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Is power generation really the gold measure of the Chinese economy? A conceptual and empirical assessment

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ABSTRACT

Amid widespread concern about the quality of the Chinese GDP data, power generation has become probably the single most cited indicator about the Chinese economy other than official statistics. For the first time, we provide an assessment on the efficacy of power generation as such an indicator, using both conceptual and empirical analyses. We show that (i) conceptually, it is somewhat misleading to use power generation as coincident indicator to infer the growth rate of GDP, due to the change of power intensity; (ii) empirically, power generation beats railway cargo and bank loan, the two other variables in the Li Keqiang index, as the best predictor in forecasting the Chinese GDP over the full sample; however, this superiority holds mainly during period of sharp change, i.e., the financial crisis period, but not when the economy is relatively stable, especially the current New Normal period. These two findings place important caveats on the common trust we have in power generation as an influential variable for measuring the Chinese economy.

> "Electricity production and consumption have been considered a telltale sign of a wide variety of economic activity. They are widely viewed by foreign investors and even some Chinese officials as the gold standard for measuring what is really happening in the country's economy, because the gathering and reporting of data in China is not considered as reliable as it is in many countries."
>
> – NY Times by Keith Bradsher, June 22, 2012

1. Introduction

Outside China's official statistics, probably no any other economic variable is more trusted than power generation (or power consumption)[1] among the people who care to monitor the Chinese economy closely. As shown by the epigraph, an important reason for such a trust comes from the widespread concern that the Chinese official economic data, especially GDP, may have been manipulated and thus are not reliable (e.g., Koech and Wang, 2012; Holz, 2014). This concern gets more serious when the economy slows down, and that, in turn, adds to the reliance we put on power generation and other real indicators.

The literature contains few, if any, empirical assessments of the efficacy of power generation as an economic indicator in China. Instead, the main line of studies are about demonstrating the (in) credibility of the Chinese output figures, especially GDP, based on power generation and others. This line of studies appeared as early as the 1990s (Rawski, 1993), and continues into today's New Economic Normal (e.g., Klein and Ozmucur, 2002; Mehrotra and Pääkkönen, 2011; Koech and Wang, 2012; Fernald et al., 2013). In these studies, power generation, along with other trusted indicators, is essentially used to establish a trusted benchmark against which the official GDP data will be checked.

In this study, taking the official data as given, we assess how effective power generation is in indicating the Chinese GDP. In contrast to the studies taking a stand with real variables such as power to check on the GDP, we take a stand with the GDP to check on power. We do so out of two motivations. First, despite concerns, the official data remain arguably the most authoritative figure about the Chinese economy. Its release delivers huge policy and market impact around the world (e.g., Kicklighter, 2014; GBTimes Beijing, 2017), and understanding the efficacy of power helps with the best way to assess and forecast that figure. Second, perhaps slightly subtle, while a questioning of the GDP figure may be justified, such a process faces its own challenges and needs to be based on a solid ground. An alternative view on power helps reveal the potential pitfalls in this process and thus a better way to infer

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[1] Smaller in quantity, power consumption is highly correlated with power generation. As power generation is more widely cited and available over a longer span, it is the primary concept we use in this study.

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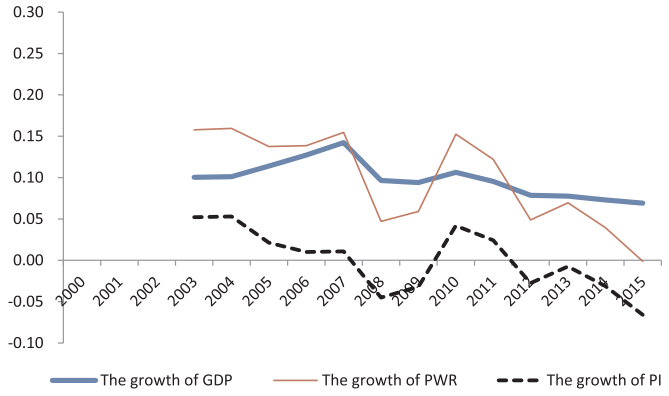

Fig. 1. Power intensity as a wedge between GDP and power generation. Note: PWR and PI stand for power generation and power intensity, respectively.

the true GDP.

To begin, our assessment starts with a conceptual examination on the theory foundation for the use of power generation as an indicator of GDP. To a large degree, our common trust of power generation is based on an intuition that is very well justified, nevertheless, without proper qualification, the intuition may be oversimplified and therefore misleading. Based on the notion of energy intensity, we develop a simple model to reveal the potential distortion involved in the use of power generation to infer GDP.

Further, we assess empirically the value of power generation for GDP forecasting. To make the empirical assessment relevant, we compare the power-based forecast to the following alternative forecasts. First, we compare the power-based forecast to the autoregressive (AR) forecast and Naïve no-change forecast. Second, more importantly, we compare the power-based forecast to two more forecasts based on bank loan and railway cargo, respectively. Loan and cargo are the other two Li Keqiang indicators that are also widely cited, albeit to a lesser degree.

The rest of this paper proceeds as follows: Section 2 develops a conceptual model for the relationship between power and GDP. Section 3 introduces the econometric model and data. Section 4 presents the forecasting results. Section 5 discusses the results. Section 6 concludes with policy implications.

2. Conceptual model

2.1. Conceptual model

Fundamental in the common use of power generation to gauge the economy is a very intuitive yet critical concept, i.e., power is an indispensable input of a modern economy, and therefore, a unit of GDP necessitates certain amount of power generation (PWR) in a given time interval, and without being said, certain here means constant. This concept is essentially the notion of power intensity (PI),[2] as shown in (1) and (2), interchangeably.

$$PI_t = PWR_t/GDP_t \tag{1}$$

$$PWR_t = PI_t \cdot GDP_t \tag{2}$$

Where t is the time interval over which both GDP and power generation are measured. Obviously, when PI is constant, the growth rate of GDP is equal to that of PWR. The constancy of power intensity, however, is not guaranteed in reality, especially in the case of China over the past decade (Zhang, 2003; Liao et al., 2007; Chai et al., 2009).

To show how the change of power intensity complicates the relationship between GDP and power generation, we attempt the following derivation. Re-expressing the quantities in (2) in terms of increments from the previous period, we obtain (3).

$$PWR_{t-1} + \Delta PWR_t = (PI_{t-1} + \Delta PI_t)\cdot(GDP_{t-1} + \Delta GDP_t) \tag{3}$$

Multiplying and dropping the second order term lead to the following equation

$$\Delta PWR_t \approx \Delta PI_t \cdot GDP_{t-1} + PI_{t-1}\cdot\Delta GDP_t \tag{4}$$

Further manipulations then give the next equation

$$\frac{\Delta GDP_t}{GDP_{t-1}} \approx \frac{\Delta PWR_t}{PI_{t-1}\cdot GDP_{t-1}} - \frac{\Delta PI_t}{PI_{t-1}} = \frac{\Delta PWR_t}{PWR_{t-1}} - \frac{\Delta PI_t}{PI_{t-1}} \tag{5}$$

That is,

$$\Delta GDP\% \approx \Delta PWR\% - \Delta PI\% \tag{6}$$

Ignoring any dynamic effect, or when a time interval is long enough, (6) tells us that the growth rate of GDP does not equal the growth rate of power generation; instead, it equals the growth rate of power generation minus that of power intensity. In other words, when power intensity rises ($\Delta PI\%$ is positive), using power generation to infer the economy results in an overestimation of the GDP growth; when power intensity declines ($\Delta PI\%$ negative) as has largely been the case for China over the past decades, an underestimation occurs.

2.2. Fit to data

We contrast the above model to the data to show how the model holds in the case of China over the past decade and more, as presented in Fig. 1. GDP and PWR are accessed from China National Bureau of Statistics (CNBS) in annual frequency, and power intensity is computed by us according to (1). As shown, between 2003 and 2015, the growth rate of power intensity fluctuates and gives a range from − 6.5% and + 5% roughly. This fluctuation is like a wedge. If the fluctuation is zero, then PWR and GDP growth rate would simply be identical in static sense. However, it is usually not zero, and once ignored, the power-based inference of GDP growth rate can be quite inaccurate.

While the above model provides a clear description of the relationship in a static sense or for the case of low frequency data such as annual data, it does not account for potential dynamics between power and output. A further issue is when we go to higher frequencies, e.g., quarterly or monthly, whether power generation generates useful information for GDP forecasting. We evaluate this issue in the rest of this paper.

3. Econometric model and data

To assess the efficacy of power for GDP forecasting, we compare it to two benchmarks. First, we compare power-based forecasting to the forecasting based on no other information except GDP itself. This forecasting includes two particular types: the forecasting based on AR model, and the forecasting based on the Naïve approach. The Naïve forecasting assumes that GDP growth follows a random walk process and takes the current period value as the best prediction for the future. We expect that power-based forecasting will beat this benchmark if power generation does provide useful information about GDP. Second, we compare the power-based forecast to those based on two other measures in the Li Keqiang index, railway cargo and bank loans, respectively. This comparison is more relevant and will tell us whether power generation is a more preferable indicator than the other two. It is for this second comparison that we need to introduce a model encompassing information other than GDP itself. We explain the model below.

[2] On the definition of power intensity, power consumption, not generation, may be used according to typical energy literature. As their values are very close (see also footnote 1), and for avoiding confusion, we have consistently used the term power generation in this study. However, when we fit the conceptual model to real data in Section 2.2 (including Fig. 1), we actually have used power consumption data, not power generation, to be in line with the typical definition of energy intensity.