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Economic growth, regional disparities and energy demand in China

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HIGHLIGHTS

- Development driving energy demand has different impacts on energy prices than others.
- EMI will reduce the response of equilibrium energy prices to local demand and production.
- Reducing transportation costs and improving marketization level enhance the role of EMI.
- More market competition and better physical and institutional connectivity are better.
- Policy implications to China may be extended to the East Asia Summit region.

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ABSTRACT

Using the panel data of 27 provinces between 1978 and 2008, we employed a instrumental regression technique to examine the relationship between economic growth, energy demand/production and the related policies in China. The empirical results show that forming a cross-province integrated energy market will in general reduce the response of equilibrium user costs of energy products to their local demand and production, through cross-regional energy transfer (including both energy trade and cross-regional reallocation). In particular, reducing transportation costs and improving marketization level are identified as two important policy instruments to enhance the role of energy market integration. The findings support the argument for a more competitive cross-province energy transfer policies and calls for more developed energy connectivity and associate institutional arrangements within China. These policy implications may also be extended to the East Asia Summit region where energy market integration is being actively promoted.

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1. Introduction

The past three decades have witnessed a rapid economic growth in China, mainly driven by two important factors including industrialization and urbanization. As one of the major inputs into these twin processes, energy demand has been strong over the whole period in China, outstripping domestic production and making the country a net importer of crude oil since 1993 and coal since 2007 (Shi, 2009). As such changes in energy demand due to economic growth is reshaping the pattern of energy trade flow among provinces in China, between China and its trading partners in the Asia Pacific region and even throughout the world,

this makes understanding future trends in Chinese energy demand a matter of both national and global importance (Lee, 2005; Lee and Chang, 2008).

Although there are benefits of hindsight with regard to the relationship between economic growth and its drivers and energy demand for a number of large advanced economies, such as the United States and the European Union, or from national aggregated studies, it is unclear which of these relationships, if any, is likely to be most relevant to understanding how economic growth and its drivers may affect total energy consumption and its distribution across provinces from a dynamic perspective in China. In particular, it is most likely that China's path of energy demand due to economic growth will be unique because of significant regional disparities in industrialization and urbanization that are not replicated elsewhere.

It is widely believed that examination of the impact of economic growth and its drivers on total energy demand in a large developing economy, like China, is still a challenging task, in

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particular from an empirical perspective (Shiu and Lam, 2004; Yuan et al., 2007, 2008). For example, the early studies used the aggregated time series data to examine the long-run relationship by using the co-integration technique developed by Engle and Granger (1987), but no consensus has been reached. Yuan et al. (2008) applied neo-classical production function to examine the relationship between energy consumption and economic growth in China and found that unidirectional causality running from energy use to economic growth. Similarly, Wang et al. (2011) reported that energy demand, capital and employment Granger cause economic growth. On the contrary, Zhang and Xu (2012) found that the causality is mainly running from energy use to economic growth.

To resolve the dispute, some recent studies have extended the aggregate-level analysis to the sub-national or sector level data (Akkemik et al., 2012; Li and Leung, 2012; Talha Yalta and Cakar, 2012; Zhang and Yang, 2013). After accounting for cross-regional and cross-sector heterogeneity, some studies (Akkemik et al., 2012; Li et al., 2011; Li and Leung, 2012) found that the causal relationship between energy consumption and economic growth can be recovered to some extent. Although progress has been made, the findings from those studies are generally sensitive to the econometric methods and data that have been used. (Akkemik et al., 2012; Talha Yalta and Cakar, 2012). In addition, these studies do not incorporate policy variables and thus the policy implications are more or less limited.

The conflicting results obtained from the existing literature arouse more research interests in the field and one emerging extension of the conventional analysis is to add economic development stages and the demand–supply equilibrium into the analysis (Ma and Oxley, 2012; Ma et al., 2009). A literature survey by Ma et al. (2010) pointed out that on the studies of economic growth, energy consumption and energy market integration (EMI) in large developing countries, there are still three issues remained to be explored: (1) the country may experience different stages of economic development and policy reforms over a short time period, which may impose different influences on the relationship between economic growth and energy consumption; (2) the country may have significant regional disparity in economic development, consumption preferences and regional policies, which have long been neglected in the study of aggregate energy demand; and (3) both the demand and production side factors can change independently and thus impose complex effects on equilibrium energy consumption price, which jeopardize the partial equilibrium analysis focusing only on demand or supply side (Ma et al., 2010).

Although more and more studies are carried out over time to test cross-regional convergence of equilibrium energy consumption prices (i.e., Ma and Oxley, 2012), there is, to the best of our knowledge, no study to quantify potential factors that could be used to explain the divergence in energy consumption prices across regions in China. The two other areas, the interaction between economic development stage and the nexus between economic growth and cross-province EMI are yet to be explored as well. As energy price plays an essential role in indicating the energy demand/supply relationship, studies at the province level will not be informative without accounting for changes in equilibrium energy consumption prices. Understanding whether there is convergence or divergence of energy product prices across regions may also help to provide useful insights on the extent to which EMI can play a role.

To fill this gap in literature, this paper aims at analysing the relationship between regional economic development mainly driven by industrialization and urbanization and its impact on changes in province level energy demand and examine the role of cross-province EMI in equalizing equilibrium consumption price of

energy products in China. The purpose is to clarify the role of integrated energy market in dealing with the gap between energy demand and supply due to imbalanced cross-regional economic development and resource endowment. Three questions are to be answered in sequence. First, how one can decompose the province level energy demand that is driven by economic growth (“development driving energy demand”) from total energy demand, given the absence of accurate, available data? Second, what is the impact of development driving energy demand on energy prices at the province level in China where there is already a relative integrated energy market? Third, how the other factors, such as cross-province disparities in transportation costs and market power, affect energy prices variation across regions?

Specifically, we employed the instrumental regression technique to examine the determination of equilibrium energy prices while accounting for both demand and supply side factors. Data used in this study covered 27 provinces in China over the whole reform period between 1978 and 2008. To emphasize economic growth and its impact on energy demand, we also split the energy demand due to industrialization and urbanization from other energy demand.

The results show that economic growth and its drivers are the most important factors affecting energy demand and its distribution across provinces in China in recent years. They raise the market price of energy products. Moreover, forming a cross-province integrated energy market has been significantly reduced the price effects of increased energy demand. This suggests that market integration help to smooth (reduce) the gap between energy demand and supply in specific regions. Finally, in addition to market integration, some regional specific factors such as transportation costs and market structure can also affect energy prices. Thus, public policies need to be carried out along with the market integration so as to minimize the negative impact of increased energy demand due to economic growth.

Contributing to previous literature, this paper, for the first time, explore the empirical relationship between equilibrium market price and energy demand/production driven by economic growth, using the trans-temporal and cross-province data in China. This helps to provide useful insights on the role of market integration policies in solving imbalance between energy demand and supply due to imbalance economic growth within China and East Asia. Second, we attempted to examine the impact of some policy related factors (such as marketization level and transportation costs) on energy prices by using cross-provincial data in China. This helps to quantify the equilibrium energy prices in market driven by energy demand and supply, and highlight the importance that future domestic energy policies may need to pay more attention to dealing with domestic market distortions through promoting competition and increase investment in public infrastructures. The results can be used to inform China's policy makers on possible choices to achieve a fully EMI.

The case study on China is also expected to have important policy implications for EMI in the East Asia Summit (EAS) region. EAS has been actively promoting EMI for a long time, but there is not a clear scenario about its future (Shi and Kimura, 2010, 2014). Like China, rapid economic growth has taken place in major East Asian countries over the past few decades and led to significant increase in energy consumption of those countries. In addition, there are huge disparities among EAS countries, among which the difference in income level were about 60 times in 2010 (World Bank, 2013). The disparities are also presented among China's provinces. EMI in China can be treated as an example of more advanced, if not full, EMI and thus may provide a possible scenario of the integrated market in the EAS region.

The remainder of the paper is arranged as follows: Section 2 discusses the relationship between economic growth and energy

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