



# Evaluating China's road to prosperity: A new economic geography approach<sup>☆,☆☆</sup>

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## ABSTRACT

Over the last two decades, China has embarked on an ambitious program of expressway network expansion. By facilitating market integration, this program aims to promote efficiency at the national level and contribute to the catch-up of lagging inland regions. This paper evaluates the short-run aggregate and spatial economic impacts of network expansion. We adopt a counterfactual approach based on the hybrid estimation–calibration of a structural ‘new economic geography’ model. Overall, we find that aggregate Chinese real income was approximately 6% higher than it would have been in 2007 had the expressway network not been built, although this does not take into account the opportunity costs associated with expenditure on the network. Although there is considerable heterogeneity in the results, we find no significant reduction in disparities across prefectures and no reduction in urban–rural disparities. If anything, the expressway network appears to have reinforced existing patterns of spatial inequality; although, over time, these will likely be reduced by enhanced migration.

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## 1. Introduction

Integration of a country's lagging with its leading regions has long been viewed by policymakers both as central to the ability to compete in international markets and as a means to reduce spatial inequalities which might compromise social cohesion. One of the most obvious and potent tools for promoting internal market integration is investment in a country's transport network. Despite governments around the world investing considerable resources in both the construction and maintenance of such networks, however, relatively little is known about their overall economic impacts or their impacts on spatial patterns of inequality.

The aim of this paper is to contribute, at both a methodological and empirical level, to the modeling and understanding of the aggregate and spatial economic impacts of large-scale national transport

projects. The paper investigates the national and spatial impacts of one of the most ambitious national transport projects undertaken in modern times – the construction of China's national expressway network (NEN). This 41,000 km network, which is second in length only to the United States' Interstate Highway System, is designed to eventually connect all Chinese cities with a population of more than 200,000 (World Bank, 2007).<sup>1</sup> Its construction, which was concentrated in the period 1997–2007, has formed an important part of China's national development strategy, having as its goal not only enhanced intra-national trade, but also the accelerated development of the country's poorest inland regions with the aim of promoting their catch-up with the country's leading coastal areas.<sup>2</sup>

Given the NEN's scale, we believe that a systemic approach to the evaluation of its national and spatial economic impacts is most appropriate. Our evaluation methodology is explicitly grounded in a structural new economic geography (NEG) model of the Chinese economy. Although the main ingredients of this model are already well-known (see

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<sup>☆☆</sup> The title was inspired by that of Fernald (1999).

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<sup>1</sup> Since 2007 expansion of the network has continued with its current length standing at around 65,000 km (according to the National Bureau of Statistics, China).

<sup>2</sup> “In the light of the national development strategy, planning and building a national expressway network will facilitate the establishment of a unified market in the country, thus promoting commodities and various other resources to flow and compete freely around the country, which is of great importance in narrowing down the development gaps between different regions, increasing job opportunities and pushing the development of related industries. Based on a summary of the experiences of economic and social development in the developed countries, the national expressway network plan is an urgent need for the building of an all-round well-off society and for the realization of modernization...” (<http://www.crcc.cn/536-1712-4102.aspx>).

Fujita et al., 1999, chp. 7), our adaptation of NEG to the Chinese context and application of NEG to transport impact evaluation are novel.

We arrive at estimates of both national and spatial impacts on several key economic variables – measures of real income and of urban and rural wages – by applying an innovative five-stage methodology. This methodology assigns values to key model parameters through a mixture of estimation and calibration. Most importantly, we estimate crucial parameters for both the urban and rural sectors using key model equations which link wages to real market access and labor efficiency. Because a region's real market access depends on the costs of transporting to market, these “wage equations” provide the conduit through which we model the impacts of the NEN. Thus, we first estimate the wage equations using real market access based on a digital representation of the Chinese road network in 2007, which includes the NEN. By using these estimated parameters in combination with calibrated values of remaining model parameters, we then arrive at a numerical solution of our structural NEG model. Estimates of impact are derived by comparing this solution with a counterfactual solution based on the initial calculation of real market access for the same digital representation of the Chinese road network, but excluding the NEN. In essence, therefore, the model answers the following question – how would the spatial distributions of real income and both urban and rural wages have differed in 2007 had the NEN not been constructed? We focus on prefectural level regions (prefectures for brevity). Hence, we estimate impacts for 331 prefectures spread over the entire territory of China. Because we estimate impacts on both urban and rural wages, we are also able to estimate the effects of the NEN on urban–rural disparities *within* prefectures.<sup>3</sup>

Our NEG-based evaluation methodology can be set against the more conventional approaches of, *inter alia*, Michaels (2008), Faber (2009) and Donaldson (2010). All of these authors use a difference-in-differences approach which rests on the before and after comparison of a treatment group of regions which are near to a newly constructed network linkage with a control group that are not. Donaldson (2010) finds large and significant positive impacts of railways in colonial India, whilst, for rural US counties through which a linkage of the US interstate highway system was constructed, Michaels (2008) reports the existence of significant trade-related impacts consistent with the Heckscher–Ohlin model. Like us, Faber (2009) focuses on the impacts of China's NEN. He estimates that, for rural counties through which an NEN-linkage was built, there was a cumulative GDP decline of around 13% over the period 1997–2006 driven by a decline in non-agricultural output. This finding is interpreted as evidence for a home-market magnification effect in a simple three-region trade model, whereby falling trade costs favor an already advantaged core region at the expense of two peripheral regions.<sup>4</sup>

The main advantage of our approach is that, because it is a systemic approach based on a fully-fledged multi-region NEG model, it is better tailored to capturing the substantial spatial general equilibrium effects expected from a project of the scale and importance of the NEN. A basic lesson of NEG theory is that the construction of a new network link can have impacts which reverberate far beyond the immediate area through which it passes with both potentially positive and negative feedback effects. This is because better transport infrastructure changes the relative strength of agglomeration and dispersion forces, and, therefore, the entire geography of real market access, within a country. Such effects, and their, direct and indirect,

impacts on levels of real income and wages, may easily be missed by a more conventional impact evaluation approach. Moreover, because our NEG model incorporates the full set of price changes resulting from transport cost reductions, we are able to measure impacts on both nominal and real levels of income and wages.

Our results suggest that Chinese real income in 2007 was approximately 6% higher than it would have been, had the NEN not been built. This is a one-off level effect, as opposed to a permanent growth rate effect, as a result of a boost to productivity levels and a reduction in prices. The estimated impacts of China's NEN investments vary both across prefectures and between urban and rural areas. In all but one prefecture, overall estimated real income increased as a result of the NEN.<sup>5</sup> The largest real income gains, however, have been concentrated in the East of China, so that, contrary to its objectives, the NEN has, thus far, done little to alleviate disparities between the coastal and interior prefectures. Across sectors, the picture is more differentiated. In about one-third of prefectures, either urban or rural real wages have declined. Typically, real wage increases attributable to the NEN have been negatively correlated across the urban and rural sectors, which is consistent with a pattern of increased specialization. Finally, the NEN has had little impact on reducing the level and dispersion of intra-regional urban–rural income disparities across prefectures.

Before progressing further, three points should be noted. First, these results only represent reasonable estimates of the aggregate and spatial impacts of the NEN to the extent that our underlying NEG model captures the main causal mechanisms through which improvements in transport infrastructure influence economic activity. These mechanisms manifest themselves most importantly in the two wage equations at the heart of our model's system of structural equations. An important concern is that the estimated values of key model parameters from these equations may be biased owing to the existence of endogeneity. Such endogeneity has several potential sources, including endogeneity of the pathway of the NEN itself, which may have arisen from the deliberate targeting of locations with higher expected economic and/or political returns in the planning and construction of the network.<sup>6</sup> For both the urban and rural sectors, such targeting could drive a positive correlation between wages and real market access. To deal with this and other potential endogeneity problems, we estimate the wage equations using an instrumental variables approach – more specifically, a feasible generalized spatial two stage least squares (FGS2SLS) approach which also controls for potential residual spatial autocorrelation.

Second, our impact estimates should be understood as short-run estimates in the sense that, in deriving our counterfactual solution based on the road network excluding the NEN, we hold the distribution of employment across prefectures fixed at its observed 2007 distribution. Our estimates do not incorporate any possible migration-induced impacts on levels of income and wages arising from the construction of the NEN. In the longer-run, we expect such additional impacts as labor responds to the changed geography of real wages that results from the shifting patterns of real market access generated by the NEN. Clearly, an understanding of these additional effects – to the extent that they are not choked-off by China's *Hukou* permanent household registration system<sup>7</sup> – is essential to a full evaluation of the NEN's impacts. Estimating such impacts would require the detailed modeling of migration decisions within an NEG

<sup>3</sup> The scale of intra-regional urban–rural disparities has become an increasingly prominent concern in Chinese policy debates (Meng et al., 2005; Ravallion and Chen, 2007; Hering and Poncet, 2010a).

<sup>4</sup> Banerjee et al. (2009) analyze the impacts of access to transport infrastructure on economic growth for a sample of Chinese districts. However, their estimates reflect the “effect of having been on ... [a transport] corridor for tens or, in some cases, even hundreds of years” where, for such a corridor, “railways, roads, canals, gas lines and electricity grids may all play a role” (p. 4).

<sup>5</sup> The exception is Changji Hui Autonomous Prefecture, where real income is estimated to have declined by 0.53%.

<sup>6</sup> This has been a central concern of the more standard econometric approach of assessing the impacts of large-scale national transport projects (Michaels, 2008; Banerjee et al., 2009; Faber, 2009; Donaldson, 2010).

<sup>7</sup> The constraints which this system imposes on official migration flows within China are frequently cited to justify an assumption of no labor mobility (see, for example, Faber, 2009, who employs this assumption in his three-region trade model of the Chinese economy).

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