industrial enterprises in the eastern regions have transferred to the Midwest, especially the mid-area. More and more high energy consuming productions are produced in the central region which improves both the industrial products export volume and the total energy consumption so that the IEI rises sharply. At the same time, the eastern region makes fun use of the adjustment and transfer to develop its industrial structure, whose exports of manufactured goods conclude a great number of high-tech products and low energy consuming products (Liu *et al*., 2008)
- The effects of institutional factors on every region of the IEI are consistent. Except for the western region, these independent variables of another two areas perform significant positive correlations with the IEI value. Coinciding with the expected outcome, the high proportion of the state-owned enterprise value will reduce the energy efficiency which suggests the industrial enterprise exists plenty of low energy utilization efficiency and greatly prevents the IEI from decreasing. The reasons why this condition happens conclude two parts. On one hand, with the low efficiency of the state-owned enterprise management, the update speed of the industrial

Table 1: Regression results of empirical study

	Industrial energy intensity EI		
Variables	Eastern	Central	Western
α_0	4.338869*** (4.778154)	2.928639*** (3.229588)	7.874328*** (6.851027)
α_{j1}	-0.093364 (-0.278253)	15.07671*** (8.650634)	1.300087 (0.702185)
α_{j2}	2.474075*** (8.871456)	0.757682*** (2.393924)	0.391988 (0.672709)
α_{j3}	-4.348171*** (-4.450244)	-2.372480** (-2.162359)	-6.201389*** (-4.288355)
α_{j4}	-0.130065*** (-8.485790)	-0.483344*** (-7.095257)	-0.754711*** (-8.043254)
R-squared	0.736970	0.649645	0.735780
Adjusted R-squared	0.727900	0.632760	0.726669
Simple Size	121	88	121
Durbin-Watson Stat	1.456424	1.337313	1.268444

Data in the table are the coefficients and t-statistics. ***represents the variables reject the Null Hypothesis by 1% level, **by 5% level and *by 10% level

technology is very slow, especially not introducing effective energy saving technology and equipment in time. On the other hand, administration's controlled prices or subsidies policy of energy consumption may distort the market configuration of the elements and cut off the reduction enthusiasm of the energy conservation and emission

- The effects of firm size on the different regional IEI are of great consistent. It shows that the scale of the enterprise can significantly decrease the IEI value to a certain extent. The average scale of the Industrial Departments is in proportion to the energy utilization efficiency but in inversely proportion to the industrial energy intensity. It proves that industrial park, development zone or other industrial districts with big scale effect often can use clean produced technology to develop the energy efficiency which effectively reduce the consumption of energy industry strength
- The effects of the economic development level on regional IEI are in consistent direction. The promotion of energy efficiency developing in the western area is more obvious than of the eastern area. Regional economic development level significantly reduce the area industrial energy intensity, improve the energy efficiency and reduce the consumption of energy industry strength, because it does so good in developing capital, advanced technology and energy saving equipment that is widely used in the production process

CONCLUSION AND SUGGESTION

Based on the panel data of the30 provinces and cities in China, to make econometric analysis, this study studied the industrial energy intensity and their influencing factors among the three regions of the East, Middle and the West zones. The main conclusions are as follows (1) The industrial energy intensity of three major regions preformed significantly "gradient descent" from the west to the east, where the provinces with higher energy consumption in 2000-2010 are all in the western region while the lower provinces are mainly in the eastern region and (2) The measurement regression results indicated that recently the "industrial gradient transfer" which means the high energy consumption industries of eastern region moved to the central and western regions, has made the central region have more industrial energy consumption. Institutional factors with the eastern and central regions significantly correlated, but, overall, a larger proportion of state-owned enterprises clearly affected the level of regional industrial development and industrial energy efficiency. Concentration of above-scale industries and regional economic development level of regional industrial energy consumption strength is more significant. Among them, the level of economic development can prevent the industrial energy intensity from increasing which is obviously in the western region.

Based on the above analysis, to accelerate the transfer of the domestic and at the same time we should also control the industries with high energy consumption industries more strictly and to accelerate the domestic economic reform, for large system management inefficient SOEs it is necessary to resist the monopoly of state-owned enterprises may be effective ways.

ACKNOWLEDGMENT

This study is partially supported by the Scientific Research Common Program of the Major Public Bidding Project of National Soft Science (2012GXS1D003), the National Natural Science Foundation of China (71173006), New Century Excellent Talents in University (NCET-2012-0691), the Science and Technology Innovation Talent in University of Henan Province: (201008), Humanity and Social Science Foundation from Henan Educational Committee (2011-JD-018), the Major Project from HNUEL (2012-001).

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