[*A PROVINCIAL ANALYSIS OF ECONOMIC TRANSITION AND ENERGY CONSUMPTION IN CHINA*]

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Overview

China's economy has been growing at more than 10% per year on average for the last 30 years. In 2016, China accounted for 23% of the world's energy use and 28% of the world's energy-related carbon dioxide emissions. In recent years, as shown in the latest economic growth statistics and energy consumption data, China's economy has slowed down, with an average growth rate of 7.4% over 2011 - 2015. The annual average growth rate of China's primary energy consumption also decreased from 9% during 1980-2013 to 1% from 2014 to 2016. In addition, China's economy is undergoing a structural shift from secondary industry to tertiary (service) industry, with the secondary industry growing at a slower rate and starting to reduce overcapacity in key industrial sectors over the past decade. Tertiary industry (such as software industry, communications, education, and culture industry) has contributed more to the National Gross Domestic Product more than ever, representing about 52% in 2016.

Given the uncertainties that China is facing during its current economic transition and multiple ambitious goals on air quality improvement and carbon dioxide emissions reduction, it is important to examine the key drivers of China's energy consumption at the provincial level. A better understanding of these key drivers can help improve forecasts and evaluate policy that may change the path of energy consumption. This analysis examines the relationship between energy consumption, gross domestic product, economic structure, overcapacity in heavy industries, population, electricity price, and industrial energy intensity in China. By using provincial data from 1995–2015, the analysis captures inherent energy productivity gains during the economic transition from industry to service sectors both from a cross-sectional and time-series perspective, and provides valuable insight on the trend in future energy demand. This analysis contributes to the existing literature by capturing the impacts of economic transition, i.e. a structural shift to the tertiary sector, overcapacity in key heavy industries, and energy efficiency gains in the industrial sector.

Methods

We consider the following econometric model to examine the effects of current economic transition for energy consumption in China using provincial panel data: $y_{it} = Z_{it}\beta + \eta_i + \varepsilon_{it}$, where y_{it} is total energy consumption of province i in year t; Z_{it} is a vector of exogenous variables, including total GDP, industry composition, heavy industry capacity, population, electricity price, and industrial energy intensity; β is a vector of parameters; η_i represents the individual effect, capturing the idiosyncratic characters of each province; and ε_{it} is the error term. We used provincial fixed effects estimators in this model to regress energy consumption on total GDP, the share of tertiary sector value-added as of total GDP (tertiary share), crude steel output, cement output, population, electricity price, and industrial energy intensity.

We also estimated the elasticity of economic growth on energy consumption: $Lny_{it} = LnZ_{it}\beta + \eta_i + \varepsilon_{it}$. We regressed energy consumption on GDP, tertiary share, crude steel production, cement production, population, electricity price, and industrial energy intensity using the log-linear function for each variable (except for the tertiary share) using provincial fixed effects.

Results

Without adding industrial energy intensity, the results of both models show that all independent variables have significant effects on total energy consumption in both linear model (Model 1) and log-linear model (Model 2). After adding industrial energy intensity, all independent variables except for electricity price have significant effects on energy consumption in the linear model (Model 3), while only GDP, tertiary share, and industrial energy intensity have significant effect on energy consumption in the log-linear model (Model 4).

Table 1. Regression Results

	(1)	(2)	(3)	(4)

VARIABLES	Model 1: No EI	Model 2: Log-linear	Model 3: with EI	Model 4: Log-linear
GDP	0.422***	0.348***	0.483***	0.296***
	(0.0787)	(0.102)	(0.0792)	(0.0571)
Tertiary Share	-9,589***	-1.316***	-11,969***	-2.025***
	(3,379)	(0.263)	(3,747)	(0.323)
Population	0.693**	0.659***	0.599*	0.293
	(0.330)	(0.191)	(0.317)	(0.177)
Steel Production	0.706***	0.0435**	0.681***	0.00673
	(0.0876)	(0.0210)	(0.0849)	(0.00884)
Cement Production	0.227**	0.146**	0.177*	0.0397
	(0.0944)	(0.0604)	(0.0909)	(0.0338)
Electricity Price	-7,594***	-0.381**	-3,543	-0.121
	(2,155)	(0.150)	(2,376)	(0.0913)
Industrial Energy Intensity			5,087**	0.681***
			(2,368)	(0.0596)
Observations	620	620	620	620
R-squared	0.929	0.947	0.935	0.983
Number of Province	30	30	30	30

Conclusions

Given the uncertainties facing China's current economic transition, pressing concerns on air quality, and ambitious goals of CO_2 reduction, it is important to examine the trend of future energy consumption. This analysis attempts to examine the relationship between energy consumption, and GDP, economic structure, overcapacity in heavy industries, population, electricity prices and industrial energy intensity in China, using provincial level data from 1995-2015. The results of this analysis provide valuable insight on the trend in energy demand in the future, given that key features in China's economic transition are likely to continue in the foreseeable future.

Among the leading factors affecting energy demand, economic structural change is the most significant driver. A transition to the tertiary sector significantly reduces energy consumption. Industrial energy intensity reduction, an indicator for industrial energy efficiency gains, is another important factor that correlates with a lower growth rate of energy consumption.

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