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# The Golden Quadrilateral Highway Project and Urban/Rural Manufacturing in India

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## Abstract

This study investigates the impact of the Golden Quadrilateral highway project on the urban and rural growth of Indian manufacturing. The Golden Quadrilateral project upgraded the quality and width of 5,846 km of roads in India. The study uses a difference-in-difference estimation strategy to compare non-nodal districts based on their distance from the highway system. For the organized portion of the manufacturing sector, the Golden Quadrilateral project led to improvements in both urban and rural areas of non-nodal districts located 0–10 km from the Golden Quadrilateral. These higher entry rates and increases in plant productivity are not present in districts 10–50 km away. The entry effects are stronger in rural areas of districts, but the differences between urban and rural areas are modest relative to the overall effect. The productivity consequences are similar in both locations. The most important difference appears to be the greater activation of urban areas near the nodal cities and rural areas in remote locations along the Golden Quadrilateral network. For the unorganized sector, no material effects are found from the Golden Quadrilateral upgrades in either setting. These findings suggest that in the time frames that we can consider—the first five to seven years during and after upgrades—the economic effects of major highway projects contribute modestly to the migration of the organized sector out of Indian cities, but are unrelated to the increased urbanization of the unorganized sector.



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## 1. Introduction

The Indian manufacturing sector is undergoing several significant structural transformations. Since the policy deregulations and economic liberalization process began in the early 1990s, substantial shifts in the spatial placement of Indian's manufacturing sector have occurred. This spatial sorting is occurring both across Indian districts and also within them (e.g., Fernandes and Sharma 2012, Ghani et al. 2012a,b). Understanding these structural shifts and how they accrue over different parts of the manufacturing sector (e.g., the organized and unorganized sectors) is an essential input for urban planning and economic policy, as they govern the distribution of economic activity and industrial development of the country. Improved spatial sorting is also needed in India for stronger productivity growth and better allocation of scarce resources.

This study considers how connectivity across districts influences the levels and spatial organization of manufacturing within districts. Specifically, we consider the development and improvements of a major highway in system in India—the Golden Quadrilateral (GQ) project. The GQ project sought to improve the connection of four major cities in India: Delhi, Mumbai, Chennai, and Kolkata. The GQ system comprises 5,846 km (3,633 mi) of road connecting many of the major industrial, agricultural, and cultural centers of India. It is the fifth-longest highway in the world. The massive project began in 2001, was two-thirds complete by 2005, and mostly finished in 2007. We compare how GQ influenced the manufacturing operations and entrepreneurship rates in the urban and rural portions of the districts through which it passed.

In an earlier study, Ghani et al. (2012a) consider the aggregate impact of the GQ upgrades on the activity of India's organized manufacturing sector using enterprise data from the Annual Survey of Industries. This study finds significant increases in manufacturing entry rates and productivity in districts that were very close to these upgrades (0-10 km), compared to districts farther away (10-50 km). We continue with this approach, taking upon the additional task of separating activity in districts by the urban versus rural locations of plants. We find that the entry effects for the organized sector are present in both types of areas, with somewhat stronger outcomes in rural settings. The differences are most substantial when considering where new plants with major output levels are locating. By contrast, the productivity gains for the organized sector are very similar in both urban and rural locations. These findings suggest that in the time frames that we can consider—the first five to seven years during and after upgrades—the economic effects of the upgrades were mostly neutral with respect to most organized sector location choices regarding urban versus rural settings, the main exception being very high output level plants being more likely to take a rural location near to the improved GQ network. We likewise identify that a key aspect of whether or not an urban or rural setting is expanded upon depends upon the distance from the major nodal cities. Urban parts of districts that are closer to the nodal cities of GQ are activated more, while rural parts of districts farther from the nodal cities experience the greatest stimulus of new entrants.

To study further the urban and rural distinctions, we also extend our earlier work to consider the unorganized manufacturing sector using enterprise data from National Sample Survey. The unorganized sector accounts for about 20% of Indian manufacturing output, but a little over 80% of Indian employments in manufacturing. We extend the scope to include the unorganized sector to revisit a second, independent theme from our earlier work. In Ghani et al. (2012b), we analyze the extent to which the manufacturing sector is moving from urban to rural locations within districts. Among its conclusions, this paper finds that the organized manufacturing sector of India is moving towards rural locations, while the unorganized sector is moving towards urban settings. The predecessor study concludes that infrastructure build-up within districts plays a modest role in location placement, with an emphasis towards retaining higher urban shares. These patterns, and especially the extent to which the unorganized sector is the key force driving urbanization of manufacturing, are important for policy makers to understand in the design of policies to promote urbanization.

Building out a new analysis for the unorganized sector across the GQ network, we find very limited impact of the GQ upgrades outside of the nodal districts. As we describe further below, we see traces of evidence of the organized sector findings repeating themselves in the unorganized sector (e.g., heightened entry rates, forms of industry sorting), but the results are substantially diminished in economic magnitudes. We confirm that these basic patterns are true in both urban and rural settings; they also hold true regardless of the gender of the business owner in the unorganized sector.

Thus, to summarize, we obtain a general conclusion that the massive GQ highway project development had a substantially larger effect on the organized sector than on the unorganized sector (or, more generically, on the largest of plants relative to the smallest of plants). For the organized sector, the aggregate impact is fairly neutral with respect to urbanization. The build out appears most significant in urban areas closest to nodal cities, while rural areas farther away are developed. By contrast, the aggregate impact for the unorganized sector was significantly less. This asymmetry for inter-district infrastructure differs from that of within-district infrastructure identified by Ghani et al (2012b), which linked to spatial movements in both sectors. This differential is reasonable, given the greater optimization in location choice that a larger plant will conduct and the ability of these plants to trade inputs and outputs at a distance. Nonetheless, we remain cautious about broad claims regarding unorganized activity beyond the manufacturing sector until further research can validate GQ's limited roles in other ways (e.g., considering household-based surveys that extend outside manufacturing).

Our project contributes to a literature on the economic impacts of transportation networks and infrastructure investments in developing economies, which is unfortunately quite small relative to its policy importance. Beyond Ghani et al. (2012a), the closest related study is Datta (2011), who evaluates the impact of GQ upgrades using inventory management questions contained in the World Bank's Enterprise Surveys for India in the years 2002 and 2005. Even with the short time window of three years, Datta (2011) finds that firms outside of nodal districts along the GQ network decrease their average input inventory (measured in terms of the number of days of production for which the inventory held was sufficient) relative to those located on other highways. He also finds that firms in districts closer to the GQ network were more likely to switch their primary input suppliers vis-à-vis firms farther away. These results suggest improved efficiency and sourcing for establishments on the GQ network after its upgrade.

Beyond India, several recent studies find positive economic effects in non-nodal locations due to transportation infrastructure in China (e.g., Banerjee et al. 2012, Roberts et al. 2012, Baum-Snow et al. 2012). These studies complement the larger literature on the United States (e.g., Fernald 1998, Chandra and Thompson 2000, Michaels 2008, Duranton and Turner 2011, 2012, Baum-Snow 2007, Lahr et al. 2005), those undertaken in historical settings (e.g., Donaldson 2010, Donaldson and Hornbeck 2012), and those focusing on other developing or emerging economies (e.g., Brown et al. 2008, Ulimwengu et al. 2009, Holl and Viladecans-Marsal 2011, Hsu and Zhang 2011). A related literature considers non-transportation infrastructure investments in developing economies (e.g., Duflo and Pande 2007, Dinkelman 2011).

This study also contributes to a literature seeking to understand the development of the manufacturing sector in India. Several studies evaluate the performance of Indian manufacturing, especially after the liberalization reforms (e.g. Kochhar et al. 2006, Ahluwalia 2000, Besley and Burgess 2004). Some authors argue that Indian manufacturing has been constrained by inadequate infrastructure and that industries that are dependent upon infrastructure have not been able to reap the maximum benefits of the liberalization's reforms (e.g. Gupta et al. 2008, Gupta and Kumar 2010, Mitra et al. 1998). Our work regarding the GQ upgrades supports many of these propositions with respect to the organized sector, while the unorganized sector's advancement appears more closely link to within-district infrastructure (like paved roads in villages). Our work also links to studies seeking to understand the allocation of activity across regions and the productivity of firms (e.g., Desmet et al. 2011, Hsieh and Klenow 2009).

The remainder of this paper is as follows: Section 2 describes the data used for this paper and its development. This section also includes a more extensive discussion of the GQ upgrades and the definitions of urban/rural areas. Section 3 presents the empirical work of the paper, determining the impact of highway improvements on economic activity. Section 4 concludes.

## 2. Indian Manufacturing Data for the Organized and Unorganized Sectors

We employ repeated cross-sectional surveys of manufacturing establishments carried out by the Government of India. Our work studies surveys that were conducted in fiscal years 1994, 2000, 2005, and 2007 for the organized sector. For the unorganized sector, our surveys consider 1994, 2000, and 2005. In all cases, the survey was undertaken over two fiscal years (e.g., the 1994 survey was conducted during 1994-1995), but we will only refer to the initial year for simplicity. This time span allows us two surveys before and after the GQ upgrades for the organized sector. For the unorganized sector, we have two surveys before and one after the upgrades. This section describes some key features of these data for our study.

*Organized Sector: Annual Survey of Industries*

The organized sector for Indian manufacturing comprises establishments with more than 10 workers if the establishment uses electricity. If the establishment does not use electricity, the threshold is 20 workers or more. These establishments are required to register under the India Factories Act of 1948. The unorganized manufacturing sector is, by default, comprised of establishments which fall outside the scope of the Factories Act. The organized sector accounts for over 80% of India's manufacturing output, while the unorganized sector accounts for a high share of employment and over 99% of establishments (Ghani et al. 2013).

The organized manufacturing sector is surveyed by the Central Statistical Organization through the Annual Survey of Industries (ASI). These surveys are used for many published reports on the state of Indian businesses and government agency monitoring of the Indian economy. The typical survey collects data from over 150,000 Indian establishments. In this respect, the surveys are comparable to the Annual Survey of Manufacturing conducted in the United States, with the Indian sampling frame being about three times larger.

Establishments are surveyed with state and four-digit National Industry Classification (NIC) stratification. The survey provides sample weights that we use to construct population-level estimates of total establishments, employment, and output by district. Districts are administrative subdivisions of Indian states or territories that provide meaningful local economic conditions. The average district size is around 5,500 square kilometers—roughly twice the size of a U.S. county—and there is substantial variability in district size (standard deviation of ~5,500). Indian districts can be effectively considered as self-contained labor markets. As we discuss further below, we use district variation to provide more granular distances from the various highway networks.

ASI surveys record several economic characteristics of plants like employment, output, capital, raw materials, and land and building value. For measures of total manufacturing activity in locations, we aggregate the activity of plants up to the district or district-industry level. We also develop measures of labor productivity and TFP. Labor productivity is measured through output per employee at the plant level, with an average then taken across plants for a district. TFP is calculated through a residual regression approach. For every two-digit NIC industry and year, we regress log value-added (output minus raw materials) of plants on their log employment and log capital. The residual from this regression for each plant is taken as its TFP. We then take the average of these residuals across plants for a district.

As our data are repeated cross-sections, rather than panels with unique plant identifiers, there are limits with respect to some of our analyses. Perhaps most notably, we do not have accurate measures of exiting plants. Our data do, however, allow us to measure and study new entrants. Plants are distinguished by whether or not they are less than four years old. We will use the term "young" plant or new entrant to describe the activity of plants that are less than four years old. We aggregate young plant activity at the district level, similar to metrics of total activity.

Our core sample for the organized sector contains 312 districts. This sample is roughly half of the total number of districts in India of 630, but it accounts for over 90% of plants, employment, and output in the manufacturing sector throughout the period of study. The reductions from the 630 baseline occur due to the following. First, the ASI surveys only record data for about 400 districts due to the lack of organized manufacturing (or its extremely limited presence) in many districts.[1] Second, we drop states that have a small share of organized manufacturing.[2] Last, we make an additional restriction for our regression sample that manufacturing activity in terms of plants, employment, and output in districts be observed at all points from 1994 to 2007.

The requirements with respect to continuous measurement of districts are motivated by a desire to have a consistent sample before and after the GQ upgrades. The requirements with respect to minimum share of states in organized manufacturing are motivated by a desire to have reasonably measured plant traits, especially with respect to labor productivity and plant TFP. With respect to the latter, we also exclude plants that have negative value added, which accounts for 6%-7% of employment. These restrictions are again not very significant in terms of economic activity, with our final sample retaining more than 90% of Indian manufacturing activity.

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[1] For instance, the ASI surveys the entire country except the states of Arunachal Pradesh, Mizoram, and Sikkim and Union Territory of Lakshadweep, so these states are naturally excluded.

[2] These states are Andaman and Nicobar Islands, Dadra and Nagar Haveli, Daman and Diu, Jammu and Kashmir, Tripura, Manipur, Meghalaya, Nagaland and Assam. The average share of organized manufacturing from these states varies from 0.2% to 0.5% in terms of establishment counts, employment or output levels.

*Unorganized Sector: National Sample Statistics*

We employ plant-level data from the years 1994, 2000 and 2005 to study the impact of highway infrastructure investments on the unorganized sector of Indian manufacturing. Establishments in the unorganized sector in India are unregistered, do not pay taxes, and are generally outside the purview of the state, so this group closely parallels common discussions and definitions of the informal sector. Our data are taken from the National Sample Statistics (NSS). Many of the properties of this dataset resemble the ASI, and the development steps are closely related, so we do not repeat them. Unlike organized manufacturing, however, we are not able to calculate TFP measures due to lack of reliable data on asset formation in the unorganized sector. On the other hand, the NSS allows us to examine differences in male- versus female-owned businesses that we describe briefly later. Our core sample for the unorganized sector contains 363 districts.

*The GQ Highway Upgrades*[3]

Road transport is the principal mode of movement of goods and people in India, accounting for 65% of freight movement and 80% of passenger traffic. While national highways like the GQ network constitute about 1.7% of the road network, they carry more than 40% of the total traffic volume. India launched its National Highways Development Project (NHDP) in 2001 to improve its transportation infrastructure. This project, the largest highway project ever undertaken by India, aimed at improving the GQ network, the North-South and East-West Corridors, Port Connectivity, and other projects in several phases. The total length of national highways planned to be upgraded (i.e., strengthened and expanded to four lanes) under the NHDP was 13,494 km; the NHDP also sought to build 1,500 km of new expressways with six or more lanes and 1,000 km of other new national highways, including road connectivity to the major ports in the country. Thus, in a majority of cases, the NHDP sought to upgrade a basic infrastructure that existed, rather than build infrastructure where none previously existed. The GQ program in particular sought to upgrade highways to international standards of four- or six-

[3] This section is an abbreviated introduction, and we refer readers to Ghani et al. (2012a) for greater details about the GQ structure and the other highway systems in India.

laned, dual-carriageway highways with grade separators and access roads. This group increased from 4% of India's highways in 2002 to 12% by the end of 2006 due to GQ upgrades alone.

The GQ network, totaling a length of 5,846 km, connects the four major cities of Delhi, Mumbai, Chennai, and Kolkata. Figure 1 provides a map of the GQ network, along with some depictions of output levels in young firms before and after the upgrades. Beyond the four major cities that the GQ network connects, the highway touches many smaller cities like Dhanbad in Bihar, Chittaurgarh in Rajasthan, and Guntur in Andhra Pradesh. The GQ upgrades began in 2001, with a target completion date of 2004. In total, 23% of the work was completed by the end of 2002, 80% by the end of 2004, 95% by the end of 2006, and 98% by the end of 2010. Differences in completion points were due to initial delays in awarding contracts (128 different contracts were employed), land acquisition and zoning challenges, funding delays, and related contractual problems. Some have also observed that India's construction sector was not fully prepared for a project of this scope. As of August 2011, the cost of the GQ upgrades was about US$6 billion (1999 prices), about half of the initial estimates. By contrast, only about 10% of the other parts of NHDP were completed by 2006.

*Distance to the GQ Network and Nodal Cities*

Our next step is to measure the distance of districts to the GQ highway network (the closest point on the highway) and to the nodal cities. We calculate these distances using official highway maps and ArcMap GIS software. Our reported results use the shortest straight-line distance of a district to the GQ system. We find very similar results when using the distance to the GQ system measured from the district centroid. The empirical appendix of Ghani et al. (2012a) provides additional details on our data sources and preparation, with the most attention given to how we map GQ traits that we ascertain at the project level to district-level conditions for pairing with ASI and NSS data.

Our empirical specifications use a non-parametric approach with respect to distance to estimate treatment effects from the highway upgrades. We define indicator variables that take a value of one if the shortest distance of a district to the indicated highway network is within the specified range; a value of zero is assigned otherwise. We report most of our results using four distance bands: nodal districts, districts located 0-10 km from a highway, districts located 10-50 km from a highway, and districts over 50 km from a highway. In an alternative setup, the last distance band is further broken down into three bands: districts located 50-125 km from a highway, districts located 125-200 km from a highway, and districts over 200 km from a highway.

In our empirical work, our core focus is on the non-nodal districts of a highway. We measure effects for nodal districts, but the interpretation of these results will always be challenging as the highway projects are intended to improve the connectivity of the nodal districts. For the GQ network, we follow Datta (2011) in defining the nodal districts as Delhi, Mumbai, Chennai, and Kolkata. In addition, Datta (2011) describes several contiguous suburbs (Gurgaon, Faridabad, Ghaziabad, and NOIDA for Delhi; Thane for Mumbai) as being on the GQ network as "a matter of design rather than fortuitousness". We include these suburbs in the nodal districts.

We finally consider distance from the nodal points of the GQ system to each district. We measure these distances from the four main nodal districts using a straight line formulation. We consider the contiguous suburbs to have zero distance for this exercise. Roughly half of the non-nodal districts that lie with 0-10 km of the GQ highway system are also within 350 km of a nodal point. The remaining districts are more remote, and we use this point for our demarcation.

*Urban and Rural Regions of Districts*

The ASI and NSS surveys identify for each establishment whether it is in an urban or rural location. Our study considers changes in urbanization over time, and thus the stability and comparability of this survey question across rounds are very important. The statutory definition of an urban setting during our period of study is:

(a) All statutory places with a municipality, corporation, cantonment board or notified town area committee, etc., or

(b) A place satisfying the following three criteria simultaneously:

  i) A minimum population of 5,000;
  ii) At least 75% of male working population engaged in non-agricultural pursuits; and
  iii) A density of population of at least 400 per sq. km. (1,000 per sq. mile).

This definition is stable through our time period. Our 1994 and 2000 surveys follow a 1991 classification of places based upon these criteria, while the 2005 and 2007 surveys follow the 2001 Census classifications. Thus, while the formal definition of an urban area has not changed during this period, some sub-units of districts move from being rural areas to being urban areas with the 2001 Census compared to the 1991 Census when the sub-units begin to satisfy the urbanization criteria. This change can influence our measured urbanization levels, and Ghani et al. (2012b) describe exercises to ensure that these reclassifications do not have a material consequence for the measured patterns.

It is important to note that India uses a more demanding set of criteria than most countries to define urban areas (e.g., Bhagat, 2005; United Nations, 2001). For instance, substantial parts of U.S. metropolitan areas like Atlanta or Phoenix would be classified as rural in Indian statistical analyses because their population densities fall below 1000 persons per square mile. Thus, our measured urbanization for India will be lower than many international standards. This consideration does not affect, however, the longitudinal consistency of our trends for India.

*Descriptive Tables*

Tables 1a and 1b present simple descriptive statistics or the urban and rural distribution of activities across districts over time and by their distance from the GQ network for the organized and unorganized sectors, respectively. Panel A of each table provides descriptive tabulations from the 1994 and 2000 data that come before the GQ upgrades, and Panel B provides similar tabulations for the surveys that follow the GQ upgrades. Columns 1-3 provide aggregates of manufacturing activity within each spatial grouping, averaging the two surveys, and Columns 4-6 provide similar figures for young establishments less than four years old. Within each panel, we tabulate activity by distance from GQ. There are nine nodal districts. Roughly one-third of districts fall within 0-10 or 10-50 km from the GQ network, with roughly two-thirds of districts over 50 km away from the network. In Table 1a, the broad trend is for declining urban shares in the organized sector, while the broad trend in Table 1b is for increasing urban shares in unorganized sector. Urbanization rates are strongest in the nodal cities, with the districts falling within 0-10 and 10-50 km from the GQ network being of relatively similar levels.

## 3. Empirical Impact of the GQ Upgrade on Urban and Rural Manufacturing

This section describes our empirical exercises. We begin with analyzing the organized sector in isolation, focusing on levels of activity. We then consider the unorganized sector by itself. We finally combine the sectors together to look at aggregate urbanization rates and spatial sorting within districts.

*Urban and Rural Patterns for Organized Sector Activity*

Table 2 begins by analyzing changes in entry rates in the organized sector surrounding the GQ upgrades. A key finding in Ghani at al. (2012a) was that districts that were very close to the GQ network—specifically within 10 kilometers or less—experienced a significant increase in organized sector entrants after the GQ upgrades commenced. This surge in entrepreneurship was not reflected in districts that were 10-50 kilometers away. The first three Columns of Table 2 repeat these results.

In Panel A, we undertake a simple pre-post analysis where explanatory variables are interactions of indicator variables for how far a district is from the GQ highway network with an indicator variable for the post-GQ upgrades (equal to one in 2005 and 2007). Indexing districts with *i* and years with *t*, the specification takes the form:

$$Y_{i,t} = \sum_{d \in D} \beta_d \cdot GQDist_{i,d} \cdot PostGQ_t + \eta_i + \gamma_t + \varepsilon_{i,t},$$

The set *D* contains three distance bands with respect to GQ: a nodal district, a non-nodal district that is 0-10 km from GQ, and a non-nodal district that is 10-50 km from GQ. The excluded category in this set includes districts more than 50 km from the GQ network. District fixed effects $\eta_i$ control for the overall levels of entry rates in each district across the sample; these fixed effects also control for the main effects of distance from the GQ network. In a similar manner, the year fixed effects $\gamma_t$ control for aggregate annual changes in the Indian economy, including the main effects of the post-GQ upgrades period. Thus, the interactions and their $\beta_d$ coefficients quantify differences in outcomes after the GQ upgrades by spatial band compared to the excluded group that comprises districts located more than 50 km from the GQ network.

Column headers provide the outcome variables studied. Column 1 considers the entry of young plants by their log count in the district, Column 2 considers the log employment in these young plants, and Column 3 considers the log output in these young plants. We weight estimations by the log of district population in 2001, and we cluster standard errors by district. Estimations have 1,248 observations as the cross of four surveys and 312 districts. We winsorize outcome variables at the 1%/99% level to guard against outliers. Our district sample is constructed such that employment, output, and establishment counts are continuously observed. We do not have this requirement for young plants, and we assign the minimum 1% value for employment, output, and establishment entry rates where zero entry is observed in order to model the extensive margin and maintain a consistent sample.

The top row shows a very substantial increase in young firm counts in nodal cities after the upgrades in comparison to districts more than 50 km from GQ. As we have noted, we are very cautious about interpreting these results much given that the upgrades were built around the connectivity of the nodal cities. The imprecision in these estimates is mostly due to the fact that there are only nine nodal districts. As effects for our other distance categories are being measured for each band relative to districts more than 50 km from the GQ network, the inclusion or exclusion of the nodal districts does not impact our core results regarding non-nodal districts.

The key pattern emphasized in our earlier work is shown in the second and third rows. There is substantial increase in organized sector entry in districts within 10 km of GQ that is not reflected in districts farther away at 10-50 km. Our sample includes 76 districts within 10 kilometers, and 42 districts in the 10-50 km band. To some degree (substantiated further in Ghani et al. 2012a), the upgrades of the GQ network can be taken as exogenous for these districts since neither group is in the nodal district set around which the upgrades were based. The districts within 0-10 km of GQ have a 0.4-0.9 log point increase in entry activity after the GQ upgrade compared to districts more than 50 km away. The point estimates for the 10-50 km range are substantially smaller in size and imprecisely estimated.

Panel B extends the spatial horizons studied in Panel A to include two additional distance bands for districts 50-125 km and 125-200 km from the GQ network. These two bands have 48 and 51 districts, respectively. In this extended framework, we measure effects relative to the 97 districts that are more than 200 km from the GQ network in our sample. The special entry behavior for districts within 10 km of GQ extends in this broader framework, with no differences observed at longer distances for the disaggregated bands between 50 and 200 km. From a simple association perspective, the manufacturing growth in the period surrounding the GQ upgrades is localized in districts along the GQ network.

The remainder of this table applies the methodology from Columns 1-3 to urban and rural areas of districts independently. We will later consider shares of activity in urban versus rural areas of districts (i.e., urbanization rates), and it is helpful now to highlight how our current framework differs from that format. First, by looking at changes in the levels of activity, we capture growth rates of districts and their organized manufacturing activity that is removed when calculating shares of activity. This is important as GQ could be increasing activity in both places at the same time. This approach is also the only means for considering productivity, as shares of labor productivity or TFP across places is not a meaningful concept.

Second, we face a data challenge in this work in that some districts do not contain an urban or rural area. Specifically, of our 312 district, 278 have urban areas and 291 have rural areas. In the estimations that consider levels of activity in urban areas, we will restrict our samples to districts that have manufacturing establishments in urban areas in all the years surveyed. In a similar manner, the estimates for rural areas require that the district have rural areas across the full sample period. This provides a consistent panel for each group. When we later move to share-based estimations, we require that both urban and rural areas be present. This requirement eliminates districts where shares are by definition either 0% or 100%, in the process lowering our sample size as described in greater detail later. This introduces selection issues that are much weaker when considering levels.

Columns 4-6 provide estimations of the GQ effects that restrict attention to urban areas in districts. The results are more muted than the total effects document in Columns 1-3. We find economically and statistically significant increases in plant entry rates for Column 4. By contrast, Columns 5 and 6 find positive point estimates for employment and output, respectively, but these coefficients are not precisely estimated like the base results in Columns 2 and 3. The output coefficients are also substantially smaller, between one-third and a half the size of what is evident in Column 3 for the full sample.

When isolating rural areas of districts in Columns 7-9, the outcomes have several key differences. First, the rural entry responses are generally larger than those estimated for urban areas, regardless of the metric. The only exception out of the six cases is the plant count estimations in Panel B. Second, unlike the emphasis on plant counts in urban areas, the rural estimates place more emphasis on employments and outputs of the organized sector. That is, the GQ effort appears to have increased the entry rates of organized sector plants in both urban and rural settings, but the largest increases in terms of employments and outputs are seen in rural settings. In fact, the development of large employment and output bases for organized manufacturing after the GQ upgrades plays the strongest role in the aggregate gains experienced on these dimensions. This differential is most accentuated in Panel A's estimations of output relative to districts 50 km and farther from the GQ network.

In a similar manner, Table 3 considers our labor productivity and TFP estimations. Columns 1 and 2 show a core increase of productivity associated with the GQ implementations in districts nearby the highway system. These increases are primarily driven by adjustments in the incumbent establishments of the districts. (We do not quantify the labor productivity and TFP changes of new entrants, as much of the impact of new entrants comes from the extensive margin and these plant-level traits are not defined in these cases.) In contrast to the differences observed for entry rates across urban and rural areas, the productivity effects appear quite uniformly realized. The labor productivity elasticity is slightly stronger in rural areas, likely reflective of the larger-scale production functions that can be used in these locations.

Table 4 reports results where we consider the total organized sector activity observed over time. Columns 1-3 again replicate our earlier work and show limited effects for the total activity contained in these districts. We believe this limited effect is mostly a consequence of our final sample point being in 2007 and thus only a few years after most of the GQ upgrades occurred (57% of upgrades occurred during 2003-2004). While the coefficient for output levels in Panel B is of reasonable size, it is not statistically significant. Columns 4-6 show null results for total activity in the urbanized areas of districts. The coefficients are all quite small in terms of economic and statistical significance. Columns 7-9 show stronger, but still limited, results for rural areas. The one exception is that the level of output in rural areas is estimated to be substantially stronger after the GQ upgrades for nearby districts compared to those more than 200 km away.

This output response is interesting in that it starts to show at least some sustained, aggregate influence of the GQ patterns. Interpretation is complicated, however, by the substantial rural increase also observed at 125-200 km distance from the GQ network. Unreported tabulations suggest this effect is stemming from rapid developments in the Uttar Pradesh state, at modest distances from Delhi.

*Distance from Nodal Cities for Organized Sector Activity*

Table 5 next reports the results from an extended estimation that adds a second distance dimension. Our core framework only measures distances from the GQ highway structure itself (where the closest access point is). Especially on this urban/rural dimension, it is reasonable to suspect that the distance from the nodal cities themselves may also play an important role. Points on the GQ system that are within close range of a nodal city may have very valuable urban land for manufacturers to exploit (e.g., taking advantage of cheaper rents in markets nearby but outside of the major cities). Likewise, locations in the hinterland through which the GQ system passes may be very valuable for other applications.

The empirical challenge of conducting these exercises is that the number of observations starts to become very thin when crossing two dimensions with each other, dramatically reducing the statistical precision of estimates. Accordingly, we take a simple approach of adding an additional interaction for a district being more than 350 km from the four main cities of the GQ system. This distance roughly divides the districts that lie on the GQ structure in half. The estimations include a simple interaction for being within 350 km of a nodal city in the post-upgrades period, and we interact our typical distance from GQ metrics with the additional distance variable. In these estimations, locations greater than 50 km from the GQ structure and also more than 350 km from a nodal city serve as the control group.

The patterns are quite intriguing. The top three rows, which resemble our traditional framework, are quantifying responses for districts within 350 km of a nodal city. These areas have a strong overall response in Columns 1-3. Significantly, the GQ upgrades also appear to be promoting activity in the urban and rural areas of districts within 10 km of the highway, with urban areas experiencing the strongest stimulus. The effects are not present for districts that are more than 10 km from the GQ highways, but still within 350 km of a nodal city. This is strong evidence of the GQ system shaping the spatial direction of development around India's connected cities.

The next three rows document the differential effect compared to these results for districts that are more than 350 km from a nodal city for the GQ system. To identify the response for these hinterland locations, one adds the corresponding coefficients from the fourth through sixth rows to the base effects documented in the first three rows. Looking at the fifth row, many of the important gains for urban areas that we see evidence of around the nodal cities are diminished in Columns 4-6. By contrast, Columns 7-9 show that rural settings that are located on the GQ system but far removed from the nodal districts have an equal or stronger response. Thus, the intriguing spatial finding is that the added connectivity of the GQ upgrades is more impacting urban locations in areas near to the GQ nodal cities, and rural areas in connected districts that are farther away.[4]

*Urban and Rural Patterns for Unorganized Sector Activity*

Before considering shares of activity, we pause to describe quickly the connection (or lack thereof) between GQ upgrades and the broad development of unorganized manufacturing activity. One effort in this project was to implement the GQ empirical strategy used in Ghani et al. (2012a) in the unorganized sector to compare against the large, rapid effects observed for the organized sector. As described in the prior section, our unorganized sector data stop in 2005, compared to 2007 for the organized sector. We are currently working to extend this time frame to 2010 for both sectors, but even by 2005 the organized sector shows a response in terms of young firm activity and productivity (Ghani et al. 2012a) and sourcing/inventory management (Datta 2011). It is thus useful to quantify whether the unorganized sector has a similarly rapid response.

[4] It may initially appear that this divergence with respect to distance from a nodal city is simply a consequence of the districts farther removed from a nodal city being more rural overall. It should be noted, however, that these results are estimating proportionate responses off of the base urban or rural activity in each district. Thus, the longer-term degree to which districts are urban or rural has been controlled for in the estimations, with the emphasis instead upon the growth in activity within each type of area.

Appendix Tables 1a-1c report three portions of our basic framework to show differences and similarities, and we highlight the key lessons here. First, unlike the organized sector, our difference-in-difference estimations find that non-nodal districts close to the GQ system behave similarly to those located farther away with respect to aggregate levels of unorganized manufacturing. This comparability of districts 0-10 km from the GQ network with those that are 10-50 km apart holds irrespective of the whether the highway development close to the district was an upgrade or a new construction (although there are traces of a stronger response for new construction). Likewise, unreported estimations do not find differences in unorganized activity depending upon the completion date of the GQ upgrade (e.g., considering areas completed prior to 2002). There is some evidence that GQ upgrades most impact the unorganized sector activity in industries that have low labor intensity, but these sorting patterns are again quite diminished compared to what is observed for the organized sector. Thus, it appears that the highway improvements had limited aggregate effects for the unorganized sector, especially in comparison to the organized sector.[5]

These results are reasonable given the structure of unorganized manufacturing in India. By definition, unorganized enterprises are small establishments. Most employees in these enterprises are not full time, and many of these establishments are household based. Given the informality of this sector, it is less likely that such establishments would depend on materials and products and connectivity to the market through national highways. The small-scale nature of these establishments makes it more likely that they target local product and labor markets. Thus, it is likely that they are more dependent on state or district roads vis-à-vis national highways.[6]

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[5] We observe more consistent evidence for increased entry of young plants in the unorganized sector in nodal cities. As described in the prior section, these results are hard to interpret given the degree to which the GQ upgrades were chosen to support these nodal cities.

[6] NSS data identify the gender of establishment owners, which is not possible in ASI surveys. We use this information to investigate whether GQ upgrades had any differential effect on economic outcomes of female- versus male-owned plants. We assess economic outcomes separately by the gender of owners and through ratios of economic outcomes in female- versus male-owned plants. Both approaches find no change in the gender balance of establishment owners due to proximity to highways in the unorganized sector.

*Urbanization Rates and Spatial Sorting of Activity within Districts*

With this background, Table 6 provides an analysis of manufacturing urbanization rates in the organized sector, unorganized sector, and for manufacturing as a whole. As we highlighted earlier, these estimations remove the aggregate consequences of the infrastructure investments, only quantifying net shifts in economic activity across types of areas. To make this analysis meaningful, we exclude districts for which there is very little manufacturing activity in either urban or rural settings. For instance, in the 2007 organized sector, 16 districts are surveyed completely in urban areas, while 29 districts are surveyed completely in rural areas. Specifically, we require that districts have 1) surveyed plants in both types of locations in every period, and 2) at least five plants in both rural and urban areas in 2000. These restrictions account for the reduced observation count in these estimations compared to the prior tables.

As would be anticipated by our earlier findings, the organized sector in Columns 1-3 shows a modest shift towards a smaller urban share. This decline is most evident in employment and output urban shares when comparing districts on the GQ highway to those that more than 200 km from the GQ network. These findings connect to the broader movement of the organized sector out of India's urban areas (Ghani et al. 2012b). The results suggest that major infrastructure projects like the GQ highway upgrades may contribute to or accelerate this spatial shift. By contrast, we observe no changes in the urbanization rates for the unorganized sector. This contrasts with the positive role observed for within-district infrastructure in Ghani et al. (2012b) for promoting the increased urbanization rates of unorganized sector activity. The inter-district connectivity provided by major infrastructure projects does not appear to play a significant role in this trend.

Table 7 provides a final analysis that builds upon the spatial mismatch framework of Ghani et al. (2012b). We do not repeat the metric design for spatial mismatch here, as it is a bit cumbersome, but instead describe its intuition. The idea is to compare how different the allocation of industries across urban and rural locations with a district is from what would have been predicted using national urbanization rates. For example, industries like office, accounting and computing machinery are predominantly in urban areas, while industries like non-metallic mineral products are predominantly rural. We measure the extent to which the observed industry sorting across urban and rural locations in a district is different from what these national patterns would suggest for a district. We observe very limited consequences, especially in terms of economic magnitudes, for this within-district sorting after the GQ upgrades. Ghani et al. (2012b) also find very little impact on the sorting due to within-district infrastructure, so on this dimension the two studies point in the same direction.

## 4. Conclusions

Many discussions of India's future highlight the need and expected growth of urbanization. Another set of discussions, which often overlap extensively, highlight the importance of enhancing India's infrastructure (e.g., World Bank 2012, McKinsey 2010, 2012). In this paper, we have quantified the degree to which one such infrastructure project—the massive upgrades to the GQ highway network that connects four of India's major cities—influenced the urbanization of the manufacturing sector in non-nodal locations.

The patterns are quite intriguing. The upgrades are connected to enhancements in organized sector activity in both urban and rural environments. Across the full span of the GQ system, increases in entry rates and plant productivity are fairly balanced between the two settings, with the main exception being that rural areas receive relatively more stimulus in terms of net output growth. Looking closer at highway segments, urban areas along the highways that are closer to the nodal districts experience greater entry, while rural areas in the hinterlands farther removed from the GQ nodal cities receive proportionately more stimulus. By contrast, the unorganized sector of manufacturing is not closely linked to the GQ developments in either location and the within-district spatial sorting of activity has little connection. Thus, the GQ experience suggests that major inter-district projects are likely to continue and accelerate the spatial adjustments of the organized sector and its general move towards rural locations. On the other hand, the GQ experience does not appear connected to the general movement of the unorganized manufacturing sector into Indian cities.

Understanding the patterns is important for policy makers and regional analysis, as they identify how infrastructure investments shape the spatial growth of regions within India and the distribution of industrialization and income. While we do not find in this study a connection to the unorganized sector, we remain cautious about this finding until future studies can collaborate it in other ways. This can be done through household surveys that extend beyond the manufacturing sector. We also believe that satellite data on economic activity would be an especially powerful tool in this context.

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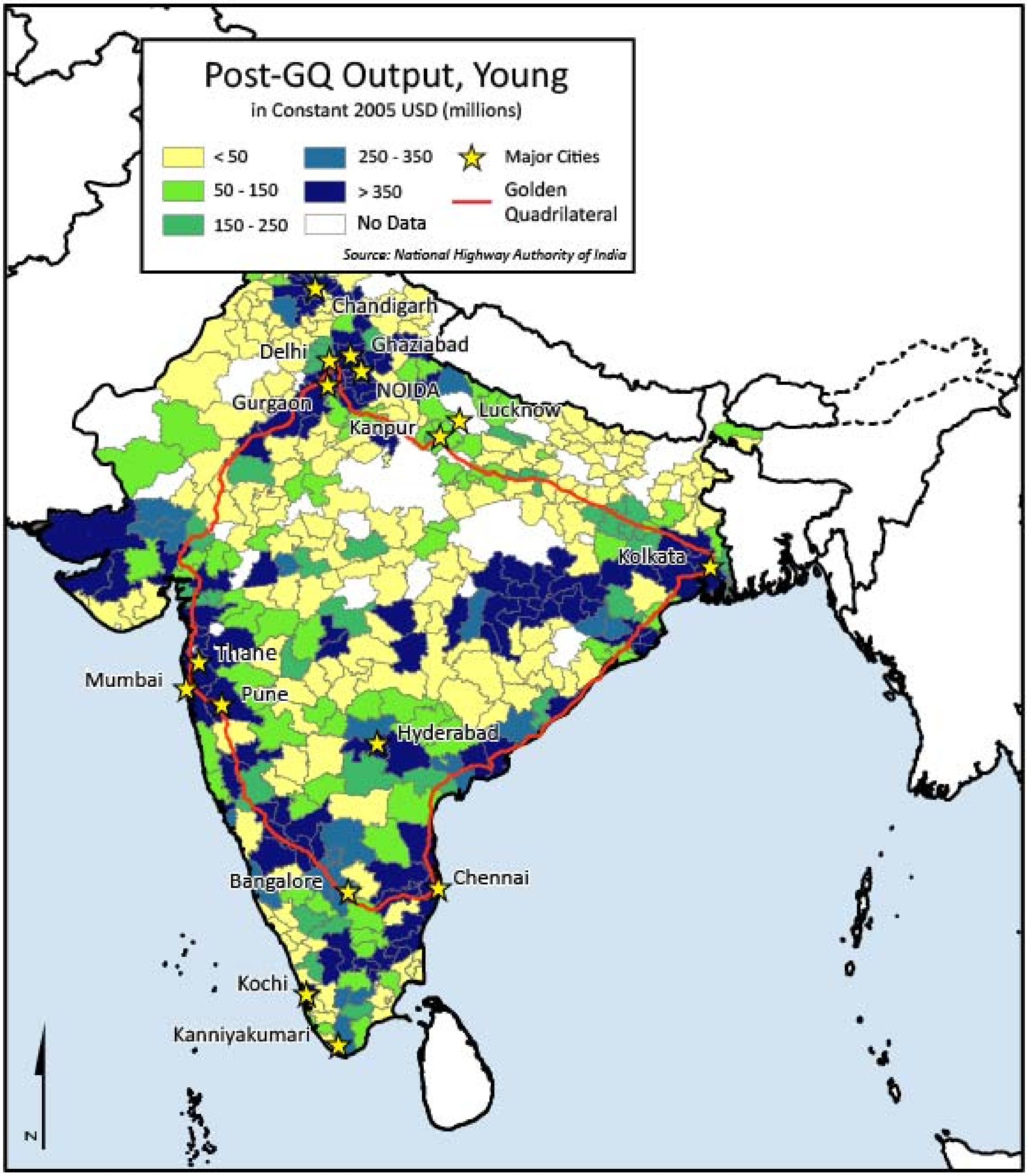
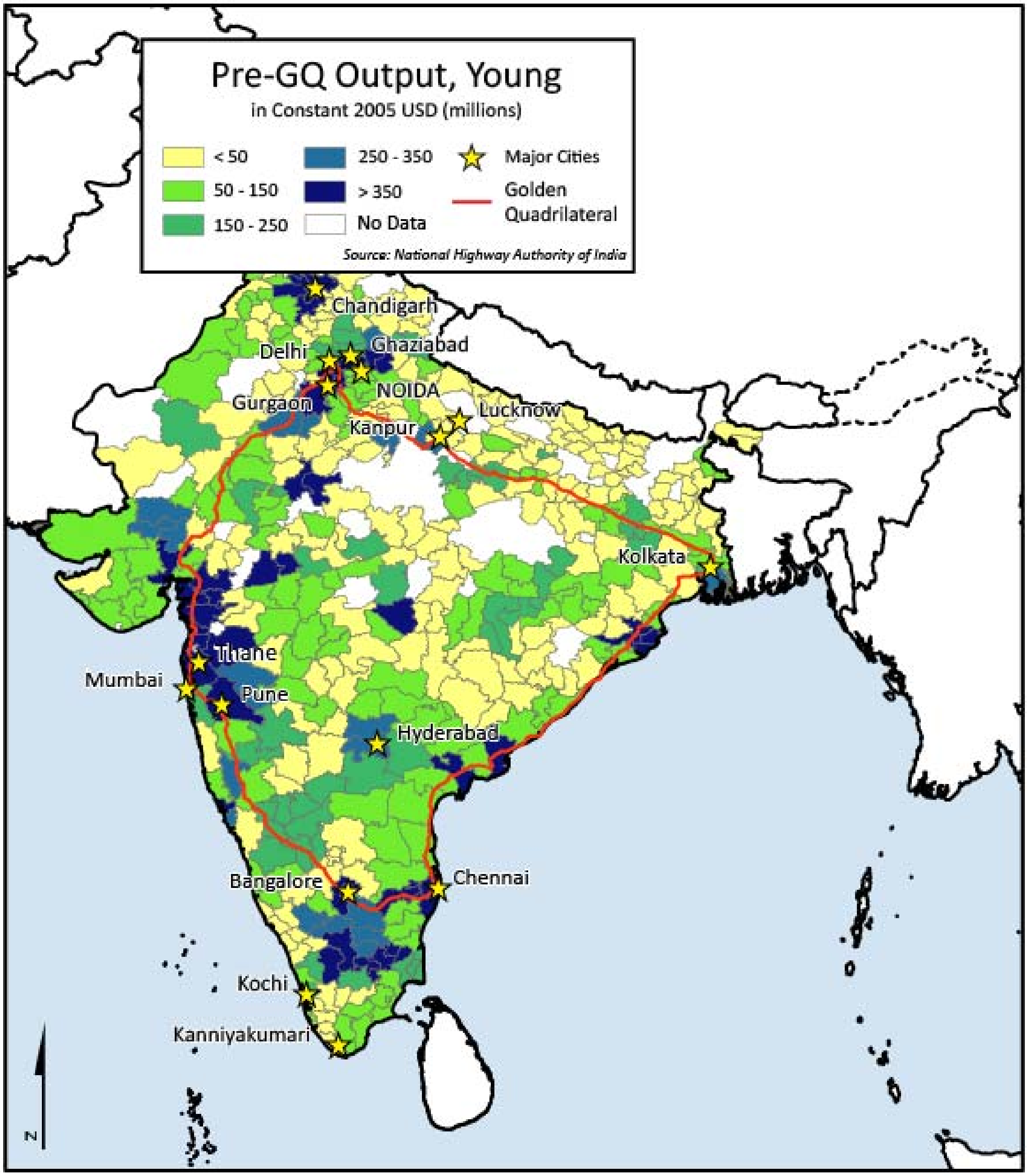
**Figure 1: GQ Network and Levels of Young Establishment Output**





Pre-GQ Output, Young
in Constant 2005 USD (millions)
< 50
50 - 150
150 - 250
250 - 350
> 350
No Data
Major Cities
Golden Quadrilateral
Source: National Highway Authority of India
Chandigarh
Delhi
Ghaziabad
NOIDA
Gurgaon
Lucknow
Kanpur
Kolkata
Thane
Mumbai
Pune
Hyderabad
Bangalore
Chennai
Kochi
Kanniyakumari
N

**Figure 1: GQ Network and Levels of Young Establishment Output, continued**

Table 1a: Descriptive statistics for organized sector

| | Levels of total activity | | | Levels of young firm activity | | |
|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Average levels of activity in 1994 and 2000, combining districts within spatial range | | | | | |
| Total | 81,641 | 5,879,283 | 3.9E+11 | 12,166 | 563,479 | 4.5E+10 |
| Nodal district for GQ | 11,365 | 723,042 | 5.8E+10 | 1,403 | 71,037 | 5.2E+09 |
| District 0-10 km from GQ | 24,816 | 2,098,769 | 1.3E+11 | 4,054 | 196,958 | 1.5E+10 |
| District 10-50 km from GQ | 6,003 | 375,423 | 3.4E+10 | 1,069 | 44,087 | 5.8E+09 |
| District over 50 km from GQ | 39,456 | 2,682,049 | 1.7E+11 | 5,641 | 251,398 | 1.9E+10 |
| Urban Total | 55,503 | 3,879,188 | 2.4E+11 | 6,307 | 267,377 | 1.9E+10 |
| Nodal district for GQ | 10,430 | 666,887 | 5.3E+10 | 1,195 | 60,447 | 4.2E+09 |
| District 0-10 km from GQ | 16,600 | 1,456,570 | 7.7E+10 | 1,944 | 94,002 | 6.1E+09 |
| District 10-50 km from GQ | 3,960 | 214,911 | 1.8E+10 | 552 | 16,314 | 1.5E+09 |
| District over 50 km from GQ | 24,514 | 1,540,821 | 9.2E+10 | 2,616 | 96,614 | 7.4E+09 |
| Urban Share | 68% | 66% | 61% | 52% | 47% | 43% |
| Nodal district for GQ | 92% | 92% | 91% | 85% | 85% | 81% |
| District 0-10 km from GQ | 67% | 69% | 58% | 48% | 48% | 40% |
| District 10-50 km from GQ | 66% | 57% | 52% | 52% | 37% | 25% |
| District over 50 km from GQ | 62% | 57% | 54% | 46% | 38% | 39% |
| | B. Average Levels of activity in 2005 and 2007 combining districts within spatial range | | | | | |
| Total | 100,951 | 3,571,552 | 1.1E+12 | 16,104 | 390,145 | 1.2E+11 |
| Nodal district for GQ | 13,751 | 489,068 | 1.7E+11 | 2,317 | 68,171 | 1.8E+10 |
| District 0-10 km from GQ | 33,774 | 1,208,338 | 4.0E+11 | 5,681 | 135,277 | 3.9E+10 |
| District 10-50 km from GQ | 7,410 | 222,213 | 8.4E+10 | 1,228 | 21,779 | 5.9E+09 |
| District over 50 km from GQ | 46,017 | 1,651,932 | 4.2E+11 | 6,878 | 164,918 | 5.7E+10 |
| Urban Total | 61,431 | 2,101,925 | 5.7E+11 | 7,621 | 186,840 | 4.3E+10 |
| Nodal district for GQ | 11,880 | 418,401 | 1.3E+11 | 1,909 | 56,496 | 1.4E+10 |
| District 0-10 km from GQ | 20,405 | 735,688 | 2.2E+11 | 2,629 | 67,447 | 1.6E+10 |
| District 10-50 km from GQ | 4,303 | 110,170 | 3.3E+10 | 550 | 8,615 | 2.2E+09 |
| District over 50 km from GQ | 24,843 | 837,667 | 1.9E+11 | 2,533 | 54,282 | 1.1E+10 |
| Urban Share | 61% | 59% | 53% | 47% | 48% | 36% |
| Nodal district for GQ | 86% | 86% | 75% | 82% | 83% | 74% |
| District 0-10 km from GQ | 60% | 61% | 55% | 46% | 50% | 41% |
| District 10-50 km from GQ | 58% | 50% | 40% | 45% | 40% | 36% |
| District over 50 km from GQ | 54% | 51% | 46% | 37% | 33% | 20% |

Notes: Descriptive totals taken from the Annual Survey of Industries.

Table 1b: Descriptive statistics for unorganized sector

| | Levels of total activity | | | Levels of young firm activity | | |
|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Average levels of activity in 1994 and 2000, combining districts within spatial range | | | | | |
| Total | 13,153,144 | 27,523,611 | 1.0E+11 | 1,630,239 | 3,903,673 | 1.3E+10 |
| Nodal district for GQ | 575,139 | 2,113,751 | 2.7E+10 | 157,661 | 635,383 | 3.1E+09 |
| District 0-10 km from GQ | 4,641,334 | 9,673,250 | 2.7E+10 | 477,638 | 1,098,275 | 3.4E+09 |
| District 10-50 km from GQ | 1,425,447 | 2,851,789 | 7.8E+09 | 184,064 | 381,498 | 1.1E+09 |
| District over 50 km from GQ | 6,511,225 | 12,884,821 | 3.9E+10 | 810,875 | 1,788,517 | 5.9E+09 |
| Urban Total | 3,749,445 | 9,784,626 | 6.7E+10 | 685,679 | 1,969,850 | 8.5E+09 |
| Nodal district for GQ | 497,259 | 1,932,472 | 2.7E+10 | 137,517 | 568,898 | 2.9E+09 |
| District 0-10 km from GQ | 1,111,031 | 2,801,811 | 1.4E+10 | 169,981 | 468,775 | 1.7E+09 |
| District 10-50 km from GQ | 376,292 | 875,257 | 3.8E+09 | 58,166 | 150,983 | 6.3E+08 |
| District over 50 km from GQ | 1,764,863 | 4,175,086 | 2.2E+10 | 320,015 | 781,194 | 3.3E+09 |
| Urban Share | 29% | 36% | 66% | 42% | 50% | 63% |
| Nodal district for GQ | 86% | 91% | 98% | 87% | 90% | 93% |
| District 0-10 km from GQ | 24% | 29% | 51% | 36% | 43% | 51% |
| District 10-50 km from GQ | 26% | 31% | 49% | 32% | 40% | 56% |
| District over 50 km from GQ | 27% | 32% | 57% | 39% | 44% | 56% |
| | B. Average Levels of activity in 2005 combining districts within spatial range | | | | | |
| Total | 15,557,212 | 29,639,174 | 1.5E+11 | 1,894,389 | 3,638,043 | 1.7E+10 |
| Nodal district for GQ | 702,054 | 2,453,966 | 4.0E+10 | 162,326 | 552,483 | 6.3E+09 |
| District 0-10 km from GQ | 4,945,968 | 9,301,020 | 3.5E+10 | 639,813 | 1,056,946 | 2.5E+09 |
| District 10-50 km from GQ | 1,619,015 | 3,136,999 | 1.3E+10 | 177,898 | 343,144 | 1.5E+09 |
| District over 50 km from GQ | 8,290,176 | 14,747,189 | 5.8E+10 | 914,352 | 1,685,471 | 6.5E+09 |
| Urban Total | 4,666,313 | 11,203,922 | 9.9E+10 | 678,982 | 1,678,906 | 1.1E+10 |
| Nodal district for GQ | 598,666 | 2,287,278 | 3.9E+10 | 135,523 | 508,670 | 6.1E+09 |
| District 0-10 km from GQ | 1,467,979 | 3,185,114 | 2.0E+10 | 192,290 | 401,740 | 1.3E+09 |
| District 10-50 km from GQ | 429,359 | 1,121,648 | 7.7E+09 | 68,442 | 172,716 | 9.5E+08 |
| District over 50 km from GQ | 2,170,310 | 4,609,882 | 3.2E+10 | 282,726 | 595,780 | 2.5E+09 |
| Urban Share | 30% | 38% | 68% | 36% | 46% | 65% |
| Nodal district for GQ | 85% | 93% | 97% | 83% | 92% | 98% |
| District 0-10 km from GQ | 30% | 34% | 58% | 30% | 38% | 51% |
| District 10-50 km from GQ | 27% | 36% | 57% | 38% | 50% | 64% |
| District over 50 km from GQ | 26% | 31% | 56% | 31% | 35% | 39% |

Notes: Descriptive totals taken from the National Sample Statistics.

Table 2: Estimations of GQ improvements for entrants into manufacturing organized sector

| | All areas of districts | | | Urban areas of districts | | | Rural areas of districts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.702 | 1.167 | 1.647 | 0.388 | 0.631 | 0.383 | -0.165 | 0.202 | 0.723 |
| Nodal district | (0.662) | (0.814) | (0.951) | (0.433) | (0.566) | (0.723) | (0.692) | (0.804) | (1.215) |
| Post GQ upgrades * | 0.436 | 0.471 | 0.928 | 0.319 | 0.221 | 0.443 | 0.442 | 0.597 | 1.059 |
| District 0-10 km from GQ | (0.172) | (0.239) | (0.346) | (0.176) | (0.252) | (0.380) | (0.183) | (0.260) | (0.389) |
| Post GQ upgrades * | -0.012 | -0.056 | -0.263 | -0.009 | -0.056 | -0.351 | -0.015 | 0.006 | -0.126 |
| District 10-50 km from GQ | (0.240) | (0.357) | (0.537) | (0.225) | (0.312) | (0.427) | (0.261) | (0.380) | (0.620) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1248 | 1248 | 1112 | 1112 | 1112 | 1164 | 1164 | 1164 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.621 | 1.071 | 1.419 | 0.416 | 0.676 | 0.414 | -0.306 | 0.048 | 0.423 |
| Nodal district | (0.668) | (0.824) | (0.968) | (0.439) | (0.575) | (0.741) | (0.700) | (0.818) | (1.234) |
| Post GQ upgrades * | 0.355 | 0.376 | 0.702 | 0.347 | 0.266 | 0.474 | 0.301 | 0.444 | 0.758 |
| District 0-10 km from GQ | (0.186) | (0.266) | (0.382) | (0.189) | (0.270) | (0.411) | (0.207) | (0.294) | (0.435) |
| Post GQ upgrades * | -0.094 | -0.151 | -0.490 | 0.019 | -0.011 | -0.320 | -0.156 | -0.148 | -0.426 |
| District 10-50 km from GQ | (0.253) | (0.379) | (0.566) | (0.236) | (0.327) | (0.456) | (0.281) | (0.407) | (0.655) |
| Post GQ upgrades * | -0.185 | -0.282 | -0.545 | 0.059 | 0.099 | -0.005 | -0.263 | -0.310 | -0.553 |
| District 50-125 km from GQ | (0.214) | (0.310) | (0.513) | (0.241) | (0.279) | (0.433) | (0.236) | (0.379) | (0.634) |
| Post GQ upgrades * | -0.136 | -0.101 | -0.356 | 0.055 | 0.084 | 0.132 | -0.287 | -0.294 | -0.617 |
| District 125-200 km from GQ | (0.229) | (0.360) | (0.513) | (0.249) | (0.364) | (0.548) | (0.236) | (0.391) | (0.571) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1248 | 1248 | 1112 | 1112 | 1112 | 1164 | 1164 | 1164 |

Notes: Estimations consider the location of organized-sector manufacturing activity in 311 Indian districts for 1994, 2000, 2005, and 2007 from the Annual Survey of Industries. Young plants are those less than four years old. Panel A estimates effects of GQ upgrades for nearby districts relative to districts more than 50 km from the GQ network; Panel B includes extended spatial rings to measure effects relative to districts 200 km away from the GQ network. The Post GQ upgrades variable takes unit value for the years 2005 and 2007 after the GQ upgrades commenced in 2001. Outcome variables are winsorized at their 1% and 99% levels, and entry variables are coded at the 1% level where no entry is observed to maintain a consistent sample. Columns 4-6 consider urban areas within districts, while columns 7-9 consider rural areas. Districts are dropped in these urban/rural splits if there are no manufacturing areas of that type within the district. Estimations report standard errors clustered by district, include district and year fixed effects, and weight observations by log total district population in 2001.

Table 3: Estimations of GQ improvements for productivity of plants in manufacturing organized sector

| | All areas of districts | | Urban areas of districts | | Rural areas of districts | |
|---|---|---|---|---|---|---|
| | Labor prod. | TFP | Labor prod. | TFP | Labor prod. | TFP |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | |
| Post GQ upgrades * | 0.084 | -0.022 | 0.037 | 0.010 | 0.126 | 0.011 |
| Nodal district | (0.135) | (0.033) | (0.145) | (0.043) | (0.264) | (0.167) |
| Post GQ upgrades * | 0.177 | 0.086 | 0.165 | 0.098 | 0.198 | 0.099 |
| District 0-10 km from GQ | (0.093) | (0.042) | (0.139) | (0.066) | (0.099) | (0.056) |
| Post GQ upgrades * | 0.043 | -0.005 | -0.000 | -0.021 | 0.115 | 0.068 |
| District 10-50 km from GQ | (0.132) | (0.074) | (0.186) | (0.085) | (0.175) | (0.099) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1244 | 1108 | 1100 | 1160 | 1160 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | |
| Post GQ upgrades * | 0.158 | -0.003 | 0.095 | 0.038 | 0.236 | 0.012 |
| Nodal district | (0.144) | (0.041) | (0.167) | (0.055) | (0.272) | (0.171) |
| Post GQ upgrades * | 0.253 | 0.104 | 0.223 | 0.125 | 0.309 | 0.100 |
| District 0-10 km from GQ | (0.103) | (0.048) | (0.161) | (0.075) | (0.116) | (0.066) |
| Post GQ upgrades * | 0.118 | 0.013 | 0.058 | 0.006 | 0.225 | 0.070 |
| District 10-50 km from GQ | (0.141) | (0.078) | (0.204) | (0.092) | (0.186) | (0.105) |
| Post GQ upgrades * | 0.076 | 0.043 | 0.034 | 0.060 | 0.138 | 0.005 |
| District 50-125 km from GQ | (0.149) | (0.076) | (0.170) | (0.084) | (0.148) | (0.092) |
| Post GQ upgrades * | 0.214 | 0.029 | 0.203 | 0.050 | 0.278 | 0.002 |
| District 125-200 km from GQ | (0.129) | (0.066) | (0.189) | (0.084) | (0.159) | (0.092) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1244 | 1108 | 1100 | 1160 | 1160 |

Notes: See Table 2. Labor productivity is total output per employee, and TFP is the average residual in each district from a weighted regression of log of value added on logs of employment and capital for each industry and year.

Table 4: Estimations of GQ improvements for total size of manufacturing organized sector

| | All areas of districts | | | Urban areas of districts | | | Rural areas of districts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.560 | 0.560 | 0.654 | 0.249 | 0.328 | 0.377 | 0.309 | 0.572 | 0.643 |
| Nodal district | (0.501) | (0.462) | (0.453) | (0.184) | (0.225) | (0.278) | (0.324) | (0.312) | (0.322) |
| Post GQ upgrades * | 0.094 | -0.039 | 0.166 | 0.046 | -0.141 | 0.030 | 0.176 | 0.012 | 0.226 |
| District 0-10 km from GQ | (0.112) | (0.131) | (0.176) | (0.135) | (0.149) | (0.225) | (0.137) | (0.152) | (0.199) |
| Post GQ upgrades * | -0.023 | -0.078 | -0.006 | 0.001 | -0.164 | -0.170 | -0.011 | -0.095 | 0.042 |
| District 10-50 km from GQ | (0.129) | (0.135) | (0.191) | (0.181) | (0.217) | (0.323) | (0.196) | (0.174) | (0.239) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1248 | 1248 | 1112 | 1112 | 1112 | 1164 | 1164 | 1164 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.513 | 0.576 | 0.744 | 0.183 | 0.281 | 0.379 | 0.283 | 0.657 | 0.845 |
| Nodal district | (0.505) | (0.468) | (0.458) | (0.199) | (0.240) | (0.298) | (0.331) | (0.319) | (0.332) |
| Post GQ upgrades * | 0.047 | -0.022 | 0.257 | -0.019 | -0.189 | 0.031 | 0.149 | 0.097 | 0.429 |
| District 0-10 km from GQ | (0.128) | (0.144) | (0.177) | (0.156) | (0.172) | (0.249) | (0.152) | (0.162) | (0.203) |
| Post GQ upgrades * | -0.071 | -0.062 | 0.084 | -0.065 | -0.212 | -0.169 | -0.037 | -0.011 | 0.244 |
| District 10-50 km from GQ | (0.144) | (0.153) | (0.202) | (0.196) | (0.234) | (0.341) | (0.207) | (0.187) | (0.252) |
| Post GQ upgrades * | -0.209 | -0.108 | -0.018 | -0.248 | -0.165 | -0.138 | -0.023 | 0.118 | 0.278 |
| District 50-125 km from GQ | (0.157) | (0.136) | (0.183) | (0.174) | (0.192) | (0.256) | (0.195) | (0.180) | (0.242) |
| Post GQ upgrades * | 0.014 | 0.163 | 0.361 | -0.017 | -0.027 | 0.146 | -0.076 | 0.206 | 0.496 |
| District 125-200 km from GQ | (0.140) | (0.155) | (0.200) | (0.170) | (0.197) | (0.278) | (0.176) | (0.178) | (0.247) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1248 | 1248 | 1112 | 1112 | 1112 | 1164 | 1164 | 1164 |

Notes: See Table 2.

Table 5: Estimations of GQ improvements for entrants into manufacturing organized sector by distance from nodal areas

| | All areas of districts | | | Urban areas of districts | | | Rural areas of districts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Post GQ upgrades * | 0.748 | 1.356 | 1.923 | 0.553 | 0.891 | 0.764 | -0.299 | 0.089 | 0.573 |
| Nodal district | (0.692) | (0.862) | (1.046) | (0.468) | (0.614) | (0.792) | (0.718) | (0.854) | (1.303) |
| Post GQ upgrades * | 0.483 | 0.719 | 1.334 | 0.530 | 0.613 | 0.935 | 0.257 | 0.426 | 0.801 |
| District 0-10 km from GQ | (0.287) | (0.417) | (0.637) | (0.280) | (0.415) | (0.611) | (0.288) | (0.430) | (0.681) |
| Post GQ upgrades * | -0.007 | 0.147 | 0.151 | 0.108 | 0.121 | -0.041 | -0.136 | -0.004 | -0.144 |
| District 10-50 km from GQ | (0.369) | (0.519) | (0.763) | (0.317) | (0.478) | (0.665) | (0.369) | (0.507) | (0.812) |
| Post GQ upgrades * | 0.061 | 0.139 | 0.258 | 0.233 | 0.366 | 0.538 | -0.185 | -0.157 | -0.207 |
| Distance 350 km+ from nodal | (0.236) | (0.349) | (0.529) | (0.226) | (0.302) | (0.438) | (0.239) | (0.371) | (0.589) |
| Post GQ upgrades * | -0.067 | -0.300 | -0.593 | -0.335 | -0.663 | -0.785 | 0.302 | 0.290 | 0.456 |
| District 0-10 km from GQ * | (0.371) | (0.510) | (0.735) | (0.377) | (0.526) | (0.778) | (0.389) | (0.536) | (0.814) |
| Distance 350 km+ from nodal | | | | | | | | | |
| Post GQ upgrades * | 0.022 | -0.401 | -0.766 | -0.113 | -0.163 | -0.364 | 0.155 | -0.079 | -0.093 |
| District 10-50 km from GQ * | (0.507) | (0.794) | (1.158) | (0.484) | (0.637) | (0.852) | (0.553) | (0.813) | (1.342) |
| Distance 350 km+ from nodal | | | | | | | | | |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1248 | 1248 | 1248 | 1112 | 1112 | 1112 | 1164 | 1164 | 1164 |

Notes: See Table 2. Estimations include an additional interaction for being greater than 350 km from a nodal city on GQ.

Table 6: Estimations of GQ improvements for urbanization of manufacturing sector

| | Organized sector urban share | | | Unorganized sector urban share | | | Total urban share | | |
|---|---|---|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.062 | 0.061 | 0.019 | -0.022 | -0.000 | -0.086 | -0.021 | 0.044 | 0.015 |
| Nodal district | (0.049) | (0.052) | (0.063) | (0.035) | (0.033) | (0.109) | (0.028) | (0.045) | (0.052) |
| Post GQ upgrades * | -0.015 | -0.034 | -0.031 | 0.004 | 0.010 | -0.004 | 0.004 | 0.013 | -0.020 |
| District 0-10 km from GQ | (0.029) | (0.032) | (0.038) | (0.028) | (0.031) | (0.042) | (0.028) | (0.026) | (0.031) |
| Post GQ upgrades * | 0.005 | 0.011 | 0.004 | -0.013 | -0.005 | -0.034 | -0.013 | -0.007 | -0.045 |
| District 10-50 km from GQ | (0.042) | (0.044) | (0.061) | (0.037) | (0.040) | (0.049) | (0.036) | (0.036) | (0.041) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 924 | 924 | 924 | 1062 | 1062 | 1062 | 1077 | 1077 | 1077 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.047 | 0.030 | -0.004 | -0.039 | -0.015 | -0.090 | -0.037 | 0.034 | 0.021 |
| Nodal district | (0.053) | (0.054) | (0.068) | (0.037) | (0.036) | (0.111) | (0.029) | (0.046) | (0.056) |
| Post GQ upgrades * | -0.030 | -0.064 | -0.054 | -0.014 | -0.005 | -0.008 | -0.012 | 0.003 | -0.013 |
| District 0-10 km from GQ | (0.034) | (0.035) | (0.045) | (0.030) | (0.034) | (0.047) | (0.030) | (0.029) | (0.036) |
| Post GQ upgrades * | -0.010 | -0.020 | -0.019 | -0.031 | -0.020 | -0.038 | -0.029 | -0.016 | -0.039 |
| District 10-50 km from GQ | (0.046) | (0.046) | (0.066) | (0.038) | (0.042) | (0.053) | (0.038) | (0.038) | (0.045) |
| Post GQ upgrades * | -0.053 | -0.084 | -0.070 | -0.033 | -0.028 | 0.003 | -0.031 | -0.025 | -0.003 |
| District 50-125 km from GQ | (0.048) | (0.051) | (0.058) | (0.033) | (0.034) | (0.043) | (0.033) | (0.031) | (0.043) |
| Post GQ upgrades * | -0.008 | -0.040 | -0.021 | -0.033 | -0.027 | -0.017 | -0.030 | -0.013 | 0.028 |
| District 125-200 km from GQ | (0.044) | (0.049) | (0.062) | (0.030) | (0.032) | (0.042) | (0.029) | (0.027) | (0.040) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 924 | 924 | 924 | 1062 | 1062 | 1062 | 1077 | 1077 | 1077 |

Notes: See Table 2. Estimations in Columns 1-3 consider the urban share of organized sector manufacturing activity in Indian districts for 1994, 2000, 2005, and 2007 from the Annual Survey of Industries. Estimations in Columns 4-6 consider the urban share of unorganized sector manufacturing activity in Indian districts for 1994, 2000, and 2005 from the National Sample Survey. Estimations in Columns 7-9 consider the total urban share for 1994, 2000, and 2005 by combining the two surveys.

Table 7: Estimations of GQ improvements for spatial mismatch

| | Organized sector mismatch | | Unorganized sector mismatch | | Total urban spatial mismatch | |
|---|---|---|---|---|---|---|
| | Plants | Employment | Plants | Employment | Plants | Employment |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | |
| Post GQ upgrades * | -0.011 | -0.004 | 0.026 | 0.026 | 0.017 | 0.017 |
| Nodal district | (0.010) | (0.011) | (0.024) | (0.018) | (0.025) | (0.025) |
| Post GQ upgrades * | 0.001 | 0.014 | -0.012 | 0.001 | -0.007 | -0.007 |
| District 0-10 km from GQ | (0.010) | (0.013) | (0.019) | (0.020) | (0.018) | (0.018) |
| Post GQ upgrades * | 0.002 | -0.006 | -0.009 | -0.004 | -0.007 | -0.007 |
| District 10-50 km from GQ | (0.011) | (0.018) | (0.029) | (0.031) | (0.026) | (0.026) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 912 | 912 | 1104 | 1104 | 1131 | 1131 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | |
| Post GQ upgrades * | 0.001 | 0.006 | 0.030 | 0.022 | 0.026 | 0.005 |
| Nodal district | (0.011) | (0.013) | (0.025) | (0.019) | (0.026) | (0.017) |
| Post GQ upgrades * | 0.013 | 0.024 | -0.009 | -0.003 | 0.003 | -0.001 |
| District 0-10 km from GQ | (0.011) | (0.015) | (0.020) | (0.021) | (0.019) | (0.018) |
| Post GQ upgrades * | 0.014 | 0.004 | -0.005 | -0.008 | 0.003 | 0.002 |
| District 10-50 km from GQ | (0.012) | (0.020) | (0.030) | (0.031) | (0.027) | (0.024) |
| Post GQ upgrades * | 0.031 | 0.019 | 0.027 | 0.007 | 0.038 | 0.014 |
| District 50-125 km from GQ | (0.012) | (0.016) | (0.027) | (0.028) | (0.025) | (0.024) |
| Post GQ upgrades * | 0.020 | 0.024 | -0.013 | -0.024 | 0.004 | -0.009 |
| District 125-200 km from GQ | (0.011) | (0.016) | (0.025) | (0.029) | (0.023) | (0.023) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 912 | 912 | 1104 | 1104 | 1131 | 1131 |

Notes: See Table 6.

App. Table 1a: Pre-post estimations of the impact of GQ improvements on unorganized activity

| | Log levels of total activity | | | Log levels of young firm activity | | |
|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Base spatial horizon measuring effects relative to districts 50+ km from the GQ network | | | | | |
| Post GQ upgrades * | 0.184 | 0.259 | 0.126 | 0.376 | 0.370 | 0.031 |
| Nodal district | (0.177) | (0.146) | (0.180) | (0.279) | (0.223) | (0.363) |
| Post GQ upgrades * | -0.086 | -0.096 | -0.077 | 0.059 | 0.093 | 0.038 |
| District 0-10 km from GQ | (0.105) | (0.109) | (0.131) | (0.208) | (0.212) | (0.234) |
| Post GQ upgrades * | -0.031 | 0.006 | 0.112 | -0.123 | -0.102 | -0.019 |
| District 10-50 km from GQ | (0.116) | (0.122) | (0.186) | (0.247) | (0.246) | (0.295) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 |
| | B. Extended spatial horizon measuring effects relative to districts 200+ km from the GQ network | | | | | |
| Post GQ upgrades * | 0.168 | 0.227 | 0.148 | 0.661 | 0.644 | 0.348 |
| Nodal district | (0.185) | (0.157) | (0.188) | (0.297) | (0.247) | (0.386) |
| Post GQ upgrades * | -0.102 | -0.127 | -0.054 | 0.344 | 0.367 | 0.356 |
| District 0-10 km from GQ | (0.117) | (0.124) | (0.141) | (0.232) | (0.237) | (0.266) |
| Post GQ upgrades * | -0.047 | -0.026 | 0.134 | 0.160 | 0.170 | 0.295 |
| District 10-50 km from GQ | (0.127) | (0.136) | (0.193) | (0.267) | (0.268) | (0.321) |
| Post GQ upgrades * | -0.074 | -0.130 | -0.112 | 0.392 | 0.293 | 0.127 |
| District 50-125 km from GQ | (0.118) | (0.130) | (0.144) | (0.240) | (0.247) | (0.296) |
| Post GQ upgrades * | 0.014 | 0.012 | 0.205 | 0.706 | 0.765 | 1.106 |
| District 125-200 km from GQ | (0.126) | (0.132) | (0.170) | (0.256) | (0.270) | (0.333) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 |

Notes: Estimations consider the location of unorganized sector manufacturing activity in 312 Indian districts for 1994, 2000, and 2005 from the National Sample Statistics. Young plants are those less than four years old. Panel A estimates effects of GQ upgrades for nearby districts relative to districts more than 50 km from the GQ network; Panel B includes extended spatial rings to measure effects relative to districts 200 km away from the GQ network. The Post GQ upgrades variable takes unit value for the year 2005 after the GQ upgrades commenced in 2001. Outcome variables are winsorized at their 1% and 99% levels, and entry variables are coded at the 1% level where no entry is observed to maintain a consistent sample. Estimations report standard errors clustered by district, include district and year fixed effects, and weight observations by log total district population in 2001.

App. Table 1b: Pre-post estimations split by new construction versus improvements

| | Log levels of total activity | | | Log levels of young firm activity | | |
|---|---|---|---|---|---|---|
| | Plants | Employment | Output | Plants | Employment | Output |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Post GQ upgrades * | 0.184 | 0.259 | 0.126 | 0.376 | 0.370 | 0.031 |
| Nodal district | (0.177) | (0.146) | (0.181) | (0.279) | (0.223) | (0.363) |
| Post GQ upgrades * | 0.072 | 0.036 | -0.014 | 0.233 | 0.306 | 0.261 |
| District 0-10 km from GQ * | (0.163) | (0.168) | (0.201) | (0.255) | (0.261) | (0.268) |
| New highway construction | | | | | | |
| Post GQ upgrades * | -0.217 | -0.204 | -0.128 | -0.084 | -0.083 | -0.145 |
| District 0-10 km from GQ * | (0.116) | (0.122) | (0.153) | (0.283) | (0.285) | (0.318) |
| Improvement of existing highway | | | | | | |
| Post GQ upgrades * | -0.031 | 0.006 | 0.112 | -0.123 | -0.102 | -0.019 |
| District 10-50 km from GQ | (0.116) | (0.122) | (0.186) | (0.247) | (0.246) | (0.295) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 |

Notes: See App. Table 1a. Estimations split local effects along the GQ network by whether the development is new highway construction or the improvement of existing highways. Effects are measured relative to districts 50+ km from the GQ network.

App. Table 1c: Estimations of location decisions of new plants by industry labor intensity

| | Log new establishment counts by industry labor intensity | | | Log new employment levels by industry labor intensity | | | Log new output levels by industry labor intensity | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-25th | 25th-75th | 75th | 0-25th | 25th-75th | 75th | 0-25th | 25th-75th | 75th |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | A. Base spatial horizon measuring effects relative to districts 50 km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 0.782 | 0.375 | 0.152 | 0.814 | 0.289 | 0.219 | 0.394 | 0.015 | 0.404 |
| Nodal district | (0.499) | (0.347) | (0.626) | (0.503) | (0.270) | (0.538) | (0.535) | (0.369) | (0.651) |
| Post GQ upgrades * | 0.401 | 0.077 | -0.384 | 0.411 | 0.073 | -0.418 | 0.134 | 0.085 | -0.559 |
| District 0-10 km from GQ | (0.372) | (0.225) | (0.386) | (0.379) | (0.225) | (0.370) | (0.413) | (0.263) | (0.483) |
| Post GQ upgrades * | -0.197 | -0.232 | -0.532 | -0.246 | -0.169 | -0.549 | -0.416 | 0.088 | -0.583 |
| District 10-50 km from GQ | (0.538) | (0.334) | (0.591) | (0.543) | (0.324) | (0.565) | (0.561) | (0.386) | (0.690) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 |
| | B. Extended spatial horizon measuring effects relative to districts 200 km from the GQ network | | | | | | | | |
| Post GQ upgrades * | 1.114 | 0.628 | 0.316 | 1.120 | 0.536 | 0.362 | 0.878 | 0.283 | 0.720 |
| Nodal district | (0.545) | (0.372) | (0.649) | (0.547) | (0.300) | (0.563) | (0.582) | (0.400) | (0.692) |
| Post GQ upgrades * | 0.733 | 0.330 | -0.220 | 0.717 | 0.321 | -0.274 | 0.618 | 0.354 | -0.242 |
| District 0-10 km from GQ | (0.428) | (0.263) | (0.423) | (0.434) | (0.262) | (0.406) | (0.469) | (0.307) | (0.537) |
| Post GQ upgrades * | 0.133 | 0.020 | -0.369 | 0.058 | 0.077 | -0.406 | 0.065 | 0.355 | -0.269 |
| District 10-50 km from GQ | (0.580) | (0.358) | (0.616) | (0.584) | (0.349) | (0.590) | (0.606) | (0.416) | (0.730) |
| Post GQ upgrades * | 0.590 | 0.408 | 0.167 | 0.430 | 0.341 | 0.108 | 0.504 | 0.198 | 0.337 |
| District 50-125 km from GQ | (0.440) | (0.290) | (0.463) | (0.425) | (0.297) | (0.456) | (0.445) | (0.378) | (0.570) |
| Post GQ upgrades * | 0.681 | 0.564 | 0.466 | 0.749 | 0.610 | 0.450 | 1.367 | 0.844 | 0.887 |
| District 125-200 km from GQ | (0.446) | (0.305) | (0.491) | (0.436) | (0.306) | (0.485) | (0.490) | (0.377) | (0.618) |
| District and year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 | 1089 |

Notes: See App. Table 1a. Industries are divided into groups based upon labor intensity in 2000 at the national level. These three bins include those with low labor intensity (the bottom quartile of intensity), medium intensity (the middle two quartiles), and high intensity (the top quartile).