Infrastructure and City Competitiveness in India*

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Abstract

Do local improvements in infrastructure provision improve city competitiveness? What public finance mechanisms stimulate local infrastructure supply? And how do local efforts compare with national decisions of placing inter-regional trunk infrastructure? In this paper, we examine how the combination of local and national infrastructure supply improve city competitiveness, measured as the city's share of national private investment. For the empirical analysis, we collect city-level data for India, and link private investment decisions to infrastructure provision. We find that a city's proximity to international ports and highways connecting large domestic markets has the largest effect on its attractiveness for private investment. In comparison, the supply of local infrastructure services – such as municipal roads, street lighting, water supply, and drainage – enhance competitiveness, but their impacts are much smaller. Thus, while local efforts are important for competitiveness, they are less likely to be successful in cities distant from the country's main trunk infrastructure. In terms of financing local infrastructure, we find that a city's ability to raise its own source revenues by means of local taxes and user fees increases infrastructure supply, whereas as inter governmental transfers do not have statistically significant effects. .

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Introduction

Following independence, India's metropolitan areas faced considerable disadvantages in attracting and developing industry. The country's industrial policy was used to pursue national policy goals of promoting spatially balanced development. Strict industrial licensing directed investment into lagging areas, and kept heavy industry out of metropolitan centres. The state was also actively engaged in large-scale industrial production and in development of industrial estates. These policies restricted the emergence of industrial clusters in competitive locations, and stifled the competitiveness of cities across the urban system. Starting in 1991, when structural reforms associated with the liberalization of the economy were put in place, the government relaxed regulations for locating industry in metropolitan areas, and reduced its own role in industrial production (Bajpai and Sachs 1999; Ahluwalia 2002).

As a consequence, new investments by the private sector now seek the most profitable locations. These include cities that offer good access to intermediate inputs and to domestic and international markets, provide reliable and high quality public services, and have a business environment conducive to entrepreneurship. Part of a city's attractiveness stems from natural geography and endowments beyond their control. Furthermore, in countries such as India, local decision makers can only indirectly influence national investment decisions that determine placement of inter-regional infrastructure such as major highways and transport hubs. That leaves local public goods and services which are within the direct control of city level decision makers. These services will be important considerations for private investment decisions and their quality will largely depend on a city's ability to sustainably raise and allocate local revenues.

In this paper, we examine the relative contribution of local as opposed to national infrastructure endowments in determining the competitiveness of Indian cities since economic liberalization, with competitiveness being measured as an individual city's share of national private industrial investment. These investment decisions are determined by profits that entrepreneurs can expect to achieve by investing in specific

cities. Profits are likely to depend on prices for physical inputs and local wage rates, as well as the quality of the city's infrastructure. For the empirical analysis, we undertake direct examination of infrastructure's contribution to the competitiveness of Indian cities. We extend the framework developed in Röller and Waverman (2001) for the telecommunications sector, and develop a model of infrastructure and industrial investment decisions at the city level, where local infrastructure is endogenously determined.

We also address the important issue of endogeneity in the assessment of inter-regional transport infrastructure. National infrastructure investment decisions are not made randomly but, rather, are made to connect cities that are already growing more rapidly than others, or to favour politically important cities such as state capitals. India's national highway development programme, including its multi-billion dollar golden quadrilateral, will not develop new roads. Instead, it will upgrade the quality of roads already connecting large and nationally important cities. Thus, inter-regional transport investments are correlated with observable and unobservable city level characteristics, and not correcting for omitted variable bias will provide misleading estimates for transport infrastructure.

This paper also asks another important policy question: Given that public infrastructure investment has significant impacts on firm investment decisions and, therefore, local development, how can local governments increase investments in public infrastructure under their jurisdiction? Specifically, which is the more effective scheme to finance public infrastructure investment: more transfers from national or state governments, or own revenue generation through municipal taxes? We examine the relative effectiveness of these two public financing schemes.

Our empirical application of this model draws on a unique data set on industrial investment and city public finance for Indian cities in the 1990s. The data allow us to estimate spatially detailed models of city-level demand, supply, and investment impacts regarding improving infrastructure and public services. By building a city's investment

profile over time, it becomes possible to assess how investment decisions respond to changes in local actions in terms of providing public goods valued by firms.

Our main findings are that proximity to inter regional infrastructure, measured by domestic market access and travel times to seaports have large and significant effects on improving a city's attractiveness for private investment. Our indicator of market access is based on the New Economic Geography literature, and improves on commonly used indicators such as road length or road density as they are fraught with measurement error and do not account for network connectivity. We also find that the supply of local infrastructure services has a positive and significant effect on city level investment attractiveness. Our measures of local infrastructure include municipal roads, street lighting, water supply and drainage. These effects are robust across econometric specifications and estimation procedures. However, the effects of domestic market access and proximity to ports are considerably larger than the effects of local infrastructure supply, indicating that a large part of city success is influenced by national program placement decisions. Local efforts are important – but are not the main drivers of a city's economic success.

Further, a city's own efforts in revenue generation have significant effects on the supply of local infrastructure, while the supply effects through inter-governmental transfers are ambiguous. These results suggest that, while local decision-makers have limited scope in overcoming disadvantages due to geography and national targeting of inter-regional transport investments, good fiscal policies can improve the delivery of local infrastructure services such as water supply and sanitation. These services translate into better quality of life for residents, but may change a city's economic fortunes.

The rest of the paper is organized as follows. In the next section, we outline the modelling framework and discuss how the integrated model of supply, demand, and growth extends existing analytic work in this field. This is followed by a brief description of the data, and we then report out main findings and offer our conclusions.

A model of infrastructure supply, demand, and competitiveness

Research on links between infrastructure and economic performance dates back to Hirschman's (1958) theories of unbalanced growth, and to contributions regarding the role of 'economic and social overhead capital' in national and regional development (Nurske 1953; Nadiri 1970). Much of the empirical work over the past 20 years is based on econometric studies, where infrastructure enters as an input in aggregate production or cost functions. The basic premise behind these studies is that infrastructure is an intermediate public good that plays an active part in the production process. Thus, increasing the stock of infrastructure – as with increasing any other stock of capital – will improve the productivity of existing firms and attract new firms into the region. Some of the most cited aggregate production function studies include Aschauer (1989) and Munnell (1990). Both papers estimate national time series regressions for the USA, and find output elasticities of infrastructure ranging from 0.3–0.4. This work gave rise to a number of infrastructure and growth studies in the 1990s that utilized various versions of cost and production functions to evaluate the contribution of public infrastructure at various spatial scales (nation, states, city) on output, incomes, and private capital formation (Holtz-Eakin and Schwartz 1995; Moomaw *et al*. 1995; Garcia-Mila and McGuire 1996).

Most of these studies estimate single equation models that face two types of econometric problem:

- Simultaneity bias, where it is difficult to identify whether infrastructure stimulates economic performance, or whether infrastructure is provided as a response to demand in high growth regions
- Unobservable sources of heterogeneity, which make some regions more attractive (for investment) and influence local infrastructure supply or national infrastructure placement decisions.

Ignoring these issues makes identification questionable, and might exaggerate the contribution of public infrastructure to private investment or economic growth more generally.

In our application to Indian urban development, we address these problems by developing a structural model that examines how national infrastructure and local public services influence city performance. We build on several key contributions to the literature on infrastructure and economic growth (Rauch 1995; Morrison and Schwartz 1996; Fernald 1999; Röller and Waverman 2001), and also draw upon the role of market access in the New Economic Geography literature (Krugman 1991; Venables 1996; Head and Mayer 2004). One of the key papers in this literature is Röller and Waverman (2001). In their model of the telecommunication industry's contribution to economic growth, investments in the sector are endogenized through a model of supply and demand, which is jointly estimated with an aggregate production function. Our model extends this work in several dimensions.

First, we distinguish national infrastructure investment and placement decisions from city level infrastructure supply decisions. By instrumenting national infrastructure placement and endogenizing local infrastructure service provision, we can assess what part of city success can be influenced by local efforts relative to national planning decisions and fixed natural endowments. Second, we add the public finance of local infrastructure service provision and endogenize this financing mechanism. This allows us to examine the relative effectiveness of various public financing schemes in increasing local infrastructure supply capacity.

Finally, we empirically address the reverse causality or simultaneity bias issue by providing time lags between manufacturing investment and the explanatory variables in a structural model. We chose a relatively long time lag of three years, such that local factors in year t influence firm investments in ($t+3$). In this way, we control for possible reverse causality coming from firm investment to local infrastructure response. We also test the robustness of empirical results by comparing various estimation methods (OLS, single equation GMM, and 3SLS), and introduce fixed effects that reflect state-level unobserved characteristics that could influence city performance as well as infrastructure provision.

Model of infrastructure and city competitiveness

We begin by assuming that investment, *I*, in the *i*th city responds to expected profits:

$$I_i = f(MA_i, INF_i, LIN_i, BS_i, X_i, \xi_i, \eta_i) \quad (1)$$

In the specification in Equation (1), MA_i represents agglomeration economies by means of regional market access attributes, which link city producers to intermediate inputs and domestic markets. INF_i captures the effects of national transport infrastructure linking cities to ports and trans-shipment hubs. These two factors depend on the endowment of inter-regional transport infrastructure, which, in the Indian context, is largely determined by national and state-level investment decisions. LIN_i represents local public infrastructure offered by the *i*th city. BS_i are complementary business services provided by the private sector in city *i*. Other observable city attractors, such as local wage rates, are included in X_i.

Next, ξ_i measures unobserved characteristics of the city that can affect returns to investment. These factors are considered by the investor when choosing a city to invest in, but are not captured in the data. These unobserved characteristics can complicate the identification of infrastructure's contribution if they influence the way in which (national) infrastructure is allocated across cities. As it is impossible to obtain data on all the factors relevant to infrastructure allocation decisions, it is essential to find instruments for infrastructure placement that are not correlated with the unobservable sources of city attraction or preference. Finally, η_i is an idiosyncratic unobserved component of profitability in city *i*.

In our model, we endogenize local infrastructure provision through the interaction of (per capita) infrastructure supply (g^S) and demand (g^D) equations:

$$\ln g^D = a_0 - a_1 \ln P + a_2 \ln y + \Omega \quad (2)$$

$$\ln g^S = b_0 + b_1 \ln P + b_2 \ln(cost) + b_3(tax) + b_4 \ln(transfer) + \Omega \quad (3)$$

$$g^D = \theta \cdot g^S$$

where $a_i, b_i \geq 0$. Following Röller and Waverman (2001), we consider 'effective' demand rather than 'observed' demand for infrastructure services. The effective demand takes into account the un-met demand, which cannot be observed due to supply constraints. More formally, the un-met demand can be defined by the gap between normative infrastructure usage requirement and the actual infrastructure service provision. In our model, $\theta = \frac{g^D}{g^S}$ measures the size of un-met demand relative to the observed level of infrastructure service provision.

The price of infrastructure, *P*, can be defined by how much consumers pay for consuming one unit of infrastructure service (in the form of user charges and tariffs). Per capita infrastructure demand (g^D) then depends on price (*P*) and income (*y*) elasticities. User charges or tariffs are revenue sources to the service providers, so the supply of infrastructure (g^S) also responds to the price of infrastructure, the average cost of infrastructure service provision (*cost*), and the revenue income of local governments in the form of municipal tax receipts (*tax*) and transfers from higher levels of government (*transfer*). Very few public utilities in Indian cities will cover the full cost of service provision through direct user charges. The parameters b_3 and b_4 thus measure the effectiveness of different financing schemes**.** Infrastructure supply costs will also be determined by various local physical attributes, such as technological, topographical, or geographical factors. For instance, if there are insufficient reliable water sources close to a city, transporting water from far away will increase the cost of provision. Finally, various observed and unobserved local characteristics (Ω) influence the supply and demand of local infrastructure.

The two general revenue sources – local taxes, and transfers from higher levels of government – might themselves be endogenously determined by local, state, and national governments. Adding two structural equations that endogenize financing mechanisms, even though in a crude form, could correct potential simultaneity bias and provide an insight into local revenue dynamics. We therefore model these two financing mechanisms in a simple way, such that:

$$\ln(tax) = c_o + c_1 \ln y + \Omega \quad (4)$$

$$\ln(transfer) = d_o + d_1 \ln y + \Omega \quad (5)$$

Tax revenues and transfers to local governments are assumed to be influenced by per capita local income levels (y) and various local characteristics (Ω).

We construct systems of regression equations by combining the structural equations of Equations 1 to 5, and estimate the models individually and jointly.

Data

Private investments

For the empirical analysis, we have compiled city-level data from various sources and created indicators for various types of local and regional infrastructure. The city level data on private sector manufacturing investment come from the CapEx database, maintained by the Centre for Monitoring Indian Economy (CMIE). By law, any private investment of more than 100,000 rupees must be registered with the Reserve Bank of India. CMIE keeps records of new and ongoing investment activities that are usually related to setting up new plants and machinery throughout the country. Investment projects are tracked from the time they are announced until their commissioning. While CMIE has been compiling information at the state level since 1995, we worked with CMIE officials to produce district- and city-level summaries of manufacturing investment by the private and public sectors. Such data sets for other countries often attribute specific investments to a company headquarters rather than to the branch location where the factory is located. Fortunately, the records of Indian private manufacturing investment identify investment by actual geographical location.

We use each city's share of national manufacturing investment in the empirical analysis. For each year, this indicator provides us with a snapshot of a city's economic competitiveness as it helps us examine how a city is doing relative to its peers. Table 1 shows the top 20 cities with the highest national shares of private manufacturing investment between 2000 and 2005. These 'superstar cities' (Gyourko *et al.* 2006) received about 60 per cent of all national manufacturing investment during the period.

At the top of the list is the Jamnagar urban agglomeration in the state of Gujarat, which accounted for 6.3 per cent of national private manufacturing investment. Jamnagar is located on the Gulf of Kutch. It has a well functioning seaport and is near one of the world's largest refineries, run by the Reliance group of industries. Other cities listed in the top 20 include Raigarh (Maharashtra), which is adjacent to the Mumbai metro region; Pune (Maharashtra), which is 250 km from Mumbai; Chennai (formerly Madras); and Bangalore. Among the top 20 manufacturing investment cities, there are three are in both Karnataka and Orissa, while the states of Gujarat, Maharashtra, and Uttar Pradesh each have two.

Regional infrastructure

To understand how public infrastructure influences city performance, we developed several measures of national transport infrastructure, and city-level public services and infrastructure (water supply and drainage, street lights, and municipal roads). Many studies on transport infrastructure and growth use state or local-level paved road length or road density as the measure of choice. For instance, in a recent paper on India, Hulten *et al.* (2006) use data on paved road length from the Ministry of Transport's Basic Road Statistics publication. The road data are disaggregated into national highways (arterial roads for interstate movement), state highways (arterial roads for inter-district movement, linking up with national highways and adjacent state highways), and district roads (other Public Works Department roads). The authors acknowledge that lack of data on road capacity (lanes) might be a problem, but a more general caveat is the sometimes arbitrary assignment of roads to categories that are only vaguely defined. For example, state

governments routinely change the nomenclature of roads, and classify state highways as national highways and district highways as state highways. In most cases, these re-classifications are not accompanied by improvements in quality. As a consequence, figures on road networks maintained by the national government are misleading, since changes of classification cannot usually be distinguished from new road construction.

A further problem with road length or density indicators is that, in studies of economic performance, it is not the presence of roads or the total length of the local network that are important but, rather, whether the roads provide fast and convenient access to places of importance. In the present study, therefore, we utilize a geographically explicit measure of market access that is based on detailed spatial data of India's inter-regional transport network following the approach outlined in Lall *et al*. (2004). Using a Geographic Information System (GIS), we compute for each city the shortest route to other cities as of 1991, which represents potential input and output markets. Travel time is determined by distance and the design speed of each link in a quality differentiated road network. The summary indicator for each urban area in our analysis is the standard market access (or population potential) measure, which is defined as the sum of the population of target cities inversely weighted by the travel time required to reach them. No detailed interaction data are available that would allow us to estimate the distance decay function that models the decreasing influence of markets with increasing distance. We therefore follow standard convention by using a negative exponential function. The resulting market access indicator provides a generalized measure of regional infrastructure endowment. Additionally, we use a more direct indicator – the travel time to seaports on the inter-regional transport network – as a measure of distance from trans-shipment hubs.

Local infrastructure supply

These data draw on the Local Finance Data System (LFDS) developed by the National Institute of Public Finance and Policy (NIPFP). This database has extensive information on local infrastructure service provision and fiscal conditions of local governments The final sample used in this analysis includes data for 151 Indian cities in 1992/93 and

1997/98. These cities represent 100 urban agglomerations (UA) (which often consist of several individual municipalities) and 51 non-UA cities. In our analysis, we use per capita figures on water supply released, drainage length, solid waste collection, surface municipal road length, and streetlights. Better local infrastructure will have a direct benefit on local production, but also reflects the quality of urban management more generally. Rather than using all variables as predictors, we produce a summary measure of local infrastructure supply as the first principal component of the log values of the five individual indicators.[1]

We calculate per capita normative expenditure level following the guidelines initially developed by the Zakaria Committee (Zakaria 1963). This committee developed per capita expenditure requirements for adequate public services based on physical norms and standards. These norms were stratified for five size categories of towns and covered water supply, drainage and sewerage, roads and works, and streetlights and electricity distribution. Since the initial norms are somewhat out of date, we instead use re-constructed and updated estimates by Mathur (2001) at 1998–99 prices. We compute a corresponding summary of municipal infrastructure expenditure from the LFDS that encompasses the same public services.

The local infrastructure price in the demand equation (Equation 8.2), *P*, can be measured by how much local residents pay for the consumption of each local infrastructure service in the form of tariffs and user charges. We assume local governments' (per capita) receipts of user charges/tariffs are equal to (per capita) non-tax revenue receipts, or proportional to them. Specifically, the price of local infrastructure is proxied, such that:

$$\begin{aligned} \ln P &= \ln\left(P \cdot g^S\right) - \ln g^S = \ln\left(\begin{array}{c}\text{per capita}\\ \text{infra purchase}\end{array}\right) - \ln g^S \\ &= \ln\left(\frac{\text{non tax revenue receipts / city population}}{\text{CPI}/100}\right) - \ln g^S \end{aligned}, \qquad (6)$$

where CPI is the all India Consumer Price Index (CPI) for urban non-manual employees with 1984–85 as the base year.

[1] This indicator preserves 33 per cent of the variance in the original set of variables.

The average (per capita) cost of local infrastructure service provision, deflated by the CPI, is defined as:

$$\ln ac = \ln\left(\frac{\text{municipal infrastructure expenditure / city population}}{\text{CPI / 100}}\right) - \ln g^{S}. \qquad (7)$$

In addition to direct user charges, local government expenditures on public services are also financed by local taxes or transfers from higher levels of government. We construct these variables such that $\ln tax$ = ln(municipal tax receipts, per capita, real), and $\ln transfer$ = ln(total transfers from higher levels of governments, per capita, real), both of which are deflated by the CPI.

Average per capita city income, $\ln y$, is proxied by the first principal component of:

(i) ln(per capita net state domestic product at factor cost, at constant price);
(ii) ln(municipal total tax revenue receipts, per capita, real); and
(iii) ln(per capita waste generated).

Table 2 summarizes the main variables used in the analysis.

Main findings

In this section, we report results from specifications estimating the contribution of infrastructure to city-level competitiveness. We discuss results from the model estimated with three-stage least squares estimators (3SLS). We also estimated specifications with ordinary least squares (OLS) and generalized method of moments (GMM) estimators – these are available on request.

In Table 3, we combine the firm investment model with a model of the local infrastructure model of supply, demand, and financing. We construct a system of

equations and estimate parameters using 3SLS. The system of equations consists of five components:

(i) Firm investment equation for private manufacturing;

(ii) A local wage rate equation;

(iii) Local infrastructure supply and demand equations;

(iv) Two local infrastructure financing equations of municipal taxes

(v) Transfers from higher levels of government.

The 3SLS estimators are preferred, as there is a major problem with identifying the effects of infrastructure using OLS. Estimates of market access and proximity to ports will probably be biased. As cities with good market access – and those close to international ports tend to be large cities – one would expect that these estimates might reflect unobserved benefits from agglomeration economies. At the same time, historical regulations on urban land acquisition for industrial use in India, coupled with environment regulations that have made it difficult for manufacturing to locate in large cities, are likely to reduce the extent to which manufacturing can locate in medium- to large-scale agglomerations. Our measures of national infrastructure development are correlated with unobserved sources of heterogeneity at the city level. We address this problem using instrumental variables.

The instruments include a dummy variable for port cities (distances to ports by roads or rail are less than 5 hours), a dummy for state capitals, and various state-level characteristics in the year 1970. The 1970 state characteristics are: population size; population density; per capita total state government revenue; the share of the manufacturing sector in the total Net State Domestic Product (NSDP); per capita NSDP; the share of the number of seats won by the Congress Party, hard-left parties, and soft-left parties; a dummy for the President's (state) rule; a year dummy; and state dummies.[2]

[2] These state-level data come from the EOPP (Economic Organization and Public Policy Programme) Indian State Database at London School of Economics.

The accumulation of infrastructure investments in the past will determine current physical infrastructure status. Time-invariant natural features, and economic and political conditions in the past, would influence infrastructure investments in the past and therefore be correlated with current infrastructure stocks. However, these natural and historical variables, by themselves, are not directly correlated with a manufacturing firm's investment decisions. For example, located in a state capital city or a state of high NSDP in 1970 does not 'directly' affect a manufacturing firm's future profit and its investment decision.

In Table 3, column 1 reports the investment equation for private manufacturing. We find that regional and national road transport improvements raise the attractiveness of a city for new investment. The parameter estimates suggest that a 10 per cent reduction in travel time to international ports increases a city's share of national private manufacturing investment by 5.3 per cent.[3] Similarly, a 10 per cent increase in the measure of road transport links that enhance domestic market access increases a city's share of national private manufacturing investment by 5.8 per cent. The index of local infrastructure also has positive and significant effect on city investment; improving the local public infrastructure index by 10 per cent increases a city's private manufacturing share by 1.2 per cent.

In summary:

(i) Access to national infrastructure has significant effects on private manufacturing investment decisions;

(ii) Local infrastructure has a positive and significant effect; and

(iii) Local economic conditions, such as prevailing local wage rates, influence location decisions.

We find that manufacturing investment is negatively influenced by local wages, and a 10 per cent increase in the wage rate reduces investment shares by 5.7 per cent. Quite

[3] City's national investment share variable is multiplied by 1000.

surprisingly, access to business services does not have a significant effect on private investment decisions after controlling for physical infrastructure.

The estimation results of the local (real) wage rate equation are in column 2. We first control for the net value-added per employee as a measure of labour productivity, which is statistically significant and positive, as expected. With regard to local factors in local wage determination, we observe interesting results. First, better local infrastructure service provision does, indeed, decrease the local wage rate. This finding is consistent with the cost of living compensation effect of Haughwout (2002). He proposes that, as local income levels and local amenities determine the welfare of local residents, firms can pay lower wages to local workers in the cities that provide better infrastructure services. Second, better access to national transport infrastructure does not have additional effects on local wage determination, as it is already incorporated into local labour productivity (net value-added per employee).

Columns 3 to 6 are the 3SLS estimates of Equations (8.2) and (8.3) for infrastructure supply and demand. We also add state dummies and a year dummy to control for unobserved attributes.

The coefficient estimate of the price elasticity of local infrastructure demand is statistically significant, with an expected negative sign. The price elasticity of local infrastructure supply has the expected positive sign, but is not statistically significant. This might imply that local governments provide infrastructure services on a non-market pricing basis, emphasizing the role of governments as public good providers. Local infrastructure provision costs have a negative effect on supply, as expected.

Interestingly, municipal tax receipts (per capita, real) have a statistically significant and positive effect on local infrastructure supply, but the effect of transfers from higher levels of government is not significant. Thus, improving municipal revenue sources is a more effective way to finance and improve the supply of city-level infrastructure services. Other variables – such as the income elasticity of local infrastructure demand, and the

cost of infrastructure supply – are less significant (significant at the 20 per cent level) but retain expected signs.

Conclusion

In this paper, we assessed the impact on city competitiveness of infrastructure provision by explicitly modelling infrastructure supply, demand, and finance. For the analysis, we distinguished between national infrastructure investment and placement decisions from city-level infrastructure supply decisions in order to identify what part of a city's success can be influenced by local efforts, relative to national planning decisions and fixed natural endowments.

To identify the impacts of infrastructure endowments, we revisited the debate on infrastructure and economic performance, which came into empirical prominence in the early 1990s. Most papers contributing to that debate faced identification problems arising from omitted variables and reverse causality. We address these issues by developing a structural model in which local infrastructure supply and demand are endogenously determined, and the effects of inter-regional infrastructure are separated from unobserved city-level sources of heterogeneity. We collect a new data set on private manufacturing investment by city, and take each city's share of national investment over time to reflect its competitiveness.

Our results highlight three important issues. First, we find that access to inter-regional infrastructure, measured by domestic market access and travel time to seaports, has considerable and significant effects in improving a city's attractiveness for private investment. Our indicator of market access is based on the New Economic Geography literature, and improves on commonly used road length or density variables as these are fraught with measurement error and do not account for network connectivity. Second, the supply of local infrastructure services has a positive and significant effect on city-level attractiveness to investment. Our measures of local infrastructure include municipal roads, street lighting, water supply, and drainage. These effects are robust across econometric specifications and estimation procedures. The effect of market access and

proximity to ports is much greater than the effects of local infrastructure supply, indicating that a large part of city success is influenced by national programme placement decisions and a city's natural geography. Local efforts are important, but are not the main determinants of city competitiveness.

Third, local infrastructure supply is most sensitive to a city's ability to raise its own revenues by means of local taxes and user fees. While simple correlations show that both local revenues and transfers are associated with infrastructure supply, causality can only be established for own-source revenues.

In India, as in many other countries, city mayors and managers are keen to improve economic competitiveness. The zeal for economic success is seen in across cities -- large and small, well connected and poorly connected. And city leaders lobby state and federal governments to increase their share of public investment. The analysis in this paper shows that investments in locally provided infrastructure services improves quality of life for residents but may not translate into economic success for cities far from large domestic markets and major sea ports. And compared to transfers from higher levels of government, expenditures from a city's own revenues are better reflected in service improvements

The policy implication for improving local service delivery is to find mechanisms that would expand local revenue bases in economically depressed cities. However, this is not an easy task as local tax bases in these places are not buoyant and local governments do not have the autonomy to change local tax rates or the administrative capacity to improve collection efficiency.

In the short run, there may be need to increase the scale of transfers that are dedicated for service delivery (as in ring fenced operations). This is likely to stimulate benefits in terms of improvements in household welfare and willingness to pay for services via direct user charges (as households see visible improvements in service performance). In the medium to long run, efforts should be placed at improving local revenue capacity using a combination of new valuation methods and enhanced administrative capacity. If an area-based system is adopted, as is used now in some of the larger cities in the country , then a method of updating the guidance values on a regular basis is necessary (see Lall and Deichmann 2006 for details). This will require not only reliable values from the Stamp Office, and from the state Ministries of Construction, but also a set of procedures for updating these values. It also will require trained staff, capable of valuing real property, and perhaps a central valuation unit in each state should be considered.

There is much to be done to implement such a system. Most local governments do not have a cadre of trained assessors to evaluate property values and update them regularly. A capital value system is even more difficult, because valuation of individual units will be required. In either case, a method of requiring updating of any new construction or major renovations, sub divisions, etc. will need to be put in place. A capital value system will be difficult and costly to implement, and it will be expensive. Its introduction will require much careful planning and will take considerable time.

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Table 1 Top 20 cities with highest private manufacturing firm investment, 2000–05

Ranking	State	UA/district	Nat. share of pri. manu. firm investment, %
1	GUJARAT	Jamnagar UA	6.267
2	PUNJAB	Rampura Phul UA	5.194
3	MAHARASHTRA	Raigarh	4.897
4	TAMIL NADU	Chennai UA	4.693
5	ANDHRA PRADESH	Chittoor	4.683
6	JHARKHAND	Jamshedpur UA	3.115
7	ORISSA	Cuttack UA	3.029
8	KARNATAKA	Bangalore UA	2.907
9	KARNATAKA	Bellary	2.729
10	UTTAR PRADESH	Sultanpur	2.645
11	KERALA	Kanhangad UA	2.617
12	MADHYA PRADESH	Sagar UA	2.547
13	ASSAM	Dibrugarh UA	2.351
14	ORISSA	Byasanagar UA	2.150
15	MAHARASHTRA	Pune UA	1.803
16	ORISSA	Ganjam	1.777
17	CHHATTISGARH	Korba	1.698
18	KARNATAKA	Mangalore UA	1.610
19	GUJARAT	Bhuj UA	1.570
20	UTTAR PRADESH	Modinagar UA	1.465
Total			59.748

Table 2 Summary statistics

Variable	Obs	Mean	Std dev.	Min.	Max.
Local infra supply	302	2.079	2.964	0.009	25.700
Avg. distance to ports, hours	244	13.112	12.724	0.010	46.354
Market access	254	12165	11164	216	66976
Wages, per worker, real (Rs)	200	5819	2470	1073	13005
Net value-added, per employee, real (Rs)	209	64281	122640	3477	1264801
Business service jobs, per capita	284	0.155	0.399	0.000	3.656
Local infra demand	302	8.603	15.562	0.056	185.247
Local infra price	302	0.042	0.105	0.000	0.883
Local avg. income	296	2.658	3.649	0.025	29.762
Avg. cost of local infra supply	302	0.076	0.203	0.001	2.361
Local tax revenue, per capita (1000 Rs)	302	0.062	0.088	0.000	0.656
Transfers, per capita (1000 Rs)	300	0.046	0.038	0.002	0.382

Table 3 Manufacturing firm investment and local infrastructure: 3SLS (standard errors in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Nat. share of pri. manu. firm invest$_{t+3}$**	**ln(wage, per worker, real)$_t$**	**ln(local infra demand)$_t$**	**ln(local infra supply)$_t$**	**ln(local tax rev., per capita, real)$_t$**	**ln(transfers, per capita, real)$_t$**
	3SLS	3SLS	3SLS	3SLS	3SLS	3SLS
ln(local infra)$_t$	1.179**	-0.150**				
	(0.590)	(0.073)				
ln(avg. distance	-5.379***	-0.031				
to ports, hrs)$_{1991}$	(1.848)	(0.190)				
ln(market	5.873***	-0.061				
access)$_{1991}$	(2.216)	(0.252)				
ln(wage, per	-5.769**					
worker, real)$_t$	(2.285)					
ln(bus. serv. job,	-0.783	0.029				
per capita)$_{2001}$	(0.583)	(0.069)				
ln(net value-add,		0.897***				
per emp., real)$_t$		(0.220)				
ln(local avg.			1.561		2.167***	0.445
Income)$_t$			(1.185)		(0.172)	(0.297)
ln(local infra			-1.376***	0.109		
price)$_t$			(0.188)	(0.954)		
ln(avg. cost)$_t$				-1.023		
				(0.737)		
ln(local tax rev.,				0.683*		
per capita, real)$_t$				(0.399)		
ln(transfers,				0.332		
per capita, real)$_t$				(0.596)		
A year dummy	Yes	Yes	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	155	155	155	155	155	155
RMSE	5.705	0.639	1.219	0.706	0.344	0.596

Notes:
*** significant at 1% level; ** significant at 5% level; * significant at 10% level.

The instruments are:

(i) The average (real) cost of local infrastructure service provision, ln(avg. cost), which is assumed to be exogenously determined by technological and topographical/geographical factors;
(ii) A dummy for port cities (distances to ports by roads or rails are less than 5 hours);
(iii) A dummy for state capitals;
(iv) A year dummy and state dummies; and

(v) (v) various state characteristics in year 1970. The 1970 state characteristics include population size; population density; per capita total state government revenue; the share of manufacturing sector in the total Net State Domestic Product (NSDP); per capita NSDP; the share of the number of seats won by Congress Party, hard left parties, and soft left parties; a dummy for President's (state) rule.