Regional electricity demand and economic transition in China

LIN Jiang, LIU Xu, HE Gang, and GUO Jin
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Outline

- Research Question
- Literature Review
- Models
- Regression Results
- Discussions
- Conclusions
Decoupling of GDP and electricity

• Re-assessing China’s electricity demand under the economic “New Normal”

• Is the slowdown in electricity consumption a temporary phenomenon or a long-term trend:
  o Slower economic growth
  o Significant shift in economic structure from industry to services
  o Reduction of overcapacity in major industries
What is the relationship between economic growth and electricity use?

Increase, fast growth

Slower growth

Plateau over time

Journal article: Economic rebalancing and electricity demand in China
Projections on electricity consumption in 2020 varies.
Literature on electricity consumption and economic growth focuses on causal relationship and influential factors

1. The causal relationship between electricity consumption and economic growth

   (1) Mixed results on the causal relationship between electricity consumption and economic growth both for China and other countries.
   - Two studies reviewed found no causality relationship between electricity consumption and GDP in China
   - One found short-run or little unidirectional causality from GDP to electricity
   - Three found unidirectional causality from electricity consumption to GDP

   (2) The causal relationship varies across provinces

   (3) Electricity consumption reduction in China is the result of economic structural optimization and industrial transformation

   (4) More quantitative empirical research is needed
2. the influence of different economic variables and/or demographic variables on electricity consumption, as well as electricity forecasting – our focus

(1) An early China study

Lin (2003), national study.
- Study period: 1978–2001
- Elasticities of GDP, fuel price, population, economic structural change, and energy efficiency on electricity consumption: 0.78, -0.016, 0.565, -0.527, and -0.332 respectively

(2) Two recent provincial level study considering the economic new normal

Ge et al. (2017), Anhui province.
- Positive effects: real GDP, industrial structure, heating degree days, cooling degree days, and investment in fixed assets,
- Negative effects: energy intensity and financial development
- Main contributor: industrial structure

He et al. (2017), Tianjin.
- Main driving force: the tertiary industry instead of energy-intensive industries.
Models

- **Linear:** \( y_{it} = Z_{it}\beta + \eta_i + \varepsilon_{it} \)

- **Log-linear:** \( \ln y_{it} = \ln Z_{it}\beta + \eta_i + \varepsilon_{it} \) (elasticity)

  \( y_{it} \) is total electricity consumption (TotalETWh) of province \( i \) in year \( t \);

  \( Z_{it} \) is a vector of exogenous variables, including total GDP, industry composition (tertiary share), heavy industry capacity (crude steel production), and population;

Note: for the log-linear function, industry composition was not transformed to log form.
## Regression Results

<table>
<thead>
<tr>
<th></th>
<th>Linear Model</th>
<th>Log-linear Model</th>
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<tbody>
<tr>
<td><strong>GDP</strong></td>
<td>0.0095*** (0.0003)</td>
<td>0.882*** (0.022)</td>
</tr>
<tr>
<td><strong>Tertiary Share</strong></td>
<td>-64.96*** (22.25)</td>
<td>-0.881*** (0.177)</td>
</tr>
<tr>
<td><strong>Crude Steel Output</strong></td>
<td>0.0049*** (0.00039)</td>
<td>0.056*** (0.012)</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>0.0097*** (0.0019)</td>
<td>0.588*** (0.119)</td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td>0.91*** (0.23)</td>
<td></td>
</tr>
<tr>
<td><strong>Province dummy</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-1856*** (457.6)</td>
<td>-8.71*** (0.97)</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.9684</td>
<td>0.9777</td>
</tr>
<tr>
<td><strong>No. observations</strong></td>
<td>620</td>
<td>620</td>
</tr>
<tr>
<td><strong>Estimation</strong></td>
<td>LSDV</td>
<td>LSDV</td>
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</table>

1. One unit change of GDP significantly increases electricity consumption
2. Tertiary share has significant negative effects on electricity consumption
3. Elasticity of crude steel production on electricity consumption is not very large
Projected electricity consumptions are similar to those of the 13th FYP

Electricity consumption AGR (2015-2020)

13th FYP: 3.6%-4.8%
Model: 3.2%-5.2%
Industrial structural change contributes to significant reduction in electricity consumption

Contribution of GDP, structural change, overcapacity, and population to the annual growth rate of electricity consumption by 2020

- **GDP**: 4.38% contribution to an increase of 0.35% in annual growth rate
- **Population**: 4.73% contribution to an increase in annual growth rate
- **Tertiary Share**: 3.19% contribution to an increase in annual growth rate
- **Crude Steel Output**: 3.07% contribution to an increase in annual growth rate
- **Annual Growth Rate**: Overall contribution to the annual growth rate of electricity consumption
Conclusions

• GDP is the most significant driver for demand growth for power, followed by economic structural change, population growth and industrial de-leveraging.

• Electricity demand growth is clearly slowing down, and there is significant uncertainty in the future growth.

• A more transparent, robust, and dynamic planning methodology and process is essential.

• China should consider other market instruments to help meet its reliability need, and guide investment decisions.

• Future research should consider impact of electrification, and efficiency
Thank You!

Jiang Lin
J_lin@lbl.gov

China Energy Group
Lawrence Berkeley National Laboratory
Berkeley, CA 94720
http://china.lbl.gov
http://btjrc.lbl.gov