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## Roads to the Market or the Town Hall? New Evidence from India's PMGSY

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# Roads to the Market or the Town Hall? New Evidence from India's PMGSY\*

## Abstract

We examine the impact of rural road connectivity on economic and novel governance outcomes in the context of the world's largest rural road program, India's PMGSY. Using a novel village-level survey designed around PMGSY's rollout, we exploit quasi-random variation in road placement to estimate causal effects of connectivity on agricultural and labor markets as well as governance and political connectivity. We find evidence that roads support market access, as local producer prices increase by 1.3 SD and agricultural outputs diversify – especially into highly perishable milk production. Despite the improved agricultural output prices and options, labor shifts away from agriculture to casual work, suggesting improved non-agricultural market access. Interestingly, increases in casual labor are almost exclusively local to the connected village, and we find a decrease of short- and medium-term migration by 0.8 SD. Additionally, road connectivity increases local state presence, with a 1.1 SD increase in an index of official government visits and a 0.9 SD increase in an index of political connectivity, and leads to higher wages on government construction projects and lower prices in government-run ration shops. Our findings highlight that, far from leading to an exodus into distant labor markets, road connectivity leads to more vibrant and diverse rural economies with stronger governing institutions.

## JEL classification

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## Keywords

infrastructure, governance, PMGSY, labor markets, migration, India

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# 1 Introduction

While global poverty has decreased substantially in recent decades, approximately 700 million people continue to experience extreme poverty, and 79% of these individuals live in rural areas (World Bank, 2024). Poor people in rural areas are often isolated from pathways out of poverty, in part because of a lack of basic infrastructure and connectivity to external markets. Poor road connectivity is often considered a major barrier to poverty reduction and development in rural areas (Banerjee et al., 2020). This has spurred infrastructure investments to improve connectivity and catalyze development in many countries.

Previous work has demonstrated that large infrastructure projects catalyze regional economic growth (e.g., Donaldson, 2015; Banerjee et al., 2020), and a growing body of research examines rural roads' impacts on village economies (e.g., Aggarwal, 2018; Asher and Novosad, 2020; Chaurey and Le, 2022; Dasgupta et al., 2024; Shamdasani, 2021; Dumas and Játiva, 2024). However, methodological and data constraints limit our understanding of these impacts.

We examine this question in the context of the world's largest rural road construction program, Pradhan Mantri Gram Sadak Yojana (PMGSY) in India. The PMGSY program, launched in 2000, provides all-weather road connectivity to unconnected villages and, to date, has connected more than 170,000 villages at a cost of \$45 billion (O.M.M.A.S, 2023b). We evaluate the impacts of this program on novel outcomes using unique village-level microdata collected in 267 villages in Uttar Pradesh (UP), one of India's most populous states.

A unique feature of the PMGSY program is that the priority for connecting a given village was determined in part by predetermined population criteria, allowing us to address the usual challenge of endogenous road placement. In particular, national guidelines indicated that habitations with populations first above 1,000 and then above 500 were prioritized in respective waves of construction. While these cutoffs were not closely respected in all states, even in noncompliant states villages with larger populations within a given district received higher priority (Shamdasani, 2021). This study exploits the second fact — that within population size bands, higher-ranked villages were connected first — to causally isolate the impact of roads. Specifically, we use an Instrumental Variables (IV) approach to estimate the causal

impacts of connectivity through a paved road on economic, social, and institutional outcomes at the village level. We instrument for road connectivity using the village's population rank within all unconnected villages in its district.

Our empirical strategy is similar in spirit to prior evaluations of PMGSY that exploit the quasi-random variation in the roll-out of the program but differs in important ways. To our knowledge, this study is the first to use variation in the population rank, rather than variation across population bands, to study the impacts of PMGSY roads.<sup>1</sup> Critically, this allows us to identify the causal effect of PMGSY in a state that did not comply with the official PMGSY population guidelines without relying on a parallel trends style assumption for villages that did and did not receive roads.<sup>2</sup>

Furthermore, we use a novel primary village-level survey dataset designed and collected around the PMGSY rollout years. This dataset has a number of advantages relative to previous work. First, it includes direct information on novel outcomes, including prices, wages, migration patterns, governance, and civic engagement. Second, it includes village-level information on outcomes such as land quality that are only available at the district level in secondary datasets.<sup>3</sup> Finally, we are able to assess the medium-term impacts of roads, as the data were collected 2–3 years after the completion of the road.

We investigate the impacts of roads on agricultural, labor market, and governance outcomes. In particular, we confirm that roads shift labor away from agriculture ([Asher and Novosad, 2020](#); [Shamdasani, 2021](#); [Garg et al., 2024](#)) without clearly impacting agricultural inputs or yields.<sup>4</sup> At the same time, we find novel evidence that farmers benefit from higher prices while also allowing the development of a more diverse portfolio of village agricultural activities (particularly animal husbandry).

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<sup>1</sup>E.g., [Asher and Novosad \(2020\)](#) and [Garg et al. \(2024\)](#) use a fuzzy regression discontinuity design comparing villages across the 1,000 and 500 population cut-offs, [Aggarwal \(2018\)](#) and [Aggarwal \(2021\)](#) use cross-district and -time variation in the fraction of villages reached by the program; and [Adukia et al. \(2020\)](#) and [Shamdasani \(2021\)](#) examine PMGSY roll-out controlling for village and time fixed effects.

<sup>2</sup>[Asher and Novosad \(2020\)](#) identify six states that did comply with these guidelines, noting that UP “built many [PMGSY] roads but did not follow the rules at all.”

<sup>3</sup>Studies conducted at the district level must assume that the fraction of connected villages in a district is not correlated with changes in the outcome over time.

<sup>4</sup>Existing evidence on how roads impact agricultural technology adoption and inputs is somewhat mixed:[Asher and Novosad \(2020\)](#) finds null effects, but [Shamdasani \(2021\)](#) find that remote villages which were connected earlier had faster agricultural technology adoption and [Aggarwal \(2018\)](#) find that districts with more connected villages have faster growth in agricultural technology adoption.

Turning to the labor market, we dive more deeply than previous literature into how the exit from agriculture plays out. We confirm that casual labor increases as workers move into informal employment (we find a nearly 40 pp increase in the primacy of casual labor income within villages). However, we find that the location of these new labor opportunities is almost exclusively within the village. Despite presumably increasing access to local labor markets outside the village, road construction actually decreases short-term migration and casual labor outside the village, with an index of migration declining by 0.8 SD. Moreover, while local labor supply increases, we find no evidence of wage decreases; in fact, point estimates suggest that wages within the village increase across the board, with large and statistically significant impacts on wages in government construction projects. Overall, this points to the fact that connectivity to external markets leads to more efficient and diverse economies in connected villages themselves, rather than connecting workers to greener pastures elsewhere.

Finally, we find that roads lead to improved government presence, political connectivity, and service delivery. Complementing the increase in government construction wages, we find a decrease in prices in government-supported ration shops within the village,<sup>5</sup> suggesting an improvement in government service delivery. We find support for two potential mechanisms driving this improvement. First, civil service connectivity increases, with a 1.1 SD increase in an index of police and government official visits to the village. Second, political connectivity increases, with a 0.9 SD increase in an index of campaign visits, events, and newspaper access. This suggests that institutional development and political access may play an important roll in the development of villages.

## **2 Rural Roads in India: Pradhan Mantri Gram Sadak Yojana (PMGSY)**

The PMGSY is a flagship rural road program launched by the Government of India (GoI) in 2000 with the aim of reducing poverty in unconnected villages. At its inception, around 330,000 of India's 825,000 villages lacked all-weather road connectivity (NRRDA, 2005), and

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<sup>5</sup>This finding is broadly in line with Aggarwal (2018), who finds that aggregated consumer prices decrease. Our results suggest that overall price declines are due in part to local ration shops. We do not see evidence of (non-governmental) consumer price changes at the nearest market, though the point estimate on an index of prices is negative (Appendix Table A2). Most villages in our sample do not report local non-fair shop consumer prices.

the program initially focused on connecting large unconnected villages to support agrarian market access (O.M.M.A.S, 2023b; National Rural Roads Development Agency, 2003). By 2013, most such villages were connected, and the focus shifted to improving and maintaining rural roads. To date, PMGSY has significantly improved rural connectivity in India, with more than 742,000 kilometers of rural roads constructed or upgraded and more than 170,000 habitations connected at an estimated investment of \$45 billion (O.M.M.A.S, 2023a,b; Ministry of Rural Development, 2022).

We study the initial road-building iteration of the PMGSY road program, now known as PMGSY-I, under which roads linking unconnected villages were sanctioned and constructed in sequential phases from 2000-2013. The villages selected for connectivity in each phase were prioritized in part according to the population size of the village or cluster of villages (habitation), with larger villages receiving higher priority. For example, the earliest phases of construction (2000–2003) aimed to connect all unconnected villages with a 2001 census population of 1,000 or more, with subsequent waves targeting villages of 500 or more (by 2007) and eventually 250 or more (until 2013).<sup>6</sup> Moreover, official guidelines recommended preference be given to road segments serving larger populations (National Rural Roads Development Agency, 2003).

However, population was not the only factor. Official guidelines emphasized completing a "Core Network" connecting villages to basic services. Funds were not available for land acquisition or road repair, making some connections infeasible. Moreover, factors such as political considerations, economic importance, and the type of link route may have influenced prioritization. Despite this, the population remained the main basis for road allocation (Lehne et al., 2018). Officials prioritized unconnected villages within a district in large part according to their 2001 census population, with larger villages typically given higher priority. The within-district population criteria meant that a village had a higher probability of receiving a PMGSY road over a similar-sized village if there were fewer larger eligible villages within its district. Consequently, a village in a district with many larger unconnected villages was less likely to receive a new road, even when the population size was held constant.

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<sup>6</sup>Population targets were slightly lower in so-called hill and desert states and tribal areas, and states with no unconnected villages were directed to use lower thresholds even in early waves.

## 3 Sampling and Data

### 3.1 Setting and Sample

To measure the impacts of PMGSY, we surveyed 267 villages in the 14 districts nearest Lucknow,<sup>7</sup> the capital of Uttar Pradesh (UP), in the summer of 2007. UP is India's fourth most populous state with over 200 million people. UP is primarily agrarian (65% of the population depends on agriculture) with high poverty (38%) ([Agriculture Department, 2020](#)) and had the most unconnected villages before PMGSY ([O.M.M.A.S, 2023b](#)), making it ideal for studying road connectivity impacts. However, unlike some states, UP did not comply with the population-based threshold rules at all, and thus regression discontinuity-based analyses of PMGSY have excluded it from analysis ([Asher and Novosad, 2020](#)).

The sample was chosen to represent two sets of villages with otherwise similar characteristics: those with completed PMGSY roads and those sanctioned for future PMGSY roads but with construction not yet started. To derive our sampling frame, we collected a list of villages that had already been connected or were scheduled for future connectivity between 2003 and 2006 from the PMGSY website ([O.M.M.A.S, 2023b](#)). Following PMGSY documentation at the time, we refer to villages sanctioned for future road construction in 2003–2004 as "Phase 3" villages, those in 2004–2005 as "Phase 4" villages, and those in 2005–2006 as "Phase 5" villages. At the time of the survey in 2007, most Phase 3 villages had completed road construction, many Phase 4 villages had begun construction, and most Phase 5 villages had not yet started construction. We excluded Phase 4 villages to avoid biasing our results by comparing villages with complete roads to those in the middle of the construction process. From Phase 3 and Phase 5 villages, we selected villages within a fairly narrow population range of 950-1,175 people (as reported in the PMGSY program data).<sup>8</sup>

This process led us to select 302 villages of similar population size to survey. During the survey, 35 of these were dropped, e.g. due to incorrect or insufficient identifying information,

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<sup>7</sup>The number of districts in UP expanded from 70 to 75 in 2005. We use the pre-2005 district definitions as PMGSY was targeted using 2001 census information. The 14 districts are Bahraich, Barabanki, Faizabad, Farrukhabad, Gonda, Sultanpur, Hardoi, Kanpur Dehat, Kanpur Nagar, Lakhimpur Kheri, Rai Bareilly, Shahjahanpur, Sitapur, and Unnao.

<sup>8</sup>This population band was selected to ensure comparable numbers of Phase 3 and Phase 5 villages around the 1,000 population threshold while also accounting for budgetary constraints. The narrow band further ensures that Phase 3 and Phase 5 villages are fairly similar in population size.

or being removed from the PMGSY list. Of our final sample of 267 villages, 144 were Phase 3 and 123 were Phase 5.

To examine the validity of our instrument, we also conduct placebo tests in a larger sample of villages. This sample is constructed by matching as many Phase 3 and Phase 5 villages from the PMGSY program list to the 2001 census as possible, including villages from all districts in UP and without population restrictions. The final placebo sample includes 1,670 Phase 3 and 1,247 Phase 5 villages.<sup>9</sup>

### 3.2 Data Collection and Processing

We surveyed selected villages using the participatory resource appraisal methodology (PRA), a method that has been shown to produce extremely accurate information at low cost (Chattopadhyay and Duflo, 2004).<sup>10</sup> Experienced enumerators gathered 25–450 villagers (the average was 132, and most were male) at a village facility, such as a temple, school, or community hall. The survey was typically conducted at dusk, when most villagers had completed work. The enumerators first drew a resource map of the village, marking all the roads that lead to the village and details of the homes connected by these roads, in order to develop common knowledge of the village population size, boundaries, and connectivity. Subsequently, a structured questionnaire was used to gather information from the villagers. The survey team encouraged participants to respond, and relied on consensus or majority opinions for survey responses.

The survey measured transport access, income sources, wages, agricultural outcomes, prices, and government/political activity.<sup>11</sup> The survey also collected data on village connectivity by a motorable road, which serves as the independent variable in our analyses.<sup>12</sup> Specifically, we ask: "Is there a motorable road to the village that a car can travel on?"

Following data collection, we undertake a number of cleaning and processing steps. We

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<sup>9</sup>Both the survey and placebo datasets are publicly available.

<sup>10</sup>PRA is a field-based survey method to collect data from the local community about village infrastructures and resources. The PRA survey method is rapid, accurate, and less expensive, especially when the implementation of the project is at the village level and the majority of the villagers are likely to be affected by the project.

<sup>11</sup>A full list of survey questions used for analysis is in Appendix Table A3.

<sup>12</sup>It is possible that some Phase 3 villages had not yet been connected by 2007 (e.g. because of implementation difficulties) or that some Phase 5 villages had already been connected.

group related outcomes from the village survey.<sup>13</sup> We then process outcomes, for example, by removing implausible values and computing household shares. Finally, where possible, we create standardized indices of related outcomes that we expect to move directionally together. Indices are computed as the unweighted averages of their standardized components following [Kling et al. \(2007\)](#), where missing component values were imputed to the sample mean of the corresponding component prior to standardization.

We supplement the survey data with the 2001 Census of India, which reports village-level socioeconomic and demographic characteristics prior to the announcement of the PMGSY program. We were able to match 253 of the 267 surveyed villages to census data using name and district.<sup>14</sup> These data serve two purposes: First, we can improve power—and potentially causal identification—by including controls from the 2001 Census in our main analyses. Second, they allow us to conduct placebo tests to confirm that the variation in road construction we exploit does not correlate with preexisting differences between villages reported in the census.

### 3.3 Descriptive Statistics

Table 1 provides key summary statistics. Panel A shows selected survey outcomes. Sample villages are primarily agrarian, with 57% of households earning income from their own farms and limited commercial connectivity (0.58 vehicle visits per day on average). Migration is common, averaging 1.19 migrants per household. We further summarize agricultural inputs and outcomes, wages and prices, and government and political presence.

Panel B reports baseline controls from the 2001 census among surveyed villages, including per capita income in the Gram Panchayat (GP), irrigation availability, and village population. Finally, Panel C reports the endogenous and the instrumental variable used in the analysis. Specifically, we instrument the existence of a motorable road to the village, as measured in the village survey (70% of villages have one). Our instrument is the within-district population rank of the village among all unconnected villages sanctioned for road connection between

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<sup>13</sup>We exclude relevant outcomes if the survey data contained more than 50 missing entries.

<sup>14</sup>The unit for connectivity under PMGSY is ‘habitation’, defined as a cluster of populations living in an area, the location of which does not change over time. This often, but not always, corresponds to a census village.

2003 and 2006 (i.e., Phase 3, 4, and 5 villages), from smallest to largest. The average population rank of villages in our sample is 76, and ranges from 7 to 192.

## 4 Empirical Strategy

We aim to estimate the causal impact of road connectivity on economic and governance outcomes. However, the potential endogeneity of road placement (before or within the PMGSY program) could lead to biased estimates in an OLS regression of any given outcome on the presence of a motorable road to the village. For instance, if roads were built according to the perceived developmental potential, local officials may have chosen to connect the richer villages first — a common scenario in large infrastructure projects. In this case, the OLS coefficients for the road’s impacts on development would be biased upward. To address this source of bias, we employ the conditional IV method described in the next section.

### 4.1 Instrumental Variables Approach

We instrument for motorable road access using within-district population rank among unconnected villages sanctioned for PMGSY roads in 2003–2006. National guidelines instructed local governments to prioritize larger villages first, creating quasi-random variation: among villages of equal size, those in districts with fewer larger unconnected villages were connected earlier.

We estimate the following first-stage equation:

$$ROAD_{vd} = \alpha_0 + \alpha_1 RANK_{vd} + \alpha_2 POPULATION_{vd} + \gamma X_{vd} + \nu_{vd} \quad (1)$$

Where  $ROAD_{vd}$  is an indicator variable for whether the village  $v$  is connected to a motorable road,  $RANK_{vd}$  is rank of village  $v$  among unconnected villages in district  $d$ ,  $POPULATION_{vd}$  is the village population as measured in the 2001 census, and  $X_{vd}$  are village controls from the 2001 census (per-capita GP income, agricultural electricity, fraction of irrigated land, distance to the nearest town, and indicators for missing values).

In the second stage, we regress village-level outcomes of interest  $Y_{vd}$  on the predicted value of  $ROAD_{vd}$  from Equation (1) and the same covariates:

$$Y_{vd} = \delta_0 + \delta_1 \widehat{ROAD}_{vd} + \delta_2 POPULATION_{vd} + \eta X_{vd} + \epsilon_{vd} \quad (2)$$

## 4.2 Identifying Assumptions

Two key conditions must be satisfied for the instrument ( $RANK_{vd}$ ) to be valid: relevance and exogeneity.<sup>15</sup> The relevance condition implies that village rank must predict road construction in the village, and is testable. The exogeneity condition implies that, conditional on the included covariates, the within-district population rank of unconnected villages is related to village outcomes only through the additional likelihood of road connectivity.

A key concern is that villages with larger populations will have a higher rank, and larger villages will also tend to have different outcomes for a number of reasons. We allay this concern by controlling for the village population. We measure population using the 2001 census, rather than the PMGSY program data, for two reasons. First, the PMGSY population numbers were potentially manipulable by program officials (e.g., by grouping habitations together or not in order to generate support for a particular road or not), leading to endogeneity concerns. Second, surveyed villages were selected to be within a narrow band of PMGSY population (as described in Section 3.1), so PMGSY population is similar among our sample by design. However, our results are robust to including the PMGSY population instead of or in addition to the census population, and to including nonlinear population controls.<sup>16</sup>

A second concern is that population rank could predict outcomes through other policies. However, we know of no policy explicitly using rank. While the Total Sanitation Campaign (TSC) used population thresholds to target latrine construction during 1999-2012 (Spears and Lamba, 2016), there is no basis for sanitation to affect our outcomes of employment, wages, or governance. Moreover, any link between our rank variable and the TSC would be substantially weakened by the fact that our instrument is population rank only among unconnected

<sup>15</sup>The third condition, monotonicity, implies that having larger within-district population rank never decreases the village priority for road connectivity, which seems likely to hold.

<sup>16</sup>Results available upon request.

villages sanctioned for a PMGSY road between 2003 and 2006, rather than villages without toilet facilities.

Finally, to support excludability, we conduct placebo tests examining whether rank predicts pre-program (2001 census) outcomes. If rank were confounded with factors driving development aside from roads, it would likely predict census outcomes. The absence of differences would further support the validity of the exclusion restriction.

## 5 Results

In this section, we present empirical findings that illustrate local-level adjustments following the introduction of PMGSY roads. Agricultural workers benefit from higher output prices, while those transitioning out of agriculture find better-paying jobs in local casual labor. Additionally, road connectivity boosts government engagement, as seen through increased visits by government officials, and more frequent police patrols. Villagers enjoy lower prices in government-supported shops and higher wages in government-supported construction. Together, these outcomes highlight the diverse economic, social, and political transformations brought about by improved rural connectivity.

### 5.1 First Stage and Outside Connectivity

Before analyzing downstream outcomes on markets and governance, we first establish the relevance of our instrument. We then show evidence that motorable roads improved the connectivity of villages, the key mechanism through which we expect roads to impact village outcomes. These initial results, which serve as proof of concept of our empirical strategy. Appendix Figure [A1](#) shows that population rank has a roughly linear relationship with the probability of a motorable road in the village in the raw data. The first-stage relationship remains strong with the addition of census covariates, with a Kleibergen–Paap F-statistic of 16.7 (Panel A of Table 2).

The 2SLS results in Panel B of Table 2 show suggestive evidence that connecting villages

with a motorable road leads to a much larger volume of vehicles passing through each day; the coefficient is positive (1.472) but not statistically significant. The point estimate implies that a motorable road connecting the village raises commercial vehicle traffic by about 1.5 additional truck, bus, and commercial vehicle visits per day off a baseline mean of 0.58, an increase of more than 250%. This result suggests that the program meaningfully enhanced village connectivity—the channel through which road access would affect agricultural activity and labor market outcomes.

## 5.2 Effects on Labor Market

We next turn to 2SLS estimates of the impacts of rural roads on labor markets in Table 3.

Panel A shows that road connectivity causes villagers to shift from earning income primarily from their own farms to casual labor inside the village, suggesting that it supports the growth of local industries. Specifically, improved road connectivity reduces the share of villages where the primary source of income in the village overall is on villagers' own farms by a statistically significant 48.7 percentage points (pp) (column 1)—a reduction equivalent to about 85% of the overall sample mean. Roads appear to dramatically expand the primacy of income from casual labor. Interestingly, we find that the location of this income-generating casual labor is primarily within the newly connected village: the primacy of casual labor *within* the village as an income source increases by 39.8 pp relative to a sample mean of 26% (column 2), while there is essentially no change in the primacy of casual labor outside the village (column 3). Questions about the share of households participating in casual labor inside and outside the village further support this conclusion. Roads lead to a statistically significant 24.8 pp decline in the share of households in casual labor both in and out of the village (column 6), offset by a statistically insignificant increase in the share of households in casual labor within the village of 19.6 pp (column 4).<sup>17</sup>

Panel B shows the impact of road connectivity on wages. The point estimates are positive, but are imprecisely estimated due to large standard errors. For example, road access increases the male wage index by 0.45 SD (column 1), consistent with a moderate improvement in

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<sup>17</sup>The share of households participating in casual labor only outside the village is largely unchanged (column 5).

men's wages, but the estimate is noisy.

Panel C examines how road connectivity impacts migration, and provides further evidence that rural roads support local economic development. The impact of roads on migration is theoretically ambiguous: while roads may increase connectivity to higher-wage labor markets, they also may increase the marginal product of local labor. We find that roads decrease our index of household migration by 0.83 SD, significant at the 5% level (column 1). Impacts are most pronounced for daily migrants, which fall by 0.65 migrants per household following road connectivity (column 2). However, point estimates for longer-term migration are negative across the board (columns 3–5, Panel C). This decline in migration aligns with increased employment opportunities outside agriculture, higher wages in local economy, and (as we show in the next section) increased agricultural prices.

In summary, labor market dynamics shift following road construction. Employment moves away from agriculture toward casual labor as local job opportunities improve, and out-migration decreases as local employment improves, leading to a significant decline in daily commutes in search of jobs. These occupational and income findings accord with previous work in other Indian states finding that road connectivity leads to a decreased dependence on agricultural income and a turn toward casual labor (Asher and Novosad, 2020; Shamdasani, 2021). However, to our knowledge, we present the first evidence that additional casual labor opportunities are concentrated within the village, and the first evidence that roads decrease out-migration.

### 5.3 Effects on Agricultural Development

Given that labor shifts away from own-farm agriculture following road construction, a natural question is whether this is a result of increased alternative opportunities or somehow due to a decrease in the return to farming. This question is particularly important in light of the dependence on agriculture for the majority of villages in UP. In Table 4, we assess how roads impact agricultural inputs and diversification, yields, and prices.

Our results suggest that roads may actually increase the returns to agriculture. In Panel A,

we first show evidence that road construction increases the price fetched for staple crops: an index of rice and wheat farm-gate prices increasing by 1.3 SD (column 1). One may expect a rise in yields along with the higher prices fetched, but we do not see any changes in yields: the coefficient estimate on our index of rice and wheat yields is -0.02 SD, though it is somewhat imprecisely estimated (column 4). Our result is consistent with [Asher and Novosad \(2020\)](#), who find precisely no impact on satellite-based measures of yield. However, their measures conflate yield reductions from decreased cultivation with any increases on still-cultivated land. We find that even yields on still-cultivated land do not increase.

We also find evidence of a broadening of agricultural pursuits beyond staple crop farming in Panel B, with roads leading to a moderate but statistically significant increase in an index of agricultural diversification (column 1). Turning to the index components, we find that dairy and goat rearing are present in 26 pp more villages following road construction (column 3), and milk cooperatives are present in 19 pp more villages (column 2), though this impact is not statistically significant. The prevalence of poultry farms appears unchanged (column 4).

Finally, in Panel C, we examine whether roads impact agricultural inputs. We do not find any evidence of changes in the outcomes we measure, which include the fraction of farms using chemical fertilizer and/or pesticides (column 2), the use of motorized farm equipment (column 3), and visits from fertilizer companies (column 4). However, our measures are quite coarse, and we do not have measures of the use of high-yield seed varieties, which are a key agricultural input in this setting.

Taken together, the results suggest that roads reduce transaction costs in agricultural markets, perhaps especially for highly perishable goods like milk, and enhance agricultural diversification and profitability. Our results provide, to our knowledge, the first evidence from India that road connectivity increases output prices for agricultural staples, which are a key input to farmer welfare.<sup>18</sup> On the other hand, the fact that roads increased agricultural diversification toward animal husbandry aligns with previous work showing that PMGSY roads led to crop diversification beyond traditional cereals ([Shamdasani, 2021](#)).

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<sup>18</sup>[Shamdasani \(2021\)](#) do not find statistically significant impacts of PMGSY on rice and wheat prices measured in the Rural Economic & Demographic Survey. ([Khandker et al., 2009](#)) find impacts of road construction on output prices in Bangladesh.

## 5.4 Effects on Corruption, Local Governance, and Political Connectivity

Our final set of results indicate that, beyond their economic effects, rural roads improve governance and social institutions. Villages with new roads experience a greater presence of government officials, more frequent police patrols, and both a reduction in fair price shop (FPS) prices and increase in government wages.

Panel A of Table 5 shows that prices for staple goods at government-supported FPS decrease, while wages paid for government-supported labor increase following road construction. The 0.43 SD decrease in an index of FPS prices (column 1) is driven primarily by a Rs. 0.7 decrease in the price of wheat (column 2), but the point estimates for rice and kerosene prices are also negative (columns 3 and 4). At the same time, we find that daily wages in government construction projects, which provide jobs guaranteed through the Mahatma Gandhi National Rural Employment Guarantee Act (NREGA) increase by Rs. 39.2.

These results are surprising since FPS prices and government construction wages are set centrally. However, overcharging in FPS shops and underpayment for NREGA work are common (Jadhav et al., 2022; Parashar, 2025; Niehaus and Sukhtankar, 2013). We thus interpret our results as suggesting that road connectivity reduces corruption in both these programs: FPS overcharging and NREGA underpayment both decreased.

Why might roads decrease corruption? One potential explanation is that as transportation costs decreased, and providers of government services demanded less overhead to cover their costs. Another explanation is that accountability to local officials increased as road connectivity allowed for greater oversight. While our data do not allow us to decisively confirm or rule out either of these channels, we find evidence that roads increased both local civil service and political activity, which are consistent with increased oversight.

Specifically, Panel B of Table 5 explores how road connectivity affects the presence of local government officials. We find that an index of local government presence increases by 1.1 SD (column 1). This result is primarily driven by two types of officials: police and lekhpal, or revenue officials. In particular, we find that police make more than 92 additional visits per year, including 43 more patrols, following road construction (columns 2 and 3), and lekhpals

visit 49 more times per year (column 7). While not statistically significant, point estimates also suggest an additional 30 visits per year from village development officers (column 6). We don't see evidence of substantially increased governance by more central officials, such as district collectors and block development officers (columns 4 and 5, respectively), though the point estimates are positive and substantial compared to the average rate of visits from such officials in our sample.

Finally, we find some evidence that roads increase political engagement. In Panel C, we find that an index of political connectivity increased by 0.9 SD (column 1). While none of the individual index components are statistically significant, the biggest driver is the additional 2.7 campaign visits per year (column 2). Thus, it is plausible that political accountability improved along with civil service presence in the wake of road connectivity.

Overall, our results present novel evidence that road construction leads not only to improved market access but also to improved government access and accountability. The delivery of core social programs, such as food rations and guaranteed employment, improves.

## 5.5 Placebo Results

As discussed in Section 4.2, we test whether Phase 3 status (instrumented by rank) predicts 2001 census outcomes to support excludability. Aside from using pre-program outcomes, the placebo test has two differences from our analyses thus far. First, to increase power, we include all 2,917 Phase 3 and Phase 5 villages matched with census data, rather than just those with survey data. We view this decision as conservative, since we are able to detect smaller outcome differences with this sample size. Second, we proxy for the endogenous outcome of whether a given village had a motorable road in 2007 (which we only know for surveyed villages) with an indicator for being a Phase 3 village.

Appendix Table A1 reports the results of the placebo analysis examining the effects of roads on pre-program (2001 census) outcomes. Panel A shows that the first stage remains strong in this larger sample of villages: the Cragg-Donald F-statistic is 51.55. Panel B shows placebo results for census outcomes related to road connectivity and agricultural and infras-

structure development. None of the 2SLS coefficients is statistically significant: We do not see any evidence that, in 2001, higher-ranked villages were more likely to have a mud or paved road connection, newspaper access, communication facilities, drinking water facilities, more forested area, more cultivated area, or access to agricultural electricity—a key input to irrigation (columns 1–7).

Finally, Panel C shows placebo results for outcomes related to health and education. All regression models control for the census population as well as the PMGSY population. We do see that higher-ranked villages are more likely to have a primary school: the coefficient estimate suggests that future road connectivity is associated with a 45 pp increase in the likelihood of having a primary school, all else equal (column 5). Thus, our instrument may not be excludable for education outcomes. However, rank does not predict the presence of medical facilities or health workers (columns 1–4) or middle and secondary schools (columns 6 and 7). Overall, this table provides strong evidence that future road placement does not correlate strongly with preexisting village conditions, helping to address concerns about endogenous road placement and excludability of the instrument.

## 6 Conclusion

The role of road infrastructure in improving rural livelihoods is a persistent question in economic development. Given the centrality of road infrastructure in market and social connections, many countries have implemented policies to improve rural road networks. However, evaluating the effectiveness of these large-scale road projects remains challenging due to limited data availability and concerns over endogenous road placement, especially in developing countries. We aim to further understanding of the impacts of rural roads by estimating the short-term impacts of the world’s largest rural road construction program, PMGSY, in India.

To address potential endogeneity in road placement, we use instrument for road placement by within-district population rank, thereby estimating the causal impacts of road connectivity on village-level outcomes. While not the subject of our paper, this strategy has promise for other administrative datasets that have been used to evaluate the impact of PMGSY

around population cut-offs. In particular, it could allow researchers to understand how PMGSY impacts outcomes for villages away from these cut-offs.

We presents several interesting findings about the multifaceted impacts of rural roads on rural development. We contribute to the existing literature on the agricultural and employment impacts of PMGSY by offering a more nuanced view on how roads impact sectoral transformation away from agriculture. At the same time, we find that roads influence village welfare not only through market activity, but also through government activity and oversight.

Specifically, we find that while rural connectivity led to an improvement in agricultural diversification and higher output prices, villagers turn even more toward casual labor, presumably where improvements in productivity outweigh the gains in agriculture. However, the casual labor markets that villagers turn to are primarily within the connected village, and villagers are less likely to undertake daily commutes to find work despite the better road access to nearby labor markets. Moreover, roads increase government activity—with more visits by politicians, police, and civil servants—and improve the delivery of government services.

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**Table 1: Descriptive Statistics for Key Variables**

	Summary		
	N	mean	sd
<b>Panel A: Selected Outcome Variables</b>			
Truck/bus/commercial visits per day	267	0.58	2.51
Share of households with primary income from own farm	267	0.57	0.50
Share of households with primary income from casual labor in village	267	0.26	0.44
Share of households with primary income from casual labor outside village	267	0.16	0.36
Agriculture daily wage (male)	265	47.94	10.64
Agriculture daily wage (female)	222	38.22	10.41
Non-government construction daily wage (male)	266	51.08	10.06
Government construction daily wage (male)	249	70.98	18.95
Migrants per household: daily	267	0.40	0.61
Migrants per household: weekly	267	0.16	0.23
Migrants per household: monthly	266	0.21	0.35
Migrants per household: yearly	266	0.39	0.68
Wheat price (INR/quintal)	259	910.33	69.51
Rice price (INR/quintal)	207	599.61	94.83
Rice yield (quintal/acre)	208	12.19	4.85
Wheat yield (quintal/acre)	259	11.75	5.63
Share households that use chemical/fertilizer/pesticide	252	0.91	0.15
Share households with motorized agriculture equipment	265	0.15	0.15
Village has milk cooperative	267	0.10	0.30
Village has dairy/goat rearing	266	0.09	0.28
Village has poultry farm	258	0.02	0.14
Kerosene price at fair shop	266	10.98	0.58
Rice price at fair shop	259	6.18	1.47
Wheat price at fair shop	254	5.00	1.05
Police visits last 12 months	265	36.92	64.18
Government official visits last 12 months	267	70.62	100.16
Campaign visits/events last 12 months	267	5.06	4.18
Share households receiving Hindi paper	262	0.01	0.02
<b>Panel B: Control Variables</b>			
Per capita panchayat income	104	72.90	98.80
Electricity for agriculture	45	1.00	0.00
Share cultivated area irrigated	194	0.76	0.25
Distance to nearest town (km)	247	12.04	10.17
Census population (thousands)	251	1.76	1.61
<b>Panel C: Endogenous and Instrumental Variables</b>			
Motorable road to village for cars	267	0.70	0.46
Population rank (small to large)	267	75.63	41.06

Note: Descriptive statistics for a selection of variables used in the analysis among the sample of surveyed villages. Panel A shows a selection of outcome variables constructed from the village survey data. Panel B shows the variables we include as controls from the 2001 Census of India. Panel C shows the endogenous variable, which we collect in the village survey, and the instrumental variable, which is constructed as the within-district PMGSY population rank among all Phase 3, 4, and 5 villages.

**Table 2:** Estimates of the impacts of roads on connection to the outside world

	(1) Motorable Road to Village
<b>Panel A: First stage</b>	
Population rank (small to large)	0.003*** (0.001)
<i>F-statistics</i>	
Cragg–Donald F	22.04
Kleibergen–Paap F	16.73
Observations	267
	Number of Vehicles Visiting each Day
<b>Panel B: 2SLS Estimates on Commercial Transport</b>	
Motorable Road to Village	1.472 (0.980)
Mean of dependent variable	0.58
Observations	267

Note: Panel A shows the estimate of  $\alpha_1$  from the first-stage Equation (1), and Panel B shows the 2SLS estimates of  $\delta_1$  from Equation (2) for the outcome of the number of daily trucks, buses, and other commercial vehicles visiting the village each day. Controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample consists of villages from which primary survey data were collected. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Table 3: 2SLS estimates of the impacts of roads on labor market outcomes**

	Main Source of Income in Village			Share of Households in Casual Labor		
	Own Farm (1)	Casual Labor in Village (2)	Casual Labor out of Village (3)	In Village (4)	Out of Village (5)	Both in and out of village (6)
<b>Panel A: Labor Outcomes</b>						
Motorable Road to Village	-0.487*** (0.160)	0.398*** (0.131)	0.119 (0.115)	0.196 (0.128)	0.020 (0.091)	-0.248** (0.113)
Dependent Variable Mean	0.57	0.26	0.16	0.28	0.34	0.36
Observations	267	267	267	267	267	267
<b>Panel B: Wages</b>						
	Male Wages			Female Agriculture Wage		
	Wage Index: Male	Agriculture	Construction			
Motorable Road to Village	0.449 (0.722)	3.450 (6.745)	6.685 (9.392)	7.877 (4.897)		
Dependent Variable Mean	0.09	47.94	51.08	38.22		
Observations	267	265	266	222		
<b>Panel C: Migration Outcomes</b>						
	Migration Share Index	Migrants per Household				
		Daily	Weekly	Monthly	Yearly	
Motorable Road to Village	-0.835** (0.404)	-0.652* (0.353)	-0.052 (0.061)	-0.239 (0.163)	-0.517 (0.359)	
Dependent Variable Mean	0.03	0.40	0.16	0.21	0.39	
Observations	267	267	267	266	266	

Note: This table shows estimates of  $\delta_1$  from Equation (2) for various outcomes. Controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample consists of villages from which primary survey data were collected. Indices are computed as the unweighted averages of their standardized components; missing component values are imputed to the sample mean of the corresponding component prior to standardization. Regressions with index outcomes additionally include indicators for missing values of each component. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Table 4: 2SLS estimates of the impacts of roads on agricultural outcomes**

	Price Index (1)	Prices in INR/Quintal		Yields Index (4)	Yields in Quintal/Acre	
		Wheat (2)	Rice (3)		Wheat (5)	Rice (6)
<b>Panel A: Agricultural Prices &amp; Yields</b>						
Motorable Road to Village	1.316*** (0.293)	24.151 (38.152)	250.151*** (54.067)	-0.018 (0.472)	1.083 (2.583)	-1.016 (2.612)
Dependent Variable Mean	0.14	910.33	599.61	-0.01	11.75	12.19
Observations	267	259	207	267	259	208
	Farm Diversification Index	Milk Coop in Village	Dairy or Goat Rearing in Village	Poultry Farm in Village		
<b>Panel B: Agricultural Diversification</b>						
Motorable Road to Village	0.468*** (0.164)	0.186 (0.133)	0.255** (0.104)	-0.034 (0.043)		
Dependent Variable Mean	-0.02	0.10	0.09	0.02		
Observations	267	267	266	258		
	Farm Input Index	Fraction using Chemical/ Fertilizer/ Pesticide	Fraction with Motorized Agricultural Equipment	Fertilizer Company Visited at least once in Past Year		
<b>Panel C: Farm Input Use</b>						
Motorable Road to Village	-0.120 (0.188)	-0.007 (0.082)	-0.002 (0.123)	-0.162 (0.168)		
Dependent Variable Mean	-0.01	0.91	0.15	0.26		
Observations	267	252	265	267		

Note: This table shows estimates of  $\delta_1$  from Equation (2) for various outcomes. Controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample consists of villages from which primary survey data were collected. Indices are computed as the unweighted averages of their standardized components; missing component values are imputed to the sample mean of the corresponding component prior to standardization. Regressions with index outcomes additionally include indicators for missing values of each component. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Table 5: 2SLS estimates of the impacts of roads on governance outcomes**

	Fair Shop Price Index (1)	Fair Shop Prices			Government Construction Wages for Men (5)	(6)	(7)
		Wheat (2)	Rice (3)	Kerosene (4)			
<b>Panel A: Government Prices and Wages</b>							
Motorable Road to Village	-0.434* (0.241)	-0.684* (0.362)	-0.073 (0.317)	-0.396 (0.451)	39.195*** (14.272)		
Dependent Variable Mean	-0.03	5.00	6.18	10.98	70.98		
Observations	267	254	259	266	249		
	Civil Services Index	Police Activity in Past 12 Months		Government Official Visits in past 12 Months			
		Police Visits	Police Patrolling	Collector	BDO	VDO	Lekhpal
<b>Panel B: Civil Service Connectivity</b>							
Motorable Road to Village	1.133*** (0.214)	91.699** (41.168)	42.925*** (7.375)	0.031 (0.137)	0.540 (0.561)	30.154 (22.588)	48.926*** (13.894)
Dependent Variable Mean	0.21	36.92	8.94	0.06	0.73	42.11	27.72
Observations	267	267	267	266	267	267	267
	Political Connectivity Index	Campaign Visits in Past 12 Months	Campaign Events in Past 12 Months	Share of Households Receiving Hindi Newspaper			
<b>Panel C: Political Connectivity</b>							
Motorable Road to Village	0.933* (0.518)	2.650 (2.790)	0.034 (0.246)	0.001 (0.006)			
Dependent Variable Mean	0.12	4.76	0.29	0.01			
Observations	267	267	267	262			

Note: This table shows estimates of  $\delta_1$  from Equation (2) for various outcomes. Controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample consists of villages from which primary survey data were collected. Indices are computed as the unweighted averages of their standardized components; missing component values are imputed to the sample mean of the corresponding component prior to standardization. Regressions with index outcomes additionally include indicators for missing values of each component. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Appendix Table A1: First Stage and 2SLS estimates of the impacts of roads on pre-program outcomes (placebo)**

	Phase 3 Village (1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Panel A: Road Outcome</b>							
Population rank (small to large)	0.001*** (0.000)						
Dependent Variable Mean	0.57						
Observations	2917						
	Village has Mud or Paved Road	Village Receives Newspaper/ Magazine	Village has Post/Telegraph/ Phone Facilities	Village has Drinking Water Facilities	Fraction of Forested Area in Village	Fraction of Cultivated Area Irrigated in Village	Electricity for Agriculture
<b>Panel B: Infrastructure and Basic Services</b>							
Phase 3 village	-0.033 (0.092)	0.007 (0.143)	0.085 (0.198)	0.002 (0.017)	0.012 (0.047)	-0.131 (0.210)	-0.139 (0.212)
Census Controls	✓	✓	✓	✓			
Dependent Variable Mean	1	0	0	1	0	1	0
Observations	2879	2879	2879	2879	2450	2917	2159
	Present in Village						
	Medical Facilities	Health Centers	Community Health Workers	Private Health Workers	Primary School	Middle School	Secondary School
<b>Panel C: Health and Education Facilities</b>							
Phase 3 village	-0.115 (0.144)	-0.057 (0.060)	-0.308 (0.202)	-0.039 (0.059)	0.445** (0.185)	0.044 (0.121)	0.036 (0.057)
Census Controls	✓	✓	✓	✓	✓	✓	✓
Dependent Variable Mean	0	0	0	0	1	0	0
Observations	2879	2917	2917	2917	2917	2917	2917

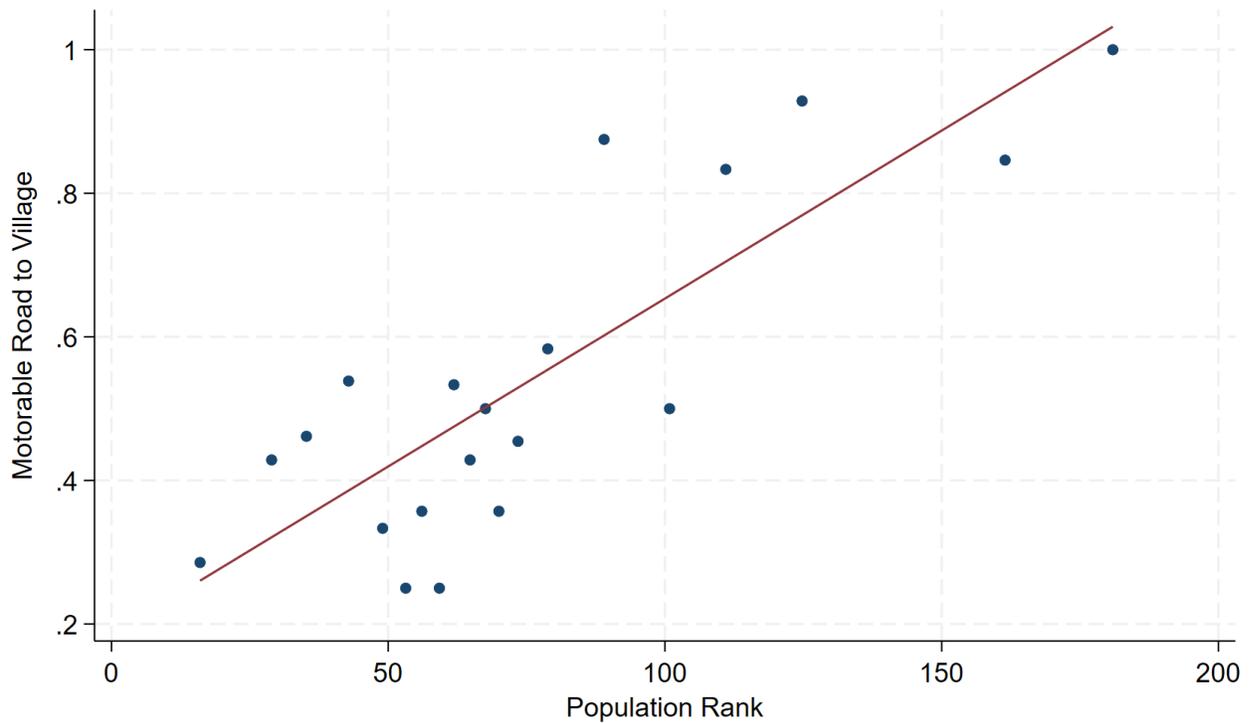
Note: Panel A shows the estimate of  $\alpha_1$  from the first-stage Equation (1), and Panel B shows the 2SLS estimates of  $\delta_1$  from Equation (2) for various village-level outcomes collected in the 2001 census, prior to the announcement of the PMGSY program. When not the outcome itself, controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample of villages consists of all Phase 3 and Phase 5 villages in UP that could be matched with 2001 census data. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Appendix Table A2: 2SLS estimates of the impacts of roads on other outcomes**

	Nearest Market Price Index (1)	Nearest Market Prices					Kerosene (7)
		Wheat (2)	Rice (3)	Arhar Dal (4)	Masoor Dal (5)	Moong Dal (6)	
<b>Panel B: Nearest Market Prices</b>							
Motorable Road to Village	-0.047 (0.297)	1.121*** (0.412)	-0.311 (1.018)	-0.883 (1.015)	-3.132 (2.390)	-6.799* (3.962)	-0.432 (3.089)
Dependent Variable Mean	-0.02	9.73	10.81	40.59	37.31	50.34	28.64
Observations	267	266	267	266	259	257	239
	Number Married in Last 12 Months		Average Age Married		Weddings With Band		
	Boys	Girls	Boys	Girls			
<b>Panel A: Weddings</b>							
Motorable Road to Village	-3.627** (1.575)	-1.114 (2.278)	0.698 (2.045)	-0.162 (2.009)	4.069*** (1.384)		
Dependent Variable Mean	7.01	7.27	19.98	17.99	1.61		
Observations	267	267	266	266	266		
	Fruit/Vegetable Seller comes to Village						
<b>Panel C: Village Retail</b>							
Motorable Road to Village	0.149 (0.159)						
Dependent Variable Mean	0.56						
Observations	266						

Note: Note: This table shows estimates of  $\delta_1$  from Equation (2) for various outcomes. Controls include per capita GP income, an indicator for agricultural electricity, fraction of irrigated land, distance to the nearest town, and village population as measured in the 2001 census; indicators for missing census values of each control are also included. The sample consists of villages from which primary survey data were collected. Indices are computed as the unweighted averages of their standardized components; missing component values are imputed to the sample mean of the corresponding component prior to standardization. Regressions with index outcomes additionally include indicators for missing values of each component. Standard errors clustered by district are in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance levels, respectively.

**Appendix Figure A1: First-Stage: Population Rank Predicts Motorable Road**



Note: This figure shows a binscatter of the relationship between the within-district population rank and an indicator for whether a village has a motorable road at the time of the survey. The figure shows the raw data underlying our first stage. However, in our first-stage equation, we include census population and other controls that are not controlled for here. The sample includes the 267 surveyed villages.

## Appendix Table A3: Variable definitions from survey and census

Table	Dependent Variable	Question	Variable Definition	Source
2	Motorable Road to Village	Is there a motorable road to village that a car can travel on?	Indicator =1 if village has motorable road	Survey
	Number of vehicles visiting each day	In a day how many share jeeps/buses/commercial vehicles come to your village?	Number of trucks/commercial vehicles driving through village	Survey
3	Main source of income in village: Own Farm	Which are the sources of livelihood for households in the village (both in cash and in kind)? Kindly ask three most important sources.	Indicator =1 if own farm selected as main source of income	Survey
	Main source of income in village: Casual Labor in Village	Which are the sources of livelihood for households in the village (both in cash and in kind)? Kindly ask three most important sources.	Indicator =1 if casual labor (farm and non-farm) in the village is selected as main source of income	Survey
	Main source of income in village: Casual Labor Outside Village	Which are the sources of livelihood for households in the village (both in cash and in kind)? Kindly ask three most important sources.	Indicator =1 if casual labor (farm and non-farm) out of the village is selected as main source of income	Survey
	Share of HHs in Casual Labor: In Village	Approximately what share of households work as casual laborers within the village?	Proportion of households working in casual labor in the village	Survey
	Share of HHs in Casual Labor: Out of Village	Approximately what share of households work as casual laborers outside the village?	Proportion of households working in casual labor out of the village	Survey
	Share of HHs in Casual Labor: In and Out of Village	Approximately what share of households work as casual laborers within and outside the village?	Proportion of households working in casual labor in and out of the village	Survey
	Wage Index: Male	Mean of standardized responses of male agriculture and construction wages		Survey
	Male Wages: Agriculture	What is the agricultural daily wage in this village in the non-government work for Men?	Rupees per Day	Survey
	Male Wages: Construction	What is the construction daily wage in this village in the non-government work for Men?	Rupees per Day	Survey
	Female Agricultural Wage	What is the agricultural daily wage in this village in the non-government work for Women?	Rupees per Day	Survey
	Migration Share Index	Mean of standardized responses for migrants per HH daily, weekly, monthly, yearly		Survey
	Migrants per HH: Daily	How many villagers from your village go daily to other village/towns for work?	Converted to proportion by dividing the number of daily migrants by the total number of households in the village	Survey
	Migrants per HH: Weekly	How many villagers from your village go at least once a week to other village/towns for work?	Converted to proportion by dividing the number of weekly migrants by the total number of households in the village	Survey
	Migrants per HH: Monthly	On an average how many individuals usually go away from the village for short term (less than a month) to look for work elsewhere?	Converted to proportion by dividing the number of monthly migrants by the total number of households in the village	Survey
	Migrants per HH: Yearly	On an average how many individuals usually go away from the village for longer term (more than a month) to look for work elsewhere?	Converted to proportion by dividing the number of longer-term migrants by the total number of households in the village	Survey
4	Price Index	Mean of standardized responses for agricultural price of wheat, rice		Survey
	Agricultural Wheat Price in INR/Quintal	What is the price of wheat as of today?	Rupees/quintal	Survey
	Agricultural Rice Price in INR/Quintal	What is the price of rice as of today?	Rupees/quintal	Survey
	Yields Index	Mean of standardized responses for yield of wheat, rice		Survey
	Agricultural Wheat Yields in Quintal/acre	What is the average yield of wheat?	Quintal/acre	Survey
	Agricultural Rice Yields in Quintal/acre	What is the average yield of rice?	Quintal/acre	Survey
	Farm Diversification Index	Mean of standardized responses for milk coop in village, dairy or goat rearing in village, poultry farm in village		Survey
	Milk Coop in Village	Does your village have milk cooperative?	Indicator =1 if village has milk cooperative	Survey
	Dairy or Goat Rearing in Village	Do any households in your village have a dairy/goat rearing for commercial purpose?	Indicator =1 if households in the village have goat or dairy rearing	Survey
	Poultry Farm in Village	Do any households in your village have a poultry farm?	Indicator =1 if households in the village have poultry farm	Survey
	Farm Input Index	Mean of standardized responses for chemical/fertilizer/pesticide share, agriculture equipment, and fertilizer company visiting village		Survey
	Fraction using Chemical/Fertilizer/Pesticide	How many households in your village use chemical, fertilizer, and pesticide in their fields?	Converted to share by dividing the number of households using chemical fertilizers/pesticides by the total number of households in the village	Survey
	Fraction with Motorized Agriculture Equipment	How many households in your village have motorized agricultural equipments (e.g tractor, thresher, trolley, fodder cutting machine etc.)	Converted to share by dividing the number of households using motorized agricultural equipment by the total number of households in the village	Survey
	Fertilizer Company Visited at least once in Past Year	In the last 12 months how many times has a representative of a fertilizer company visited your village?	Indicator =1 if the number of times a fertilizer company representative visited is greater than 1	Survey
5	Fair Price Shop Price Index	Mean of standardized responses for prices of wheat, rice, and kerosene at fair price shops		Survey
	Wheat Price in Fair Price Shops	What are the prices of wheat at fair price shops?	Rupees	Survey
	Rice Price in Fair Price Shops	What are the prices of rice at fair price shops?	Rupees	Survey
	Kerosene Price in Fair Price Shops	What are the prices of kerosene at fair price shops?	Rupees	Survey
	Government Construction Wage for Men	What is the construction daily wage in this village in the government work for Men?	Rupees per Day	Survey
	Civil Services Index	Mean of standardized responses for police visits, police patrolling, collector visits, BDO visits, VDO visits, and Lekhpal visits		Survey
	Police Visits in Past 12 Months	How many times police has come in your village in the last 12 months?	Number of police visits in village	Survey
	Police Patrolling in Past 12 Months	Sum of: How many times police came for patrolling during the election period? AND How many times police came for patrolling in the last 12 months (excluding the election period patrolling)?	Number of police patrols in village	Survey
	Collector Visits in Past 12 Months	How many times did district collector visit your village during last 12 months?	Number of collector visits in village	Survey
	BDO Visits in Past 12 Months	How many times did BDO visit your village during last 12 months?	Number of BDO visits in village	Survey
	VDO Visits in Past 12 Months	How many times did VDO visit your village during last 12 months?	Number of VDO visits in village	Survey
	Lekhpal Visits in Past 12 Months	How many times did Lekhpal visit your village during last 12 months?	Number of Lekhpal visits in village	Survey
	Political Connectivity Index	Mean of standardized responses for campaign visits, events, and newspaper access		Survey
	Campaign Visits in Past 12 Months	How many times did party candidates visit during the election period?	Total number of campaign visits in village, across all parties	Survey
	Campaign Events in Past 12 Months	How many times political party supporter campaign/organized event in your village during the election period?	Total number of campaign events in village, across all parties	Survey
	Share of HHs Receiving Hindi Newspaper	How many households get Hindi newspapers?	Converted to share by dividing the number of households receiving Hindi newspaper by the total number of households in the village	Survey
A1	Phase 3 Village	Dummy variable = 1 if the village is PMGSY Phase 3 village.		Census
	Village has Mud or Paved Road	Dummy variable = 1 if the village has a mud or paved road.		Census
	Village Receives Newspaper/Magazine	Dummy variable = 1 if the village receives newspapers or magazines.		Census
	Village has Communication Facilities	Dummy variable = 1 if the village have communication facilities		Census
	Village has Post/Telegraph/Phone Facilities	Dummy variable = 1 if the village has post telegraph and telephone facilities		Census
	Village has Drinking Water Facilities	Dummy variable = 1 if the village have drinking water facilities		Census
	Fraction of Forested Area in Village	Fraction of total village area having forest area		Census
	Fraction of Cultivated Area Irrigated in Village	Fraction of total village area having irrigated area		Census
	Electricity for Agriculture	Dummy variable = 1 if the village has power supply for electricity for agriculture		Census
	Medical Facilities Present in Village	Dummy variable = 1 if the village has any medical facilities		Census
	Health Centers Present in Village	Dummy variable = 1 if the village has any health centers or sub centers		Census
	Community Health Workers Present in Village	Dummy variable = 1 if the village has community health worker present		Census
	Private Health Workers Present in Village	Dummy variable = 1 if the village has registered private medical practitioners present		Census
	Primary School Present in Village	Dummy variable = 1 if the village has a primary school		Census
	Middle School Present in Village	Dummy variable = 1 if the village has a middle school		Census
	Secondary School Present in Village	Dummy variable = 1 if the village has a secondary school		Census
A2	Number of Boys Married in Last 12 Months	How many boys from this village got married in the last 12 months?	Number of boys married in village	Survey
	Number of Girls Married in Last 12 Months	How many girls from this village got married in the last 12 months?	Number of girls married in village	Survey
	Average Age of Boys Married	What is the average age of marriage for boys in your village in the last 12 months?	Age	Survey
	Average Age of Girls Married	What is the average age of marriage for girls in your village in the last 12 months?	Age	Survey
	Weddings with Band	Of all the marriages held last year, in how many marriages a musical band came?	Number of marriages that included a band	Survey
	Nearest Market Price Index	Mean of standardized prices for wheat, rice, arhar dal, masoor dal, moong dal, and kerosene at nearest markets		Survey
	Wheat Price at Nearest Market	What are the prices of wheat at the nearest market?	Rupees	Survey
	Rice Price at Nearest Market	What are the prices of rice at the nearest market?	Rupees	Survey
	Arhar Dal Price at Nearest Market	What are the prices of arhar dal at the nearest market?	Rupees	Survey
	Masoor Dal Price at Nearest Market	What are the prices of masoor dal at the nearest market?	Rupees	Survey
	Moong Dal Price at Nearest Market	What are the prices of moong dal at the nearest market?	Rupees	Survey
	Kerosene Price at Nearest Market	What are the prices of kerosene at the nearest market?	Rupees	Survey
	Fruit/Vegetable Seller Comes to Village	Does any fruit/vegetable seller from other village come to your village to sell vegetables/fruits?	Indicator =1 if fruit/vegetable sellers visit village	Survey

Notes: This table describes how we define our outcome and control variables from the village survey and 2001 census data.