A Summary of the Research on the Influencing Factors of Energy Consumption in China

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Abstract. Studies on energy consumption are growing expontionally in recent years. While the answers on the mainly driving factor on energy consumption are in question. This paper reviews the existing literature which mainly divided the affecting factors on energy consumption into 7 parts, and drew the conclusion as following: (1) there are many approaches being used to the studies, not only including the ordinary least squares, partial least squares, vector auto-regression, error correction, state space model, auto-regressive distributed lag model based on time series, but also including panel vector auto-regressive, panel co-integration, generalized moment method, panel smooth transformation method, spatial econometric methods, etc. based on panel data; (2) empirical results confirmed that the influence of the economic growth, financial development, foreign direct investment, import and export, industrial structure, urbanization and demographic factors on energy consumption in China;(3)the shortcomings of the existing researches lie in the empirical research too much which are almost based on macro data, while the researches are rare based on micro data and lacks mechanism description as well. In the future, with the development of modern econometric, newly empirical analysis methods and tools needs be used to investment the related issues being in question, and get the more robust conclusions.

Introduction

Energy is an important resource and material basis for human survival. Since the reform and opening up of China, the rapid development of Chinese economy, industrialization, urbanization, increase of energy consumption induce to, the energy shortage, which become a serious economic and social problems, which restricts the development of our social economy. With the development of industrialization, modernization, China became the world's largest energy producer and second largest energy consumer. If Chinese economy maintains rapid growth momentum in the coming decades, China huge energy demand will bring the environmental, economic, political, and a series of social problems. The studies on the main driving force behind the rapid growth of Chinese in-energy consumption, whether for the development of a long-term sustainable energy strategy or short-term energy saving, is of great significance.

Qian &Wang(2003)[1]deemed that energy demand or consumption depends on the factors of energy price, capital price, wage and output level. Li Yanmei(2007)[2] thought that households and firms demand for energy depends on many factors, the main factors affecting energy consumption includes energy prices, consumer income, consumer preferences, consumer expectations, climatic conditions,related infrastructure conditions technological progress, related policy, etc. Lang Chunlei(2011)[3]classified the factors affecting energy demand into economic factors, technical factors, institutional factors, and population factors In which, economic factors including economic growth, energy consumption structure, industrial structure, industrial structure, energy price changes, external economic factors and so on.

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The Effects of Different Factors on the Chinese Energy Consumption

Economic Growth and Energy Consumption.
Wang & Shen (2007)[4] established traditional linear regression model and spatial linear regression model to reveals the quantity relationship between Chinese provincial economic growth and energy consumption during 1999-2006. The empirical results show that Chinese regional economic growth and energy consumption has a significant positive correlation in the spatial distribution. Yu Yanping et al (2012)[5] studied the spatial correlation and heterogeneity in energy consumption among different provinces, as well as the mechanism of the spatial effects of economic growth on energy consumption et al by means of constructing Bayesian spatial econometric model. The results show that there exists a little strong correlation in energy consumption among all provinces, and the correlation tends to strengthen. In addition, Economic growth causes energy consumption to increase. Zhang Yantao(2012)[6] applied the unit root, cointegration and error correction models based on Fully Modified OLS(FMOLS), dynamic OLS (DOLS), canonical cointegrating regression(CCR) respectively to reinvestigate the causal relationship between energy consumption and real GDP for China during 1979-2008. The empirical results show that there is long run bidirectional causality between energy consumption and real GDP in China, while there is no causality between energy consumption to real GDP in short run. Wang &Long (2008)[7]established the threshold cointegration model to analyze the relationship between China's economic growth and energy consumption during1953-2006, and the results showed a non-linear forms of cointegration. He & Pan (2013)[8] applied panel smooth transition regression (PSTR) model to examine the nonlinear relationship between energy consumption and economic growth for 30 provinces in China from 1990 to 2011. Three nonlinear models show a positive relationship between economic growth and energy consumption in China.

Financial Developent and Energy Consumption.
Ren & Huang (2011)[9] constructed three indicators of financial development to study the relationship between financial development, economic growth and energy consumption. The results show that on the entire country level, there is close linkage between financial development and energy consumption. In which, There is a positive relationship between the energy consumption and the deposits and loans ratio of financial institutions, the credits ratio of the non-state owned sector and a negative relationship between the energy consumption and the Foreign direct investment (FDI) ratio. On the regional level the FDI ratio has significant negative impact on the energy consumption for the eastern regions; the impact of financial development on the energy consumption is not significant for the central regions; the financial interrelation ratio and the credits ratio of the non-state owned sector has significant positive impact on the energy consumption for the western regions. Muhammad Shahbaz et al(2013)[10] investigated the relationship between energy use and economic growth by incorporating financial development, international trade and capital as important factors in case of China over the period of 1971-2011. The autoregressive distributed lag model(ARDL) bounds testing approach to cointegration was applied to examine long run relationship among the series. The results show that financial development and energy use Granger cause each other. Wang Zhenhong et al (2014)[11]used the panel data of 30 provinces and cities in China during 2000-2011, by constructing a panel vector autoregressive(PVAR) model and using the impulse response function and variance decomposition, to empirical analyze the dynamic effect of financial development, urbanization and economic development for energy consumption. Research shows that the financial development has positive effect on long-term effects on energy consumption, financial related rate contribution to the fluctuation of energy consumption rate of 29.3%. Additionally, Markov Switching Vector Autoregressive (MS-VAR)is used to analysis of relationship between energy consumption and financial development nearly 30 years. Research showed that energy consumption had significant impact on financial development in regime two and regime three, and financial development would significantly affected the energy consumption in regime three. The result also show that energy consumption and financial development didn't exist bi-direction granger causality(Liu &Huang, 2014)[12].

FDI and Energy Consumption.

Yue Ting et al (2011)[13] decomposed energy consumption intensity change of Jiangsu Province from 1998-2008. And the energy consumption intensity was decomposed into FDI scale effect, FDI structure effect and FDI technology effect, using LMDI model. Decomposition and analysis results show that FDI scale effect reduces the energy consumption intensity. FDI structure and technology effect fluctuates and do not promote the reduction of energy consumption intensity on the whole. Su &Wang (2011) [14]constructed Panel VAR model and then used the provincial data of China from 1995 to 2008 to study the relationship between FDI and energy consumption intensity in China. The results show that there is the significant positive relationship between FDI scale and energy consumption intensity, but the effect decreases quickly with the time; the effect of FDI scale on energy consumption intensity is around 4.3%; there exists the significant inverted-U relationship between FDI scale and energy consumption intensity. Zhang Min et al(2012)[15] used the time series data during 1986-2009 to estimates the relationship between FDI from different region and Chinas energy consumption intensity. The results show that the impact of FDI share variation from different region on China's energy consumption intensity is quite different. Lei Jiang et al (2014)[16] used a panel of 29 Chinese provinces during the period of 2003-2011 to estimate the driving factors of energy intensity by means of a spatial Durbin error model and found FDI had a significant negative spatial spillover impact on energy intensity.

Import, Export and Energy Consumption.

Zhu Qirong(2007)[17]analyzed the relationship between the energy consumption and export in Shandong by means of cointegration and Granger causality test. The research concludes that the positive relationship between the energy consumption and the export is significant. Granger causality test shows that the growth of the export in the province not only impacts the energy consumption but also is subject to it. Based on data from 1978 to 2008, Su &Cai (2009)[18], used Granger causality test and two state threshold cointegration model to study on the relationship between export and energy consumption in China. Granger causality test shows that the existence of one-way Granger causality between the export trade and energy consumption. And estimation of the two state threshold cointegration model indicates that, export trade and energy consumption exist nonlinear cointegration, namely the change of export trade and energy consumption tends to long-run equilibrium relationship adjustment with noncontinuous characteristics, and the error correction speed of adjustment is not consistent; in two states, the export trade are greater than the energy consumption in response to the degree of error correction for the degree of response error correction. Zhao & Hong (2009)[19]used the input-output structure factors decomposition method to analyze the influence of foreign trade energy consumption on 1992-2002 years. The influence factors of energy consumption in China is divided into energy intensity effect, input-output structure effect, domestic demand effect, and net exports effect. According to the input-output table of 1992, 1997 and 2002, the researcher believed that China's foreign trade made the energy consumption reduced by 11823.58 tons of standard coal during 1992-2002.

Industries Structure and Energy Consumption.

Shi & Zhang (2003)[20] used multiple regression model to analyze the impact of industrial structure changes on energy consumption based on the time series of 1980-2000 years, the results showed that the structure change is an important factor affecting energy consumption, but because of the characteristics of various industries, different varieties of energy demand, influence and action direction structure change is not completely consistent. After 1995, the impact of industrial structure changes on energy consumption intensity has been on the rise. Chen & Ma (2009)[21] selected related indicators of 1991-2006 years, and used the factor decomposition model to analyze the impact of industrial structure changes on energy consumption in China, the results show that the effect of industrial structure adjustment on the impact of energy consumption is not very prominent, in the first few years of the industrial structure change reduces the energy consumption in a certain extent in early 1990 to 2002, the influence of industrial structure on energy consumption is bring is to raise the level of energy consumption, especially consumption of 2005-2006 years, the adjustment of industrial structure is higher, further analysis shows that, the influence of industrial structure on

energy consumption mainly comes from the industrial sector, and the impact of fluctuating. Shi & Liu (2014)[22] used the grey correlation approach to analyze the relationship between Chinese provincial energy consumption and the three industry, taking energy consumption and industrial structure data of China and individual province during 2005-2012 as the sample data, the results show that the third industry has the greatest impact on the national energy consumption, energy consumption of the whole country change with the third industry change. According to 1952-2012 data as the basis, Yin Shuo et al(2014)[23] constructed error correction model (VECM) to study the dynamic effect between energy consumption, industrial structure and energy efficiency of the three. The study found that, in the long run, the energy consumption and the change of industrial structure showing a positive relationship, show that the development of second, three industry to increase the impact on energy consumption significantly, and has extensive features.

Urbanisation and Energy Consumption.

Based on the Vector Auto-Regression model, Liu Yaobin (2007)[24] applied Granger causality model and cointergration analysis to test the dynamic correlations between development of urbanization and growth of energy consumption. The result shows that there exists not only a one-way Granger relationship but also a long-term relationship between urbanization and energy consumption. In current conditions, the contribution of urbanization to the energy consumption is smaller, and it's trend is decreasing. With 1996-2006 years of panel data of Chinese 30 major provinces, Cheng & Chen (2009)[25] used the level of urbanization as the explanatory variables, and total energy consumption, oil, coal, electric power as the explained variable, to examine the effects of urbanization on energy consumption. The results show that in the three regions, urbanization has significant positive effects on total energy consumption. However, the effects of level of urbanization on single species energy and total energy consumption are some differences in the three regions, namely, the effect of urbanization on total energy consumption, oil, coal, and electricity consumption presents gradually decreasing trend from the east to the west. Based on annual data over the period from1953 to 2011, Zhang &Dang (2013) [26] applies smooth transition regression(STR) model to analyze the relationship between Chinese urbanization and energy consumption. The empirical results show that the relation between urbanization and energy consumption can be expressed through the nonlinear LSTR2 mode1. When the speed of urbanization dropped quickly (decreasing rate higher than 2.39%) or rose quickly (rising rate higher than 15.37%), the nonlinear influence of urbanization on energy consumption will show. At this time the 1% change of urbanization will cause the change of 10.59% of energy consumption. Qiang Wang(2014)[27] empirically investigated the effects of China's urbanisation on residential energy consumption (REC) and production energy consumption(PEC) through a time-series analysis. The results show that compared with rural areas, urbanisation slows per capita REC growth because of the economy of scale and technological advantages associated with urbanisation, but has greater promotional effects on the growth of REC and the improvement of REC structure.

Population Structure and Energy Consumption.

Wu & Li (2008)[28]used spatial econometrics model and analyzes the energy consumption, and its influencing factors of China's provinces from 2002 to 2005 based on spatial samples of China' s 30 provinces. The results show that there is spatial interdependence of energy consumption of Chinese provinces, and the energy consumption behavior is influenced collectively by the province itself and its neighborhood. The positive influence of population growth on energy consumption cannot he ignored. Xing Xiaojun et al(2011)[29]used Granger test and cointegration analysis method to study the relationship among China's energy intensity, total number of population, population age structure and population structure of urban and rural distribution during1994-2008, the results showe that Chinese demographic dividend phenomena existes not only in production, but also exists in energy consumption, and per capita energy consumption in the urban area is far higher than that of the rural area. Fang Bin et al (2011)[30]extended the traditional IPAT model with latest China input-output table by combing the structural decomposition analysis (SDA) to analyze the impacts to China's increasing energy consumption caused by the population growth, production structure and residents' lifestyle change, The results indicate that the population growth has been controlled

effectively because of Chinese adopted the family planning policy. The population growth is very small to promote the growth of Chinese energy consumption between 1992 and 2007.

Collusion

To sum up, the existing literatures collected respectively different sample data, and used a variety of econometric method to analyze the quantitative relationship among economic growth, financial development, foreign direct investment, import and export trade, industrial structure, urbanization and demographic factors and energy consumption. From the perspective of methodology, based on time series data, there are many approach being used to the study including the ordinary least squares (OLS) regression, partial least squares regression (PLS), VAR, cointegration analysis and VECM, the structure factor analysis, structural mutation analysis, parametric and non parametric methods, the state space analysis, ARDL, simultaneous equation estimation, Granger causality test and Toda-Yamamota test, impulse response function and variance decomposition method; based on panel data, there are many approach being used to the study as well such as PVAR, panel cointegration analysis, generalized method of moment estimation (GMM), FMOLS, DOLS, CCR method, panel STR, spatial econometrics methods, etc. From the perspective of results research, empirical results confirmed that the influence of the economic growth, financial development, foreign direct investment, import and export trade, industrial structure, urbanization and demographic factors on energy consumption based on China's statistics data.

The shortcomings of the existing researches lie in the empirical research too much. However, there lack which influence mechanism description and theoretic model construction, so the next step, it is necessary to enrich this literature on such contents. In addition, the existing empirical studies are almost based on macro data, while the researches are rare based on micro data. In the future, with the development of modern econometric, newly empirical analysis methods and tools are constantly emerging, which can be used to investment the related issues being in question, then the more robust conclusions can be drawn.

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