TRANSPORTATION ENERGY DEMAND AND EMISSIONS IN CHINA'S PROVINCES TO 2030

Paul Natsuo Kishimoto, Massachusetts Institute of Technology, +1 617 302 6105 <pnk@MIT.EDU>
ZHANG Da, Tsinghua University, +86 10 5153 7222 <zhang-d05@mails.tsinghua.edu.cn>
Valerie J. Karplus, Massachusetts Institute of Technology, +1 617 800 7982 <vkarplus@MIT.EDU>

Overview

Transportation is a rapidly growing component of China's energy system, although it currently contributes a smaller share of greenhouse gas emissions than in other countries. China's economy continues to grow rapidly, despite despite efforts to make growth more environmentally sustainable and shift the driver of GDP growth from investment towards domestic consumption. The transport sector participates in, and is affected by, these broader trends. Future energy demand associated with transportation raises energy security concerns, and externalities of transport activity—notably congestion and local air pollution—have prompted overlapping policy responses by central, provincial and local government actors.

In order to provide salient and credible forecasts of future transport demand and its associated energy use and impacts, it is important for models to reproduce the regional disparity within China in economic structure and levels of development. Large differences in per-capita GDP determine households' ability to purchase and fuel vehicles, which they may prefer to public or commercial passenger transport. Resources (especially coal), light and heavy industry, and services have very different shares of output in each province, and demand freight transport services in different degree. Provinces also differ widely in levels of development, a gap that central government policy aims to address.

This paper contributes a methodology and baseline projections for studying the combined effects of growth, regional heterogeneity and policy on transportation in China at the provincial level. We also demonstrate how a representative policy impacts the transportation sector.

Methods

The China Regional Energy Model (C-REM) is a multi-sector, multi-region computable general equilibrium model of China's economy, with extensive supplemental physical accounts for energy and CO_2 emissions. A *static* version of C-REM (calibrated to 2007 data) has been described (**?**), and has been applied to study transportation and its energy demand through addition of sectoral detail in the transport sectors (**?**).

We describe a recursive-dynamic version of the model which forecasts forward from 2007 through 2030 in 5-year time steps (2010, 2015, etc.). Overall GDP growth for its 30 China regions is calibrated to match observations in 2010, and produce 2015 figures consistent with observed growth between 2010–2013. Similarly,

we describe how model quantities for the outputs, mode shares and energy demands of five transport sectors—road and non-road freight; road and non-road passenger; and household private vehicle transport—for the same time periods compare with provincial-level data that we collect or assemble.

We then project transportation activity through 2030 for each Chinese province, within this full-coverage, multi-regional framework. We also implement representation of a transport sector–specific tax road sector output, to examine the effects within our dynamic framework.

Results

We present results at the provincial level in economic and physical units, including freight tonne-kilometres and passenger-kilometres by road and non-road modes. We also project stocks of private vehicles and their total distance driven, and the fuel energy use and CO_2 emissions associated with each transport sector. Performing counterfactual analysis with the policy instruments, we compare changes in overall & per-capita GDP, a consumption measure of welfare, and the same transport indicators, to study provincial transport system responses.

These results offer increased detail both on previous recursive-dynamic CGE forecasts of Chinese transport that treated the country as a whole (e.g. **?**), and previous static regional analysis.

Conclusions

Our work produces estimates of future energy demand and CO_2 emissions from transportation, and will show how Chinese provinces' contributions change over time. We will examine whether changes in the broader economic context cause poorer provinces to experience transportation development pathways which are distinct from those historically shown in wealthier provinces. This knowledge is important to discussions between local, provincial and central government policymakers which determine the contribution of individual jurisdictions towards national-level environmental, energy and economic targets.

We will also discuss potential applications and refinements of the modelling capacity developed—for instance, the study of local air pollutant emissions associated with transportation energy use.