Transport Costs and Economic Geography: Evidence from Indonesia’s Highways

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A fundamental question in regional and urban economics is whether lower transport costs cause agglomerations to develop, or if, instead, they promote the dispersion of economic activity. This question is important for developing countries, which often have large regional disparities in income and are investing heavily in roads and railways. Do better transportation networks allow firms to shift production away urban areas and spread jobs to remote places? Or, do better road linkages actually strengthen existing agglomerations, exacerbating spatial inequalities?

The theoretical literature on this question, particularly recent “new economic geography” models, offers conflicting predictions. Support for the notion that road improvements might help remote areas to grow comes from Helpman (1998), who shows that when transport costs fall, firms move away from cities to save on rents. However, in an influential paper that started this literature, Krugman (1991) shows the opposite: reducing transport costs causes agglomeration. Other theories have more nuanced predictions, and the absence of sharp predictions demands credible empirical work. In this research, my goal is to test different theories of transport costs and economic geography, so that we can better predict which regions will benefit from infrastructure improvements, and which regions may suffer.

The welfare and distributional consequences are not obvious and potentially quite interesting. Under a standard spatial equilibrium model (e.g. Roback, 1982), improvements in local productivity are capitalized into rents, leaving consumer welfare unchanged. However, this model assumes a perfectly elastic supply of local labor, which is unrealistic for a developing country. If individuals have strong locational ties, they will be less willing to move in response to infrastructure improvements, creating substantial “location rents” in the affected areas. Are the effects on aggregate productivity large enough to compensate people whose ties to particular regions make them unwilling to move?

Data and Methodology

To study how lower transport costs shape the development of regions, I focus on a particular setting: the response of Indonesian manufacturers to large road improvements in the 1990s. During the 1970s and 1980s, only a few major highways in Indonesia were paved, and these connected provincial capitals and other large cities. However, in the early 1990s, there was an 83 percent increase in funding for road improvements, and networks throughout the archipelago were rapidly improved. Upgrading projects were not uniform over space or time, yielding substantial variation that can be used to estimate their effects.

To construct measures of transport costs, I make use of new data from Indonesia’s Department of Public Works. These data are extremely detailed, documenting the evolution of road quality measures (width, roughness, and surface type) along kilometer-post intervals of major inter-urban highways, annually from 1990 to 2007. The data allow me to create annual transport cost measures between districts on the islands of Java, Sumatra, and Sulawesi, the three islands with the largest amounts of population and manufacturing activity.

With a series of reduced form exercises, I first document that Indonesia’s road improvements induced a modest dispersion of manufacturing activity. During the 1990s, I find that the spatial concentration of employment, measured by the spatial Herfindahl and the Ellison and Glaeser (1997) index, fell on average by 20-25 percent. Importantly, the amount of dispersion varied across industries in predictable ways. For instance, producers of perishable goods, which deteriorate rapidly in transit
and must be consumed close to where they are produced, did not experience any dispersion, while producers of durable goods did. I also find that new manufacturing plants were increasingly locating in the neighboring areas of existing cities, but they were not moving to the remotest parts of Indonesia. Finally, with a series of linear fixed effects regressions, which are identified due to aspects of Indonesia’s road improvement program, I estimate positive, significant average effects of road improvements on new establishments and employment.

Unfortunately, this reduced form analysis has many limitations. It sheds no light on the mechanisms behind these effects, and because it only delivers an average treatment effect, it is unable to characterize much heterogeneity in treatment response across regions. In order to provide more policy-relevant counterfactual predictions, I next develop and estimate a structural model.

I begin with a multiple-region model of monopolistic competition and regional trade (e.g. [Head and Mayer, 2004]), in which firms face a tradeoff between locating closer to their sources of demand and paying higher factor prices. The model’s key prediction is that firm profits depend on a location’s market potential ([Harris, 1954]), a weighted average of real regional incomes, where the weights decline with transport costs. Importantly, the model allows for sectoral differences in willingness to substitute between location characteristics, motivated by the industry differences highlighted in the reduced form exercises. With some distributional assumptions on the unobserved components, I show how parameters of the model can be estimated with discrete choice techniques.

Unfortunately, identification is extremely challenging. Many characteristics of locations that firms consider when determining where to operate (including local wages, rents, and access to other markets) are themselves affected by the decisions that firms make, and this simultaneity undermines causal interpretation. New road improvements may also be targeted to developing particular areas, and estimates of the effects of better market access may be confounded with the fact that areas with more accessibility were selected by policymakers, creating targeting bias.

To overcome these identification problems, I use new panel data on location characteristics and adapt techniques from industrial organization that allow researchers to estimate discrete choice models with endogenous choice characteristics (Berry et al., 1995). Annual data on road quality and market access enable me to control for time-invariant unobservables that might be correlated with the provision of infrastructure. For example, in Indonesia, long-term spatial plans dictated that certain areas would be targeted for road improvements. These plans were revised only once a decade, so that controlling for location fixed effects removes any targeting bias from parameter estimates. Fixed effects also allow me to separate out the effect of other unobserved factors, such as time-invariant productive amenities, from parameter estimates, so that I can isolate the effects of road improvements from omitted factors.

To deal with simultaneity problems, I combine the inclusion of location fixed effects with several sets of instrumental variables. I first use functions of lagged location characteristics as instruments, under the assumption that regional productivity shocks are innovations, unpredictable given past information. Next, I search for factor price shifters: instruments that affect wages, rents, taxes, and market access across locations but are uncorrelated with productivity shocks. Plausible instruments for wages include minimum wage laws and natural agricultural shocks, while instruments for rents include rugged terrain and elevation interacted with lagged growth.

I find that better market access increases a location’s mean profits, but there is substantial heterogeneity in firms’ willingness to pay for greater market access, both within and across industrial sectors. Counterfactual simulations of what would have happened to firm locations had the government of Indonesia actually implemented certain planned projects predict further industrial suburbanization. With better roads, manufacturing activity would have moved further outside of existing urban centers, but it would not have relocated to the remotest parts of Indonesia.
References


