How might interprovincial migration affect the impact of China’s energy policies?

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Summary
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- The Chinese government is considering two potential policy approaches for managing national energy use and associated carbon emissions in future Five-Year Plans (FYP): an energy intensity target and an energy cap. This study is focused on examining the effect of migration on these two policies.
- China is experiencing large interprovincial migration. (Box 2)
- Large share of migration is from energy intensive provinces to ‘cleaner’ provinces. (Box 3)
- To examine the effect of migration on policies, we combined the China Regional Energy Model (C-REM) with an econometric migration model. (Box 3 & 4)
- The model predicts future interprovincial migration to rapidly peak by 2015-2020, but remain important. (Box 6)
- If migration is ignored or underestimated in the design of the policies, the energy cap will put more burden on eastern China and energy intensity targets will put more burden on middle and west. We compare the two policies under uncertain migration and find the energy intensity target to be more robust. (Box 7 & 8)
- Future work will focus on estimating the impact of urbanisation (Box 9)

China Regional Energy Model (C-REM)
4
- C-REM is a multi-regional, multi-sector, recursive-dynamic, computable general equilibrium (CGE) model. The model is one of the major analysis tools developed by the China Energy and Climate Project (CECP). The primary goal of the model is to analyze the impact of existing and proposed energy and climate polices on China on technology, inter-fuel competition, the environment, and the economy. The model details 30 provinces of China. Since migration in China is large, combining C-REM with a migration model results in much stronger analytical capacity. The sectorial and regional aggregation is shown below:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Energy</th>
<th>Gas</th>
<th>Coal</th>
<th>Oil</th>
<th>Electricity</th>
<th>Water</th>
<th>Non-energy</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-REM</td>
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Migration results
6
- Total interprovincial migration will peak in 2010-2015 at around 90 million. The predicted decline in total migration is caused by diminishing wage differentials, as the GDP growth rates in out-migration provinces are higher than in the in-migration provinces (shown below).

Net interprovincial migration between 2005-2010
2
- Largest interprovincial migration flows are from the middle provinces to the eastern coastal provinces.

Migration prediction model
3
- Base year data: 2007 world IO table from GTAP database, provincial IO table, resource and energy data from Chinese National Statistic Bureau.
- This study is the first dynamic implementation of the model. The model steps are 2007, 2010, 2015 and 2020. We use 2010 data to calibrate the model.
- Trade between regions follows the Armington assumption (including electricity transport).
- Energy consumption is defined as direct secondary energy use.

Combination of the two models
5
- The combination of the two models uses a recursive dynamic mechanism. Changes in population predicted by the migration model will determine the labor supply in the economic model. Because of limited data availability, we assume migration does not affect the average labor productivity and labor participation.

Policy robustness analysis
8
- We define three scenarios to compare the robustness of the policies:
  1. No Migration (ENN). We design both the energy cap and energy intensity policies such that they are identical if no migration takes place, and reflect the 12th FYP.
  2. Energy Cap policy With Migration (ECM). This scenario imposes the same provincial energy caps as in (1) and adds migration.
  3. Energy Intensity policy with Migration (EIM). This scenario imposes the same provincial energy intensity targets as in (1) and adds migration.

At national level:
- Energy intensity targets will lead to higher GDP and lower energy consumption, and thus dominates the energy cap overall. There are several reasons for this:
  1. Fixed energy resources are mostly located in the out-migration middle and west. Energy intensive industries will not move out of these provinces as fast as the migrants.
  2. The east is richer than middle and west. If facing a tough target, it will have a better chance to move its heavy industries to the middle and west, which is against the original intention of the policy design.
  3. The industrial structure of middle and east is different. If people move to the east, they will more likely work in a less energy intensive sector, e.g. service sector.
  4. Energy use reductions are cheaper in the middle and west.

At provincial level:
- Comparing the welfare change between these two scenarios, we find that the energy intensity targets lead to smaller deviations and are thus more robust than caps (see below)

Future research
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- Changes in household energy consumption patterns associated with migration and income changes.
- Investigate the impact of the urbanization process on energy consumption and energy policy design.

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