The Research on the Energy Consumption and Energy Trading in China

Li Chong[1], Liu Xihua[1]*, Bai Xue[1], Zou Huijun[2], TO/MINH HUONG[1]

1:School of Economics, Qingdao University, Qingdao 266071, China
2:Qingdao Rural Commercial Bank, Qingdao 266071, China

Abstract
A good grasp of the relations between rapid economic development of China and stable energy supply is an important means to achieve coordinated development among energy, economy and society. This paper uses cointegration test, Granger causality test and vector error correction model, and other empirical method to analyze the relationship between the total amount of energy consumption and energy trade from 2000 to 2013, reveals that energy has a high degree of dependence on imported trade. The results showed that energy consumption has relatively strong positive impact on the energy business in the short term, then a weak negative effect in the long term. The impact of energy trading on the energy consumption is not significant in the short or long term.
Keywords: ENERGY CONSUMPTION, ENERGY TRADING, VECTOR ERROR CORRECTION MODEL

1. Introduction

A country's energy strategy includes strategic energy consumption and energy trading strategies. As of the end of 2013, the total energy consumption of China has reached 375,000 tons of standard coal. Total energy consumption now ranks first in the world (where coal consumption, oil consumption, gas consumption and hydropower, nuclear power, wind power consumption reached 247,500,69,000,21,750,36,750 tons of standard coal). Excessive energy consumption issue has been very prominent. If in accordance with our long-term economic growth target, that is, after 2020 the GNP quadruples on the basis of 2000 to fully achieve the goal of building a moderately prosperous society, then energy consumption will become a critical factor.

As of 2011, total net imports of energy reached 53,815 tons of standard coal, accounting for 15% of total energy consumption in the current year. While the proportion in 2000 was only 3%. That is in the period from 2000 to 2011 decade, the total energy consumption improved 2.39 times. The energy net imports has increased five times. Seen in this light, the rapid economic development and a steady supply of energy is imminent. Good grasp of the relationship between the two is an important means to achieve coordinated development between energy, economy and society, but also one of an important and urgent task.

2. Literature Review

In the study of energy consumption and energy trade, foreign researches are more mature. They studied energy consumption in a country or region using input-output method, and use structural analysis to study trade efficiency of energy consumption. Arye.L. Hillman and Clark W. Bullard (1978) [1] use Lenotief input-output method to study the energy consumption and energy trading; Lenzen (1998) [2] analyzed the Australian final consumption of primary energy consumption; Lenzen (1998) [2] analyzed the Australian final consumption of primary energy consumption; Sanchez Choliz and Duarte (2004)

[3] studied the carbon dioxide emissions caused by energy consumption in the Spanish economic development, evaluated the impact of the Spanish energy trade on energy consumption. In this regard, the domestic research relatively late. Dong et al (2006) [4] explored China's trade dependence on energy from the empirical point of view using Cobb Douglas production function; Hongwei Yang et al (2007) [5] discussed the high energy consumption and the energy shortage problem from a quantitative point of view; Li Li (2010) [6] provides a realistic basis for driving energy net imports of energy consumption; Zhang Bo (2014) [7] using VAR model, the Sino-Russian trade in energy factors were quantified analysis.

This article will use ADF unit root test, cointegration test, Granger causality test empirical analysis and vector error correction model to examine the relationship between the total consumption of Chinese energy and energy trade.

3. China's trade status and energy consumption

3.1. Situation of China's energy consumption

For the total energy consumption, the level of China's energy consumption enhances with the enhancement of the level of economic development. Since 1953, the total energy consumption has the overall upward trend. And since 2000, this upward trend is accelerating. In 1953, the total Chinese energy consumption is only 54.11 million tons of standard coal. To 2013, the total energy consumption of China reached 3.75 billion tons of standard coal. In sixty years it grew about seven times.

On the energy consumption structure, for consumption ratio of coal, oil, nuclear and wind power and hydropower, natural gas, although there is no fundamental change in status. But energy consumption structure has demonstrated a clear differentiation. In 1957, coal energy consumption accounts for the proportion of total energy consumption is as much as 92%. But by 2013 this proportion had fallen to 66%.The dependence of current social and economic development of China's on coal has been greatly reduced. At the same time, the proportion of oil consumption in the total energy consumption has improved significantly, which it ups from less than 5% in 1957 to nearly 20% in 2013. Hydro, nuclear and wind power consumption increased from 3% to 10%. Energy consumption share of natural gas increased from 0.1% to 5.8%. Thus, the proportion of Chinese consumption of conventional energy sources is in the gradual decline, while the proportion of new energy consumption is gradually increasing.

Table 1. Energy consumption type proportion of China and the major nationals

	Coal	Oil	Gas	**H**ydropower, nuclear power, wind power
United States	22.8	38.6	27.0	11.6
Canada	8.3	30.4	26.7	34.6
Germany	24.5	39.3	24.2	12.0
Japan	23.5	42.6	17.0	17.0
Korea	28.9	43.9	12.8	14.4
Brazil	5.2	46.2	8.1	40.5
Russia	13.0	19.7	55.2	12.1
Australia	42.6	35.8	19.4	2.2
India	52.4	31.7	10.0	5.9
China	70.6	18.6	3.7	7.1

On the energy consumption type, developed countries mainly use oil and gas, which has high energy efficiency, low energy consumption per unit of output and less pollutant emissions. And China is a coal-based country. In 2010 total energy consumption, the coal consumption accounted for 70.6%, while Japan is 23.5%, the United States was only 22.8 percent. During this period, the average level of world coal consumption is only 29.4%. Compared with the world's energy consumption patterns, China's energy consumption structure has serious type of irrationality.

3.2 Situation of China's Energy Trade

Since 2000, the total energy consumption of China were shown a substantial growth. But the

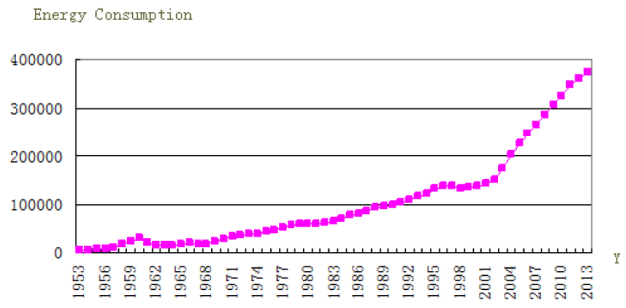

Figure 1. The trends of the total amount of China's energy consumption from 1953 to 2013

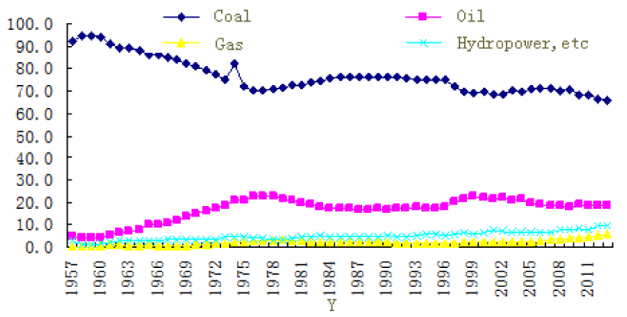

Figure 2. China's energy consumption structure

growth rate of total energy production is slower than the growth rate of total energy consumption. Thus, there is the downward trend of China's energy production to meet the overall presentation. From 2001 to meet the energy production rate of 95.66%, down to 2013's 90.67 percent. In 2007 the rate of production to meet the minimum value reached 88.15%. This fully shows that the gap in China's total energy consumption increased year by year.

Table 2. Comparison of China's total energy production satisfaction

Year	Total energy production	Total energy consumption	Production satisfaction (%)	Total coal production	Total coal consumption	Consumption of coal production satisfaction (%)	Total oil production	Total oil consumption	Consumption of oil production satisfaction (%)	Total gas production	Total natural gas consumption	Consumption of gas production satisfaction (%)
2000	135048	145531	92.80	98855	100707	98.16	23228	32308	71.90	3646	3202	113.89
2001	143875	150406	95.66	105029	102727	102.24	23452	32789	71.52	4029	3610	111.60
2002	150656	159431	94.50	110732	108413	102.14	23804	35553	66.95	4369	3826	114.18
2003	171906	183792	93.53	130992	128287	102.11	24239	38964	62.21	4641	4595	101.02
2004	196648	213456	92.13	151616	148352	102.20	25171	45466	55.36	5506	5336	103.18
2005	216219	235997	91.62	167786	167086	100.42	25946	46727	55.53	6487	6136	105.71
2006	232167	258676	89.75	180626	183919	98.21	26235	49924	52.55	7894	7502	105.23
2007	247279	280508	88.15	192136	199441	96.34	26706	52736	50.64	9149	9257	98.84
2008	260552	291448	89.40	200104	204888	97.67	27358	53335	51.29	10657	10784	98.82
2009	274619	306647	89.56	212280	215879	98.33	27187	54890	49.53	11259	11959	94.15
2010	296916	324939	91.38	227438	220959	102.93	29098	61738	47.13	12470	14297	87.22
2011	317987	348002	91.38	247394	238033	103.93	28937	64728	44.71	13673	17400	78.58
2012	331848	361732	91.74	253864	240914	105.38	29534	68006	43.43	14269	18810	75.86
2013	340000	375000	90.67	257040	247500	103.85	30260	69000	43.86	15640	21750	71.91

As China's most important source of energy, most of the production of coal still remain above 100%. This shows that China's coal production basically meets the domestic consumption demand. As one of the world's most important strategic resource, the total amount of oil production and oil consumption showed a steady growth trend. But faced with huge oil consumer demand, for oil production there is still a big gap, and the gap is showing a tendency to expand year by year. Although natural gas consumption in China accounts for a relatively small energy consumption. But taking into account the energy efficiency, low pollution and other characteristics, it is being paid more attention. Beginning in 2007, with the increasing use of natural gas amount. China's natural gas production satisfaction has a downward trend year by year. 2013 Production satisfaction has dropped to 71.91 percent.

From 2000 to 2013, China's imports of energy is rising, while lower exports and decreased energy, resulting in the last ten years China's energy net imports rising. Decline in energy exports on the one hand is mainly for that China is no longer primarily dependent on energy trade to promote economic growth, and on the other hand it consideres the strategic for energy security, to protect the stock of domestic energy, with no longer over-development, in order to provide protection to meet future demand for energy consumption.

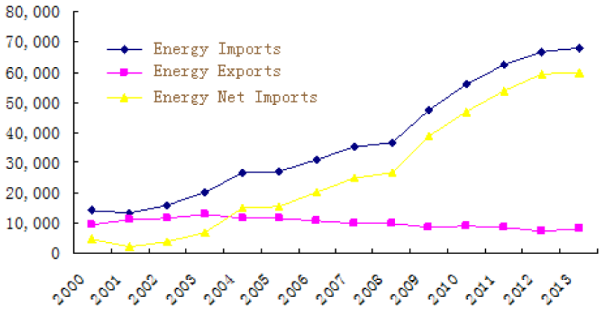

Figure 3. Chinese energy imports, exports and net imports (Unit: million tons of standard coal)

4. Empirical Research

By constructing the empirical model, we further study the relationship between China's energy consumption and energy trade in recent years, and analyzes the relationship between energy consumption and energy trading.

This paper selects the total energy consumption (Unit: million tons of standard coal), and the total amount of net imports energy (unit: million tons of standard coal) for energy consumption (ENCONSUM) and energy trading (ENTRADE) proxy variable, and the time span is 2000 to 2013.

4.1. Unit Root Test

The data of China's energy consumption and energy trade exists the same trend of changing, and the positive correlation between the two is also very strong. In order to prevent «spurious regression» problems, it needs do unit root test for the raw data, to determine whether the presence of unit root or stable.

Table 3. Unit root test outcome

Variable	T Statistics	1% Threshold	5% Threshold	10% Threshold	P	Conclusion
ENCONSUM	-0.082	-4.057	-3.199	-2.071	0.9324	Not stable
ENTRADE	-0.869	-4.057	-3.199	-2.071	0.7674	Not stable
D(ENCONSUM)	-2.571	-4.121	-3.144	-2.167	0.0849	Stable
D(ENTRADE)	-5.499	-4.121	-3.144	-2.167	0.0013	Stable

The level values of energy consumption and energy trading are not stable. Energy consumption of the first-order differential value D (ENCONSUM) rejected unit root null hypothesis at 10% (P value of 0.0849, less than 0.1) significance level, showing it is a stationary sequence. At the same time, energy trade of the first-order differential value D (ENCONSUM) rejected unit root null hypothesis at 1% (P value of 0.0013 , less than 0.0001) significance level, showing it is a stationary sequence. In other words, the level values of energy consumption and energy trade are not stable. But the first-order differential values are stable, ie both are first-order single time series.

4.2 Cointegration Test

This paper uses Trace test and Maximum Eigenvalue test to determine the long-run equilibrium relationship between energy consumption and energy trade. The results show that trace statistics and maximum eigenvalue statistic refused null hypothesis of cointegrating equation at the 5% significance level, namely that there is the presence of co-integration relationship between variables. Meanwhile, the test accepted the null hypothesis of the existence of a cointegrating equation at most, thought more than one cointegrating equation does not exist. Taken together, the two test results show that there is the presence of cointegration or long-term equilibrium relationship between China's energy consumption and energy trade variables.

Table 4. Cointegration test results of China's energy consumption and energy trade

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.912832	30.90220	15.49471	0.0001
At most 1	0.126517	1.623196	3.841466	0.2026

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.912832	29.27900	14.26460	0.0001
At most 1	0.126517	1.623196	3.841466	0.2026

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
*** denotes rejection of the hypothesis at the 0.05 level**
****MacKinnon-Haug-Michelis (1999) p-values**

4.3 Granger Causality Test

Do Granger causality test for China's energy consumption and energy trading data. Due to the requirements of Granger causality test data for a smooth data, while ADF unit root test results show that the previous first-order differential value of two variables is stationary series, therefore, we uses first order difference values of two variables to do Granger causality test.

From the results in Table 7, at the 10% significance level (p value of less than 0.1), energy trade is Granger cause of energy consumption, and energy consumption is the Granger cause of energy trade. This means that there may be interaction between the energy consumption and energy trade. Therefore, we can build the vector error correction model to further analyze the impact of significant.

Table 5. Granger Causality Test results of China's energy consumption and energy trade

Null Hypothesis:	Obs	F-Statistic	Prob.
DENTRADE does not Granger Cause DENCONSUM	12	3.97471	0.0887
DENCONSUM does not Granger Cause DENTRADE		3.13875	0.0776

4.4. Vector Error Correction

Although both variables are not stable variables, but because of long-run equilibrium relationship between the two, so you can use regression analysis. In this paper, the vector error correction model is used to study.

Cointegration equation is obtained of China's energy consumption and energy trade with the following results:

ENTRADE (-1)= -3850.361-0.088ENCONSUM (-1)+ut (1)
(749.38) (0.06760)

Calculation error correction model of Chinese energy consumption and energy trade. Model set lag order of 1 and 2, to study energy consumption and energy trading are influenced by which factors. Excluding the non-significant factors, final results of VECM are as follows:

D(ENTRADE)=17861.10+0.508 (ENTRADE(-1))
(3739.40) (0.1792)
+0.716D(ENCONSUM(-1))-0.288(ENTRADE (-1)+ 3850.361+0.088ENCONSUM (-1))+e t
(0.1998) (0.103)
[R2= 0.792, Adj. R2= 0.689, F-statistic=39.819] (2)

D(ENCONSUM)= 20058.98+ 0.359 D(ENCONSUM(-1))+ e t
(7344.91) (0.039)
[R2= 0.670, Adj. R2= 0.641, F-statistic=20.301] (3)

From the goodness of fit and adjustment of goodness of fit, the two equations have a high degree of fit. And the value of F statistic shows that overall linearity of both equations are significantly higher. This indicates that the vector error correction model constructed has a high robustness.

From the formula (2), energy trade is effected by itself with a positive effect with a impact factor of 0.508, while is effected by the previous period energy consumption with the positive impact ofimpact factor of 0.716.

From the formula (3), in the short term energy consumption is only affected by itself ofthe previous period, and long-term and short-term impact on energy consumption of energy trade is not significant.

Conclusions

Through the analysis of this paper we can find:

China's total energy consumption continues to rise. The reason is mainly rising energy demand due to China's economic development. From the point of view of energy consumption patterns, China mainly depends on coal energy, converse to oil energy in recent years gradually. The new energy consumption ratio has improved, but is still low relative to developed countries. The gap of cChinese demand for energy is higher and higher, and is more and more dependent on imports.

By calculated the net imports of energy. We found China's energy net imports is rising in the last ten years. This reflects a significant shift coal trade patterns and the general tendency of net imports, reveals a high degree of dependence on imports of Chinese energy trade.

Empirical studies shows that energy consumption has relatively strong positive impact on the energy business in the short term, then a weak negative effect in the long term. The impact of energy trading on the energy consumption is not significant in the short or long term.

Acknowledgements

This work is supported by the Key Project of National Natural Science Foundation of China (No. 71273148) and the fund of Natural Science of Shandong Province, China (No. ZR2010GM003).

References

1. Arye. L.Hillman, Clark.W.Bullard. Energy: the Hechscher Ohlin Theorem and U.S. International Trade[J]. The American Economic Review, 1978(3):96-106.
2. Manfred Lenzen. Primary energy and greenhouse gases embodied in Australian final consumption: an input-output analysis [J]. Energy Policy, 1998(26):495-506.
3. Sanchez-Choliz, J.,Duarte,R., CO2 emissions embodied in international trade: evidence for Spain[J]. Energy Policy, 2004, 32 (18):1999–2005.
4. Her-Jin Lim, Seung-Hoon Yoo, Seung-Jun Kwak. Industrial CO2 emissions from energy use in Korea: A structural decomposition analysis[J]. Energy Policy, 2009, (37): 686-698

5. Christopher L. Weber. Measuring structural change and energy use: Decomposition of the US economy from 1997-2002[J]. Energy Policy, 2009, (37): 1561-1570
6. Mac B, Stern DI. China's changing energy intensity trend : a decomposition analysis[J]. Energy Economics, 2008, (30): 1037-1053
7. T.Y. Chen J. Burnett C.K. Chau. Analysis of embodied energy use in the residential building of Hong Kong [J]. Energy, 2011, (26): 323-340
8. Shonali Pachauri, Daniel Spreng. Direct and indirect energy requirements of households in India[J]. Energy Policy, 2012, (30): 511-523
9. Reinders A.H.M.E., Vringer K., Blok K. The direct and indirect energy requirement of households in the European Union[J]. Energy Policy, 2013, 31(2): 139-153
10. Li Hong, Zhang Per Dong, He Chunyu, Wang Gang. Evaluating the effects of embodied energy in international trade on ecological footprint in Chian[J]. Ecological Economics, 2007, (62): 136-148
11. Allan J. A. Virtual Water: a Long Term Solution for Water Short Middle Eastern Economics? Paper Presented at the 1997 British Association Festival of Science [R]. University of Leeds 2007, (9): 519-520
12. Erik Dietzenbacher. Virtual Water and Water Trade in Andalusia: A study by Means of an Input-Output Model [R]. Working Paper, 2010: 259-267

Research on Commercial Bank's Personal Financing Business Usage Intention Model

Yuming Luo*

Department of Economics and Management, Luoyang Institute of Science and Technology, Luoyang, Henan, 471023, China.

Abstract
For deeply understanding of factors affecting consumer choice, using Technology Acceptance Model (TAM) for reference, the paper develops a model for commercial bank's personal financing business. The instance analysis indicates that the model and the result are effective and significant about consumer choice. In the future it is necessary to further extend effects factors. And to explore the relationship between various factors under different economic and financial environment changes will be a new direction.
Keywords: COMMERCIAL BANK, PERSONAL FINANCIAL SERVICES, INTENTION TO USE, TECHNOLOGY ACCEPTANCE MODEL, STRUCTURAL EQUATION MODELING.