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Transport Mode Choice for Commuting: Evidence from India

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Abstract

Using the first ever available information in Census of India 2011, covering 640 sub-national units (districts) in India, we analyze the correlates of modes of transport used by non-agricultural workers at the regional level covering both rural and urban areas. Providing a holistic picture from the perspective policy and academic perspective, we bring out some key stylized facts. Further, using the Seemingly Unrelated Regression (SUR) estimation, we model the transport mode choice for commuting by the workers in the context of rural and urban India, and further extend it based on distinction in motorized and non-motorized transport modes. We find that urbanization level, population size and density along with education attainment and worker's sex ratio (gender ratio among workers), age (elderly) and land use mix play very important role in regional pattern in transport mode choice for commuting. These results highlight the dire need for proper development of transport infrastructure and understanding its various dimensions from socio-economic, demographic and spatial point of view in the context of developing countries.

Key Words: Transportation, Commuting, Motorized, Non-Motorized Transport, India

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JEL Codes: L91, O18, R00, R23, R40

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1. Introduction

During the process of economic growth and development, one observes rapid changes in the extent of mobility of workers across and within rural and urban regions. The key drivers of mobility of workers vary across three stages of transformation of non-farm employment in developing countries. In particular, the relative importance of migration and commuting changes over these stages (FAO, 1998). These three stages and smooth transition across them remains largely dependent on physical connectivity i.e. transport infrastructure and integrated transport systems. In the first stage, rural–urban linkages are relatively weak and this can be partially attributed to poor transport infrastructure. In the second stage, among other things, one observes, "a rapid rise in the labour force obliged to commute between the countryside and rural towns and intermediate cities" (p. 295, FAO, 1998). In the third stage, rural–urban linkages and dependence become stronger; commuting and migration by labour becomes more important, and expansion in rural non-farm employment is not driven by linkages with agriculture. Many developing countries including India are currently traversing from second to the third stage. In countries undergoing such transition, historical investments in the transport infrastructure and systems, along with other drivers like population density, strength of the rural-urban continuum, and occupational structure determine the mode of transport used by workers, and in turn the pattern of economic activities and regional development.

In this paper, we present select stylized facts on the modes of transport used by non-farm workers in the context of an emerging developing country viz. India. This can be to some extent attributed to the information made available on commuting and mode of transport used by these workers, for the first time, as part of Census of India 2011[1] for all the states and union territories comprising of 640 districts. Further, we explore the relationship between mode of transport used and level of urbanization, age pyramid, occupation profiles, and average income levels at the sub-national level.

A clear articulation of stylized facts provides the building block for policy formulation at the sub-national level, demand estimation for transport infrastructure and in particular public provisioning of transport. The Government of India has recognized the centrality of investments in roads, railways,

[1] Information on commuting by individuals was collected in 2001 but not released ostensibly due to concerns over data quality.

airports and waterways in realizing the objective of hastening the structural transformation of Indian economy and doubling of incomes, especially in rural India[2]. It is an established fact that improvements in transport connectivity provide a stimulus to local economy by reducing the transport costs thereby hastening the pace of integration of input and output markets, and in particular segmented regional labour markets. The contours of these changes are already evident in India. First, over the period 1993-94 and 2009-10, we observe a near four-fold increase in number of two-way rural-urban commuters engaged in non-agricultural activities between (Sharma and Chandrasekhar, 2014). These commuting workers account for nearly 13 percent of the total non-agricultural workers in India[3]. These two-way flows are largely concentrated in the urbanised states of India. Further, many of the workers migrating from rural India for short duration during the course of the agricultural year work in the construction sector (Agrawal and Chandrasekhar, 2015). Taken together, these numbers are indicative of the second and third stages of transition in non-farm employment mentioned at the outset. Second, the nature of work, and hence the source of income, is an important determinant of distance travelled for work. Rural (urban) households whose principal source of income is regular wage/salary or casual labour in non-agriculture (regular wage/salary) are more (more) likely to have individuals commuting over 10 kilometers for work. Since the availability of transport infrastructure is better in urban areas, it should not come as a surprise that urban residents commute longer distances for work. Ideally, data on time spent on commuting would have helped us explore the relationship between time spent and distance travelled for work, which would have shed light on nature and extent of transport connectivity. However, information on time spent on commuting is unavailable. What we have instead are the trends in monthly household expenditure on conveyance. Over the period, 2004-05 and 2011-12, the share of conveyance in monthly consumption expenditure has increased marginally in both rural and urban India from 3.8 to 4.8 per cent and from 6.5 to 7.5 per cent respectively (Government of India 2013, p.21). Needless to say, there are variations in share of conveyance expenditure on total expenditure across the states of India depending on the level of urbanization and transport connectivity. In the absence of comprehensive transportation surveys or similar data in the Indian context, a glaring major data gap and resultant lacuna exists in our knowledge on the mode of transport used by the workers. At best, a handful of studies in the literature focus on

[2] While presenting the union budget for 2016-17, the Government of India stated that it will "reorient its interventions in the farm and non-farm sectors to double the income of the farmers by 2022". Reference http://indiabudget.nic.in/ub2016-17/bs/bs.pdf

[3] These estimates are on the lower side since they do not include those who commute long distances within rural areas (across villages) or within an urban agglomeration (for instance, across the five districts that are part of the Mumbai metropolitan region), across cities or across states as in the National Capital Region of Delhi.

this issue for select few cities of India – Bengaluru (Manoj and Verma, 2016), Rajkot(Munshi, 2016), Kolkata (Sadhukhan et al., 2016). Fortunately, the release of data from Census of India 2011 on mode of transport used by non-farm workers helps us extend the literature beyond city specific studies. We present a granular picture, uncover stylized facts and also identify the importance of key drivers of mode of transport at the sub-national level.

In order to provide a conceptual framework for this paper, we draw on inter-related strands in the empirical literature on mode of transport used by the workers. Synthesizing the findings from the literature, we identify three sets of factors: a) geographic and spatial; b) demographic; c) socio-economic and individual factors.

The first strand in the literature looks at the plausible impacts of land use patterns (residential, commercial or mixed use), planned and unplanned geographical expansion of urban boundaries and population density of the region. In this literature the focus has been on specific outcomes including reduction in commuting time and impact on congestion. Population density is a resultant of land use regulations and rules governing built up area. In regions with higher population density (or built up area), one would observe lower demand for motorized transport and individuals are likely to travel shorter distance (Levinson and Kumar, 1997; Sun et al., 2016). This is particularly evident in regions that permit mixed land use (Munshi, 2016). Among the insights from this literature is that deteriorating city-shape (i.e. unplanned geographical expansion) is likely to increase workers' commuting time. Hence, appropriate investments in public transport are needed to mitigate the effect of haphazard expansion (Harari, 2016).

The economic profile of an urban center changes over time. This not only affects the nature of its relationship with neighboring rural areas but also other cities. The strength of linkages with other cities is determined by the nature of transport systems, an aspect systematically explored by Parr and Jones (1983). Each city can be viewed as being in one of the following five stages of development: pre-urban, urban specialization, urban consolidation, urban transformation and urban dispersal. In the pre-urban stage the quality of interurban transportation is low and hence the linkages with other regions are weak. In the latter stages one observes mass and efficient transportation and deeper inter-regional integration[4].

[4] Based on these insights, we argue that the 640 Indian districts are at different stages of transition. This would get reflected in the predominant mode of transport used across districts.

The second strand in the literature looks at how mode of transport chosen is affected by the extent of rurality[5], and the strength of the rural-urban continuum. There is increasing evidence that the occupation profile varies along the rural-urban continuum, i.e. depends on the linkages of villages with its nearby areas. Individuals desirous of taking advantage of non-farm jobs and higher wages in urban areas[6] will drive the demand for affordable transport options. For instance, in south-eastern Nigeria efficient and subsidized transport systems have encouraged commuting to the urban centers of Aba and Port Harcourt (Bah et al., 2007). In Indonesia, women working in the fast growing export processing industries located in the urban areas, drove the demand for motorized transport. There are instances of bus services being provided by the factories (Collier, 1993 as cited in Douglass, 2007).

The third strand in the literature looks at the following correlates of commuting patterns: age pyramid, gender and marital status, educational attainment, and income. The use of a particular mode of transport will vary across the age distribution and the mix of transport options available need to reflect the age specific requirements. For instance, public transport options need to be sensitive to the fact that the elderly are less likely to use their own transport (Kim and Ulfarsson, 2004; Schmöcker et al., 2008). Similarly, in light of the increase in women's workforce participation rate in both rural and urban areas of developing countries, the need for a gender sensitive transport policy has long been articulated (Law 1999). Women remain more reliant on either men for transport mode i.e. owned vehicle (car, motorbike etc.) or on public transport (Pickup, 1984). In households with two wage earners, the place of residence is chosen in such a way that men commute longer distance while women commute shorter distances (Crane, 2007; Sandow, 2008). One reason for such behavior is "household responsibility hypothesis" suggesting that working women also take care of children and other household chores and therefore travel less than men (Crane, 2007). Finally, coming to the case of income, in line with intuition, at higher levels of incomes households are more likely to use private motorized transport[7] (Dargay and Gately, 1999; Buehler, 2011; Palma and Rochat, 2000).

[5] The extent of rurality of different regions can be examined by many yardsticks including the slope of the income gradient, the change in the share of farm and non-farm economic activity as distance from the city increases or from the lens of source of income of rural households.

[6] In the Indian context, Kundu et.al (2002) finds that per capita incomes decline steeply 'in the immediate vicinity of the urban centre'. Sharma (2016) finds that share of non-agricultural activities is higher in villages close to the city.

[7] Dargay and Gately, 1999, using a cross country dataset find that, in the case of low and middle income countries, vehicle ownership increase at twice the rate of per capita income level. Buehler (2011), in the context of Germany and USA, finds a negative relationship between income level and use of public transport.

The evidence and discussion on these conjectures related to correlates of modes of transport and their supporting evidence are laid out in the rest of the paper. In the next section, we provide a background and context for our study. Section 3 gives description of data and key summary statistics. The focus of Section 4 lays out the empirical model for commuting mode choice of workers. The key results and their implications on improving our understanding of the correlates of modes of transport across the districts of India are laid out in section 5. Section 6 concludes with some key remarks.

2. Background

The nature of transport infrastructure changes over the course of a country's economic development. In general, the growth of output attributable to the transport sector typically is higher than that of a nation's gross domestic product (GDP) growth. The share of transport sector in GDP has increased steadily in India since 1991, when India ushered in liberalization policies and set on a path for growth and inclusive development (Government of India., 2014).

The current investments in transport infrastructure have been unevenly distributed at the sub-national level. This is despite the policy stance of systematically investing in transport infrastructure in an equitable manner in order to strengthen regional linkages. This aspect was clearly articulated in the Approach Paper to India's XI Five Year Plan which stated, "With 3,682 urban local bodies in the country spread across the 593 districts in the country, such linkages could allow urban economic engines – with their access to markets, infrastructure and credit — to become the flywheel of rural growth, resulting in a more inclusive form of growth in the country" (Government of India 2006, p. 93). In addition to investing in the national highways, developing the Golden Quadrilateral[8], the Government of India has spent considerable resources providing last mile connectivity in rural areas under the Pradhan Mantri Gram Sadak Yojana (PMGSY). It is only logical that these investments, in addition to affecting commuting time also determine two key averages, viz. the share of commuters using motorized transport, and the share of commuters using private and public transport.

Presently, whatever we know about commuting and its attributes in the Indian context comes by triangulating information from three different sources of information made available by India's National Sample Survey Organization (NSSO): survey of employment and unemployment particulars,

[8] The Golden Quadrilateral connects the following large metropolitan cities: Chennai, Kolkata, Delhi and Mumbai.

survey of housing amenities and survey of consumption expenditure[9]. In addition, there are specific micro studies[10]which provide rich insights.

In the last two decades, we observed a rapid increase in short term migration and commuting by workers. The survey of employment and unemployment provides estimates of daily commuting between rural and urban areas. Mohanan (2008) estimates that in 2004-05, among individuals engaged in non-agricultural activities, there were 8.9 million rural to urban and 3.6 million urban to rural commuters in India and 12.2 million commuting workers without any fixed place of work (i.e. work either in rural or urban areas depending on availability of work, nature of their occupation and seasonal factors). Sharma and Chandrasekhar (2014) point out that among non-agricultural workers, the number of commuters between rural and urban areas increased from 6.3 million in 1993-94 to 24.6 million in 2009-10. Chandrasekhar (2011) finds that the states adjoining the National Capital Region of Delhi i.e. Punjab, Haryana, Rajasthan, Uttar Pradesh have a large number of rural residents reporting working in urban areas. These four states account for nearly 35 percent of workers (all-India) living in rural areas but working in urban areas suggesting interesting commuting dynamics (rural-urban and urban-rural) in these four states. In addition, four southern states – Andhra Pradesh, Karnataka, Kerala and Tamil Nadu – account for nearly 25 percent of such workers, while Maharashtra and Gujarat account for 11% of workers living in rural, but working in urban areas. These averages

[9] One point to be noted here is that, there surveys do not collect information on transport mode choice by the commuting workers and therefore cannot be used for an individual level analysis of modal choice for commute.

[10] One of the earlier studies documenting the commuting by workers was by Basu and Kashyap (1992) based on a series of micro surveys conducted over different parts of India. They argued that with the acceleration in the growth of non-agricultural employment in late 1980's and early 1990's, there has been a rise in the mobility of workers in both rural to rural and rural to urban streams. They found that commuting is a large part of this mobility, with workers travelling from 5 to 30 kilometres one-way on daily basis. They showed that migration or commuting was primarily off-season (in agriculture) phenomenon, largely dominated by male workers. Coelho and Vijaybhaskar (2013), the context of Ambur (in Tamil Nadu), find that due to the development of leather and allied industries in the surrounding rural areas, the daily commuting from urban to rural as well as peri-urban to rural areas can be observed. Around 20 percent of workers in Ambur travel more than 10 kilometre to their workplace. This commuting pattern has led to change in the transportation facilities in this town and its surrounding areas. Due to non-availability of apt public transport infrastructure, most of the large firms have to run their own shuttles, buses; while the small and medium firm's workers will have to rely on public buses and shared auto rickshaws. Sharma (2017), based on a primary survey conducted in the Burdwan-Durgapur region of the state of West Bengal, find that commuting is largely male dominant with only 12 percent of sampled commuters were female workers. Average one way distance travelled by commuters was 27 kilometres (where some commuter were travelling as much as 180 kilometres on one side) spending around 51 minutes in one way journey. Among the commuters, around two third individuals commute six days a week and around one fourth travel to work on all days of a week. The authors find that due to regional features of the sampled workers, railways was the primary mode of transport for commuters followed by buses and own transport (mainly bicycles). Moreover, the workers use multiple modes of transport in the process of commuting.

are not surprising since these states not only have higher level of urban population, but also sizeable urban centres that would attract the commuting workers.

Unlike the survey of employment and unemployment, NSSO's survey 69th round (July– December 2012) Survey of Drinking Water, Sanitation, Hygiene and Housing Condition sought information on maximum distance to the place of work normally travelled by any earner of the household. Table 1 presents the distribution of households by maximum distance to the place of work normally travelled by any earner of the household in 2012. We find that of the 174 million rural households, 11.7 percent of households have no member of the household that travel for work while in 23.1 percent of households the maximum distance travelled by any member is less than 1 km. If one were to focus on household where either no member travels or the distance travelled is less than 1 km then there are no apparent differences between rural and urban households, whereas the rural–urban differences are apparent if one were to look at the proportion of households where a member travels more than 10 km: in rural and urban areas it is 12.3 per cent and 20.4 per cent respectively. This finding again points towards the fact that in urban areas not only would we observe more commuting but individuals are likely to commute longer distances for work as compared to rural areas.

The current occupation structure affects the distance travelled for work and hence the demand for transport options. In Table 2 and Table 3, we present how the distance travelled varies by the main activity undertaken by rural and urban households. In rural India the two principal sources of income: viz. income from cultivation and casual labour in agriculture. Minimal commuting is observed among individuals engaged in both these activities. In contrast, in both rural and urban areas, households classified as regular wage/salary and are more likely to have individuals commuting over 5 kilometers for work.

There is an association between distance travelled for work and indicators of well-being of the household. In India, the official metric for measuring well-being is the monthly per capita expenditure (MPCE) of the households. An examination of the distance travelled by members of households across MPCE quintiles in rural areas does not suggest stark differences in the distribution of distance travelled (Table 4). However, we indeed find that in the highest MPCE class, 28 per cent of households have a member who travels at least 10 kilometers for work, which is not the case for lower MPCE households. A logical question that follows pertains to the share of expenditure incurred on conveyance by the households with commuters. The primary source of information on expenditure

on conveyance is the NSSO's survey on consumption expenditure. The share of conveyance in monthly consumption expenditure has increased marginally in both rural and urban India. It has increased in rural areas from 3.8 to 4.8 per cent between 2004-05 and 2011-12 and in urban areas from 6.5 to 7.5 per cent during the same period (Government of India 2013, p.21). There are variations in share of conveyance expenditure on total expenditure across the states of India depending on the level of urbanization and also across the MPCE deciles.

3. Data and Summary Statistics

There are four types of workers: cultivators, agricultural labourers, household industry workers and others. For the year 2011, district level aggregate information is available on distance commuted and mode of travel separately for rural and urban and by gender (male, female) for those workers who are classified as others. As per Census of India 2011, these workers account for 41.6 percent of the workforce in the country, and 86 percent of the urban workers[11].

We next turn towards identification of stylized facts based on the district level patterns on modes of transport used by workers. At the aggregate level, in India, 30 percent of these workers do not travel for work while 22.6 percent walk to work (Table 5).

Nearly 75 percent of women workers either walk or do not have to travel to their workplaces (Table 6). Even when they have to commute, women are more likely to commute shorter distances than men. It could be surmised that prevalent social norms and lack of commuting choices, women are forced to take up jobs that do not require them to take longer commutes (Law, 1999; Jensen, 2003).

In order to pictorially depict whether there are regional clusters (i.e. an above average share) of workers who do not travel to work, we compute the corresponding location quotients[12].There are clusters of

[11] According to the Census, 2011 data, there are 200 million workers in the country who report themselves as 'other workers' out of which 85 million are based in rural India, and 115 million are located in urban India. Between 2001 and 2011, the share of other workers has increased from 37.6 per cent to 41.6 per cent. However, in urban India, the share has remained stagnant at around 87 percent mark.

[12] Let W and W_{nt} be the total number of workers in India and number of workers in India who do not travel for work. Let W_d and $W_{d,nt}$ be the number of workers in district d and number of workers not traveling for work. We can then define location quotient $(LQ_{d,nt})$ as follows: $LQ_{d,nt} = \left(\frac{W_{d,nt}}{W_d}\right) * \left(\frac{W}{W_{nt}}\right)$. When the location quotient for a district for a particular mode is less (greater) than one, it implies that the share of workers in the district who do not travel for work is lower (greater) than the national average.

districts where the share of workers who do not travel for work is greater than the national average (Figure 1). The entire state of Uttar Pradesh, certain districts of Bihar, Northern Karnataka, and Andhra Pradesh fall in this category and the districts are spatially clustered. Similarly, we do find clusters of districts where the share of workers who walk to work is greater than the national average (Figure 2). It is indeed the case that these patterns are driven by level of urbanization. The correlation between the proportion of workers who do not travel for work or walk to work and the level of urbanization is negative (Figure 3). At the other end of the spectrum, we do find a positive correlation between the level of urbanization in a district and the proportion of workers using motorized transport (Figure 4). By motorized transport we are referring to public (bus and train) and private and semi-private transport (motorcycle, car and taxi) modes of transport[13]. We find that one third of workers use some type of motorized transport for commuting at the all India level. In the rural areas, around 37 percent of workers use motorized transport, whereas, surprisingly, only 22 percent of urban workers use such modes of transport. These two findings though seem to be opposite to each other, do have a simple explanation. In India, the information under Census of India is collected at the residential location of workers. Many individuals live in rural areas but location of workplace is in urban areas. In the literature, the relationship between level of urbanization and proportion of workers commuting between rural and urban areas is well documented. Our results indicate that it is the rural-urban continuum and diversification of workplace location that is driving use of motorized transport in rural areas. On the other hand, in urban areas lower usage of motorized transport (and essentially lower mobility) can be due to better matching between residential and workplace location, reducing the need for motorized transport[14].

A classification of regions (in our case district) can be done based on dominant use of public modes of transport. Drawing on the framework used by Parr and Jones (1983) we divide the districts in India based on share of workers using either bus or trains or both modes of transport. We find that southern states, regions surrounding national capital region of Delhi, parts of Haryana, Punjab and Rajasthan have higher share of bus as well as train usage indicating higher level of urban transformation and

[13] A distinction between public (train and bus) and private & semi-private (car, motorcycle and taxi) is warranted from the perspective of transportation policy and sustainable urban planning. These underlying patterns not only reveal individual preferences but also the nature of urban growth and development from the lens of regional science.

[14] We did investigate the relationship between urbanization and commuting choice by delving into the districts with urbanization rate of seventy-five percent or above. On an average, these districts do exhibit a pattern slightly different from the rest of the country; walking to work remains the predominant mode of commuting to work in these districts as it did for the rest of the country. However, we notice that there are variations within these districts.

dispersal. In the central India, comprising of Madhya Pradesh, Chhattisgarh, Inner parts of Odisha, eastern parts of Uttar Pradesh and Jharkhand, there is lower use of bus as well as train by the workers. This indicates transiting from the first two stages of urban development towards the third stage (based on the classification of Parr and Jones, 1983).

We conclude this section by focus on specific correlations (Table 7). We find that the correlation between the share of workers living in census town[15] in a district and the usage of motorized transport (bus and car) for commuting is positive and the correlation with the proportion of workers who do not travel to work is negative. We find a positive correlation between density of population and the share of workers using motorized modes of transport (bus, train, car). The correlation between density of population and share of workers who do not travel or walk to their workplace is negative. The correlation between night time lights and proportion of workers using motorized transport (bus, train, car, motorcycle) is positive while the correlation between night lights and share of workers who do not travel or walk to their workplace is negative. Specifically, in case of rural India, we find that the correlation between share of households where the income of the highest earning member is less than Rs 5000 per month and use of motorized transport (bus, train, cabs, car, and motorcycle) is negative and the correlation is positive for use of non-motorized transport modes (bicycle, foot and no travel). Finally, the correlation between proportion of individuals over the age of 60 and use of bus and motorcycle is positive while the correlation between share of elderly and usage of car for commuting is negative.

4. Commute Mode Choice: Empirical Model

It is of interest to understand the correlates of modes of transport across the districts of India. As the outcome variable we have following variables: proportion of individuals in a district travelling by Foot, Bicycle, Motorcycle, Cabs (including three wheelers and four wheelers), Car, Bus, Train, Others. We estimate a seemingly unrelated regression model, i.e. we jointly estimate a set of equations, where in each equation the outcome variable is the proportion of workers using a particular mode of transport. Estimation of seemingly unrelated regression model is appropriate in this case since the estimates are

[15] The population of the census town is considered as urban although these towns are governed under the rural set up. A Census town is a transitory step from a village to become a town.

efficient. The base category is proportion of individuals in the district who use other modes of transport. The model is estimated separately for rural and urban India.

Among the explanatory variables which are measured for the district as a whole are the following: logarithm of population of district, logarithm of density of population in the district, the level of urbanization of the district where the districts are grouped into four quartiles, the age distribution of the district (proportion of individuals in the following groups - 0-14, 15-25, 25-60, 60+). We include the rural and urban worker sex ratio (number of women workers per 1000 men workers among those above 7 years of age), and as an alternative to literacy we include the rural and urban distribution of educational attainment of workers (proportion of workers who are illiterate, proportion with educational attainment below matriculate level and proportion with educational attainment above matriculate level). We control for the occupation structure of the district by including the share of workers engaged as cultivators, agricultural labourers, and working in household industry. In order to capture the extent of concentration[16] of workers within the same occupation, we calculate the following measure $\sum_{i=1}^{4} s_i^2$ where s_i is the proportion of cultivators, agricultural labourers, workers in household industry and other occupations respectively. In addition to the above variables, we also include the proportion of population of households in rural and urban areas of the district belonging to different social groups (scheduled caste, scheduled tribe households and other households) and different religions (Hindus, Muslims, Christians, Sikhs and individuals from other religions). Controlling for the social group composition of the district is important since scheduled tribe households are likely to be less mobile compared to households from other social groups.

For rural India, we include the following indicators related to income: proportion of rural households having a salaried member, and proportion of rural households where the income of highest earning household member is less than Rs 5000 per month. We include these as controls in the specification for rural India.

In case of urban India, we also add a proxy for mixed land use. Data is available from Census of India 2011 on use of census houses in urban India: residence, residence-cum-other use, shop/office, school/college, hostel/lodge, hospital/dispensary, places of worship, other non-residential use, locked. Using this information, we create three measures that capture mixed land use. The first

[16] This is a very widely used measure of concentration in industrial structure and relevant literature. It is termed as Herfindahl Index.

measure is a variant on the diversity index - $1 - \sum x_i^2$ where x_i is the share of occupied census houses used for purpose$i$. The second measure is an entropy index given by -$- \sum x_i \ln x_i$. The third measure is the share of occupied census houses used as residence.

5. Commuting Mode Choice: Results

Coming to the results, we structure this section as follows. First, we discuss the results for determinants of transport mode choice for rural and urban regions separately. We separate the results based on rural and urban dichotomy because they are structurally different in terms of demography, access to markets, spatial heterogeneity (land use mix, local labour markets) and household socio-economic structure. Next, we dissect the transport mode choice into motorized and non-motorized transport, to analyze their correlates and implications from policy and academic point of view.

5.1 Seemingly Unrelated Regression (SUR) Model: Rural and Urban

We begin by discussing the results in the context of rural areas (Table 8). Since there are eight different modes of travel available for the commuting workers in a region, instead of discussing all of them, we focus on some key results. In the rural areas, around 45 percent of workers either do not commute or commute by feet. We observe that with increased level of urbanization in a district there is decrease in travel by foot whereas worker with no commute increases. For all other transport modes of commuting, there is no association with level of urbanization. A reason for such pattern can be explained by increase in distance to work (located in probably urban areas) with higher level of urbanization in a region. In this context, either a worker prefers to live near to the workplace with no commuting or uses other modes of transport, but access to workplace by feet reduces with increased level of urbanization.

Coming to the role of population level and intensity (i.e. size and density), we find that there with increase in population level in a district, workers in rural areas will use more bicycles and bus service as preferred mode of transport. This does not come as a surprise because in rural India, where still bicycle is a predominant mode of transport for short distances combined with bus service for longer distances. Sharma (2017), in the context of rural parts of West Bengal (India) documents similar findings. With an increase in population density in a district, we find that workers use more public

transport (train and bus) as well as bicycle, motorcycle, whereas there is a reduction in no travel and travel by foot. A plausible explanation can be as follows. Many of the public transport facilities are provided in the regions with higher population density. Therefore availability of these modes for commuting leads to increased usage.

A key (proxy) indicator of type of economic activity and occupation is education level of workers. Workers with higher level of education are more likely to be earning more than other workers. Based on level of education, we divide the workers in two categories- with less than secondary education (matriculation) and more than secondary education. As expected we observe that higher share of workers with less than matriculation are associated with more usage of bicycle as preferred mode of travel. On the other hand, with increase in the share of more educated workers, public transport (bus and train) and personal transport (car and motorcycle) are preferred for transport mode of commuting. One more indicator capturing the income level is the household income (whether more than or less than Rs. 5000) is used for analyzing the income effect on transport mode choice. We find that with increase in share of households in rural areas earning more than Rs. 5000, the use of bicycle and on foot is substituted by use of car. This result is in line with Dargay and Gately (1999).

Another aspect that affects the transport mode choice is the gender of the worker. From Table 6, it is evident that women not only travel shorter distance to work but also do not use any mode of transport (75 percent of women either do not travel or travel by foot) to work. These results are echoed in the regression results for rural areas. With increase in share of women in workforce (higher worker sex ratio), there is lower usage of any public or personal mode of transport in the district. Crane (2007) and Sandow (2008) justify these patterns using "Household responsibility hypothesis". Also, we do not find any specific result in the context of social identity and use of transport mode for commuting. A region with higher share of either scheduled caste (SC) or tribe (ST) does not show any particular association with the transport mode choice. In case of elderly workers, we show that they are more likely to use bus service and less likely to use car.

A key characteristic of a region (district) affecting the regional transport mode choice pattern is nature of economic activities in local labour markets. We use occupation concentration index as a proxy for this in rural areas. We do not find any specific result in our regression for rural areas.

Coming to the urban areas, we find that with higher level of urbanization there is shift towards travel by foot and less usage of private transport (motorcycle or car). We do not have any particular

explanation for the same. With increase in population level in a district, there is increased use of private transport vehicles (car and motorcycle) in urban areas as opposed to rural areas where bus and bicycle were the main mode of transport. With an increase in population density in urban areas, there is more usage of trains and bicycle and less use of car as a transport mode for commuting. Workers with lower level of education (proxy for lower income jobs) use bicycles and train along with walk by feet whereas use of car, bus, motorcycle goes down. On the other hand, among workers with higher level of education (matriculation or above), the use of bicycle and walk by feet is substituted by car or no travel at all. In urban areas, an increase in worker's sex ratio is associated with increased use of bus and car and walk by foot, along with decrease in travel by bicycle and no travel at all. These results are opposite to that of rural areas. Interestingly, in the context of social identity (SC and ST) and commuting mode choice, we find that higher share of SC and ST workers in an urban districts is associated with lower mobility of workers (less use of motorized, non-motorized and public transport mode) and more immobility (higher no travel). One plausible reason can be that these workers are associated with the deprived section of the society with less access to modes of transport. Coming to the elderly workers, we find that they are less likely to travel by foot and are more likely to use motorcycle as a mode of transport. This result is in sync with rural areas, but comes as a surprise as compared to literature on transport mode choice (Kim and Ulfarsson, 2004; Schmöcker et al., 2008). Since we do not have an indicator of income for urban India, in an alternative specification, we include night time lights as a proxy for income. We observe that greater share of workers report using car for commuting in districts with better night-lights. For the sake of brevity, we do not report these results here but are available upon request from the authors.

Lastly, considering the case of mixed land use (diverse use of house dwellings) indicator, we find that higher share of mixed land use in an urban district is associated with higher use of bus service (public transport) and less use of motorized and non-motorized transport (motorcycle and bicycle). Also we observe positive relationship between mixed land use and no travel for work. These results are mixed as compared to the literature on land use and mode of transport.

Next, we discuss the determinants of the use of motorized and non-motorized transport at regional level in the context of rural and urban India.

5.2 Motorized and Non-Motorized Transport Modes

The distinction between motorized and non-motorized transport modes in the context of developing countries becomes important due to multiple reasons. First, due to low level of income and not well developed transport infrastructure, use of non-motorized transport modes still plays a major role in connecting residence and workplace locations. Second, the use of non-motorized transport modes in urban areas is becoming difficult due to non-planned and unsustainable nature of transport planning. Further, with very high growth rates and increasing per capita level of income, the use of motorized transport modes (especially personal two and four wheeler vehicles) is on the rise (Schafer and Victor, 2000; Pucher et al., 2005) in rural and especially urban areas.

Motorized modes include motorbikes, cars, taxis, buses, and trains, whereas non-motorized modes include bicycles, on foot, and no-travel. First, we discuss the results for the rural areas followed by urban areas. In rural context, we find that more urbanized regions are associated with lower non-motorized transport modes and higher motorized transport usage. These results are in line with prior studies (Asensio, 2002; Pucher and Renne, 2005). The population level and its density in a region are positively related to the usage of motorized modes of transport in rural areas. This result can be explained by the higher accessibility and faster modes of transport in a congestion environment (Yamamoto, 2009). Higher the share of workers with educational attainment above matriculation, greater is commuting using motorized modes of transport. This is associated with changing life style and income level of the workers and its impact on transport mode choices. This result is further supported by the following finding. In districts with greater proportion of salaried households or households where the higher income earner makes at least Rs 5,000 a month, one observes use of motorized modes of transport.

Also in rural districts with better sex-ratio, we find that there is lower usage of motorized means of transport. Not surprisingly, we find that greater the share of elderly in the population, the more likely it is that people will use motorized transport. These results are in sync with the existing literature in context of both developed and developing countries (Pickup, 1984; Kim and Ulfarsson, 2004).

Coming to the results for urban areas, we find that districts with larger population are also the ones where workers use motorized transport modes. This can be due to larger distances travelled by the workers in these regions. In districts with higher proportion of workers who are educated below matriculation, we see greater usage of non-motorized modes of transport. This reflects not only lower budget capacity for travel but also lower preference for time used in travel. Overall, what we find is a

strong positive association between educational attainment and income levels on one hand and the use of motorized modes of transport on the other.

6 Concluding remarks

Investments in transport infrastructure are acknowledged to be transformative in nature since they facilitate increase in the mobility of individuals and workers, reduce transport costs and integrate various markets. These investments hasten structural changes in the economy by stimulating growth, facilitating social inclusion, and improving sustainability (Berg et al 2016). During the process of economic growth and development, one would observe rapid changes in the extent of mobility of individuals and workers, in particular.

In this paper, we use data from Census of India 2011 covering 640 districts in order to understand what drives the commuting choice among non-agricultural workers. Among the stylized facts that we find is that higher the population density, greater is the proportion of workers using train. Higher the share of workers living in a census town, which is an intermediate category between rural and urban areas, the higher is proportion of workers using bus. We find that use of motorized transport is higher in districts where a larger proportion of workers are at least matriculates, or are salaried or income of the highest earning member of rural households is above Rs 5,000.

This study provides a building block for analyzing the issue of transport mode choices in relation to individual and household characteristics. Due to data limitations this paper is descriptive in nature in terms of providing insight into understanding the pattern of commuting mode choice by workers in India. We feel that is an urgent need for complementary studies shedding light on issues related to investment on transport infrastructure and changing nature of transport policies and their impact on commuting mode choice. Finally, although an individual's commuting mode choice, place of residence, the available transport system need to be studied together, this continues to be a neglected area in many developing countries including India.

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FIGURES

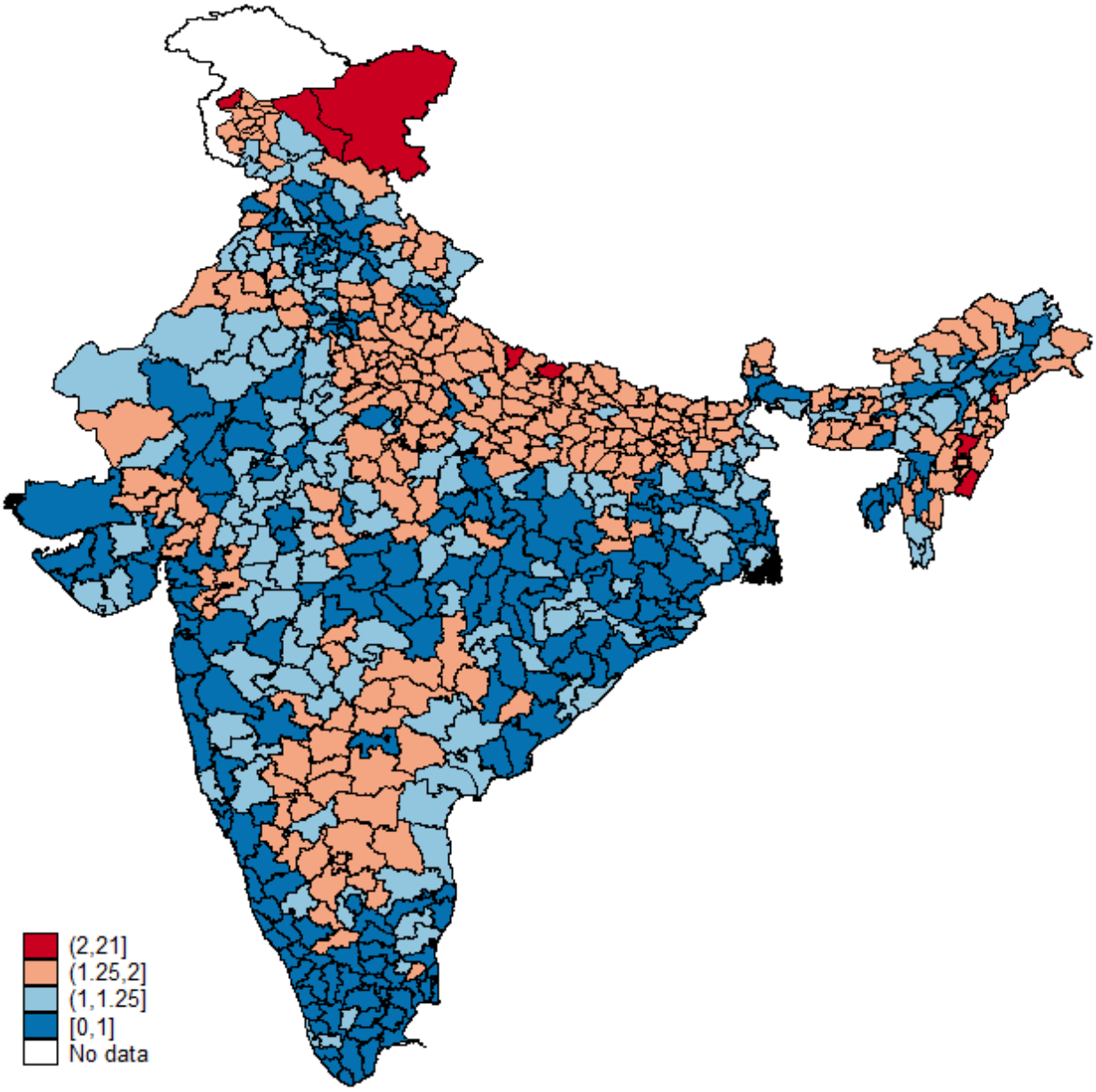

Figure 1: Clustering of Workers who Report not having to Travel for Work

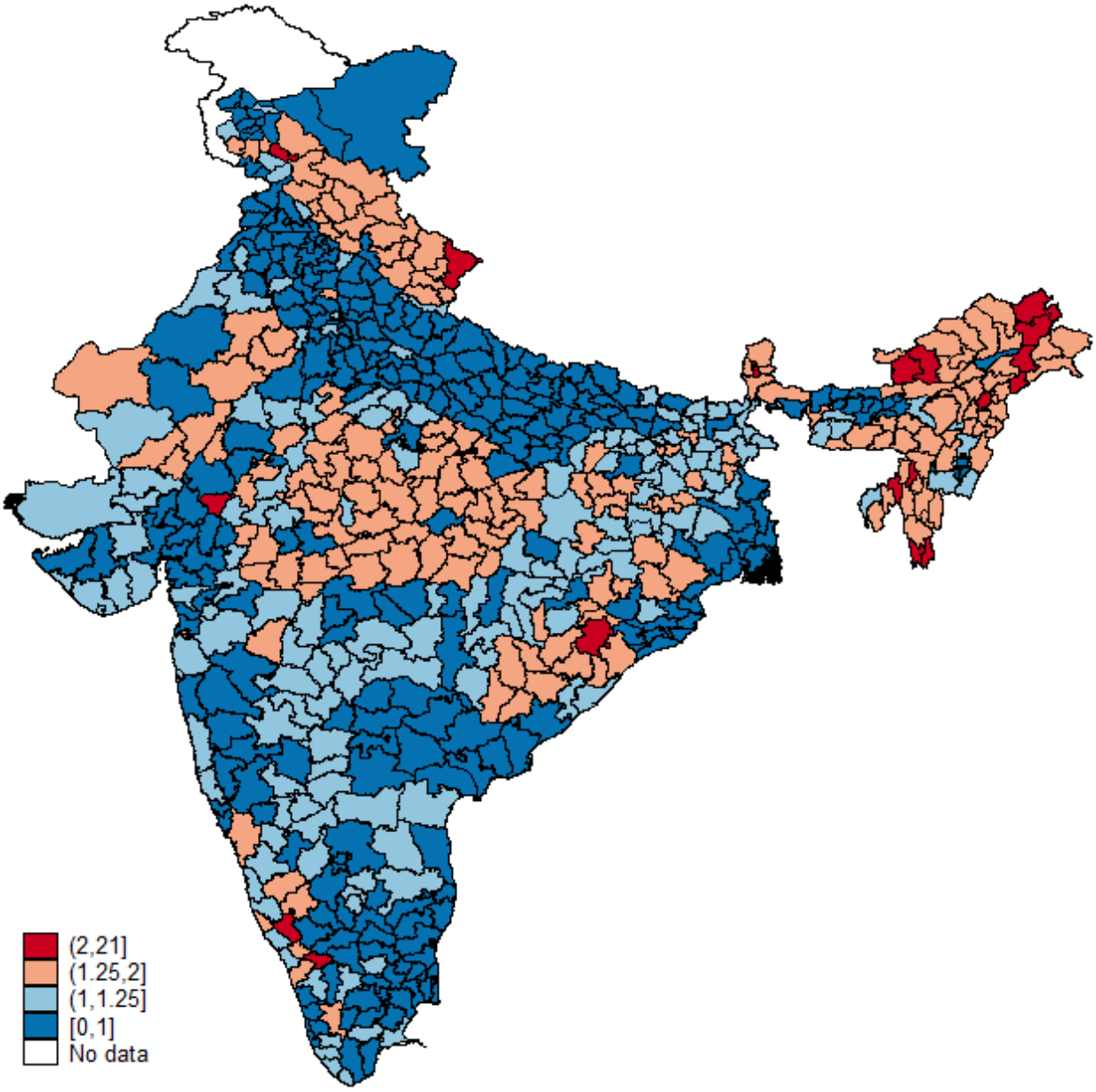

Figure 2: Clustering of Workers who Report Travelling to Work on Foot

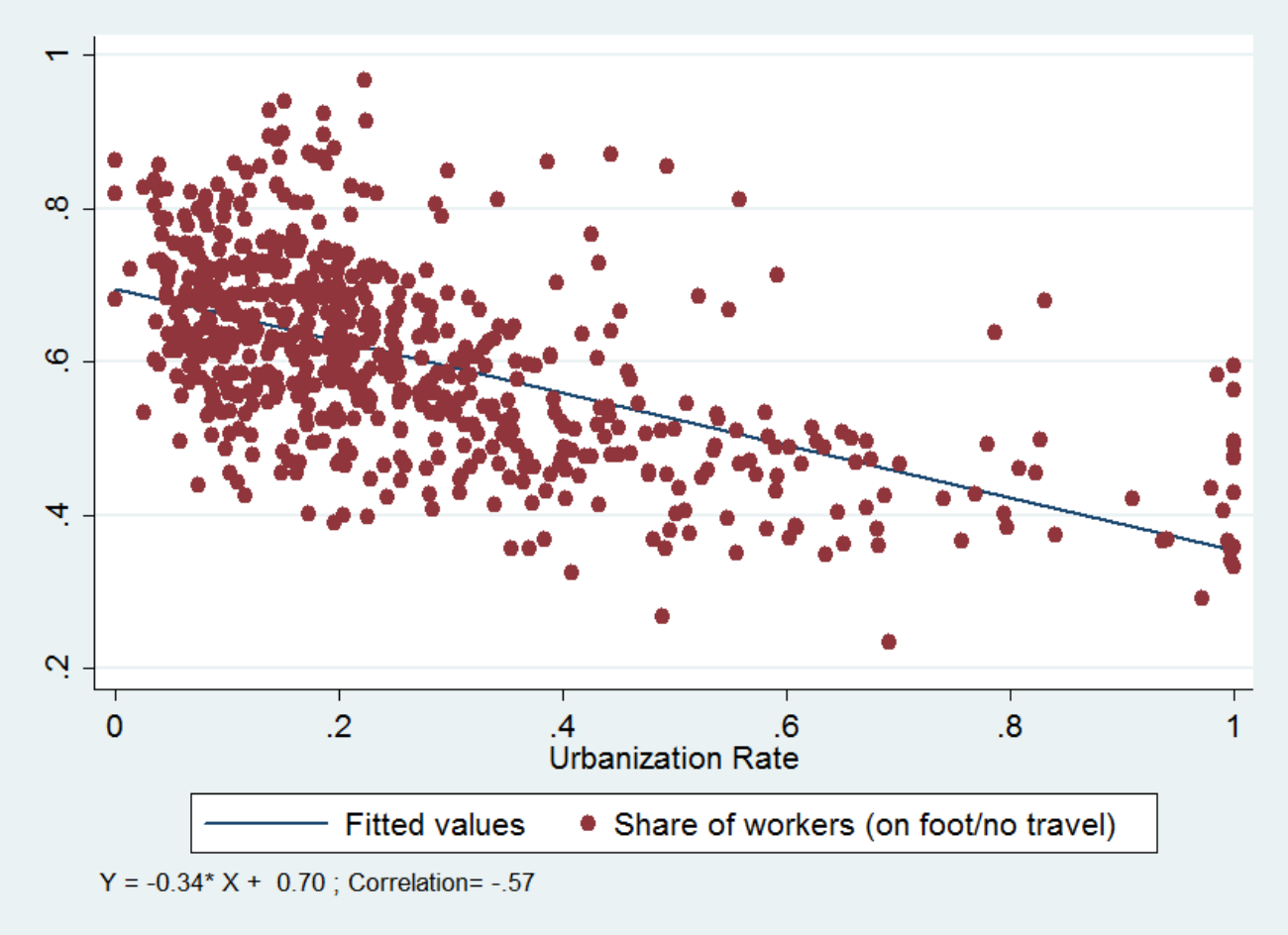

Figure 3: Scatter Plot of Proportion of Workers Not Travelling for Work or Travelling on Foot and Level of Urbanization

Figure 4: Scatter Plot of Proportion of Workers Using Motorized Transport and Level of Urbanization

TABLES

Table 1: Distribution of Households by Maximum Distance to the Place of Work Normally Travelled by any Earner of the Household in 2012

	Rural (million)	Urban (million)	Total (million)	Rural (%)	Urban (%)	Total (%)
Not required to travel	20	15	35	11.7	18.6	13.9
Less than 1 km	40	12	52	23.1	14.7	20.5
1-5 km	73	24	98	42.2	30.2	38.4
5-10 km	19	13	32	10.7	16.1	12.4
10-15 km	8	6	14	4.6	7.9	5.6
15 – 30 km	6	5	11	3.7	6.3	4.5
30 km or more	7	5	12	4.0	6.2	4.7
Total	174	80	254	100	100	100

Source: Calculations based on unit level data from NSSO's 69th round (July– December 2012) Survey of Drinking Water, Sanitation, Hygiene and Housing Condition

Table 2: Distribution of Rural Households by Household Type and Maximum Distance to the Place of Work Normally Travelled by any Earner of the Household in 2012

	No Travel	Less than 1 km	1-5 km	5-10 km	10-15 km	15 – 30 km	30 km or more	Total
Self-employed in Agriculture	7.3	35.1	51.5	4.1	1.1	0.4	0.6	100
	22.0	53.4	43.0	13.3	8.7	3.5	4.8	35.2
Self-employed in Non-Agriculture	14.8	22.9	29.1	14.8	7.4	5.9	5.2	100
	19.9	15.5	10.8	21.7	25.6	25.1	20.3	15.7
Regular Wage / Salary	3.5	15.9	28.9	17.4	9.2	12.2	12.9	100
	3.4	7.8	7.7	18.3	22.8	37.4	36.3	11.3
Casual Labour in Agriculture	2.2	20.5	63.0	9.6	2.3	1.0	1.4	100
	3.6	16.7	28.1	16.8	9.5	4.9	6.6	18.8
Casual Labour in Non-Agriculture	1.5	10.3	33.3	24.9	11.8	8.4	9.8	100
	1.7	5.6	10.0	29.4	32.8	28.9	30.7	12.6
Others	91.6	3.6	2.6	0.9	0.5	0.1	0.8	100
	49.5	1.0	0.4	0.5	0.7	0.1	1.3	6.3
Total	11.7	23.1	42.2	10.7	4.6	3.7	4.0	100
	100	100	100	100	100	100	100	100

Source: Calculations based on unit level data from NSSO's 69th round (July– December 2012) Survey of Drinking Water, Sanitation, Hygiene and Housing Condition

Table 3: Distribution of Urban Households by Household Type and Maximum Distance to the Place of Work Normally Travelled by any Earner of the Household in 2012

	Not required to travel	Less than 1 km	1-5 km	5-10 km	10-15 km	15 – 30 km	30 km or more	Total
Self-employed	15.1	20.9	32.4	13.6	7.1	5.5	5.4	100
	28.0	49.0	36.9	29.0	31.3	30.1	29.7	34.4
Regular Wage / Salary	3.7	13.3	33.8	20.4	10.3	9.1	9.3	100
	8.2	36.6	45.3	51.3	53.2	58.8	60.7	40.5
Casual Labour	3.2	14.3	39.5	24.2	9.3	5.3	4.3	100
	2.2	12.5	16.8	19.2	15.2	10.8	8.8	12.9
Others	93.7	2.4	2.5	0.6	0.2	0.1	0.4	100
	61.7	2.0	1.0	0.5	0.3	0.2	0.7	12.2
Total	18.6	14.7	30.2	16.1	7.9	6.3	6.2	100
	100	100	100	100	100	100	100	100

Source: Calculations based on unit level data from NSSO's 69th round (July– December 2012) Survey of Drinking Water, Sanitation, Hygiene and Housing Condition

Table 4: Distribution of Households in each MPCE Quintile Class by Maximum Distance to the Place of Work Normally Travelled by any Earner of the Household

Rural India

MPCE Quintile	No Travel	Less than 1 km	1-5 km	5-10 km	10-15 km	15 – 30 km	30 km or more	Total
0-20	9	24	48	11	4	3	3	100
20-40	10	24	44	10	4	3	4	100
40-60	10	24	44	11	4	3	3	100
60-80	11	23	42	11	5	4	4	100
80-100	16	21	36	11	5	5	6	100
Total	12	23	42	11	5	4	4	100

Urban India

MPCE Quintile	No Travel	Less than 1 km	1-5 km	5-10 km	10-15 km	15 – 30 km	30 km or more	Total
0-20	17	18	37	15	6	3	4	100
20-40	15	18	35	15	7	5	5	100
40-60	16	16	34	15	8	5	6	100
60-80	18	15	30	16	7	6	7	100
80-100	24	9	21	18	10	10	8	100
Total	19	15	30	16	8	6	6	100

Source: Authors' Calculation from Census of India 2011 tables

Table 5: Distribution of Transport Mode: Census 2011

	No travel	On foot	Bicycle	Moped/ Scooter/ Motor Cycle	Car/ Jeep/ Van	Tempo/ Autorickshaw/ Taxi	Bus	Train	Water transport	Any other
Rural	25.9	20.5	16.0	15.0	2.9	3.1	11.6	3.9	0.3	0.7
Urban	44.7	29.9	2.6	4.5	2.1	2.8	10.9	2.1	0.1	0.3
Total	30.0	22.6	13.1	12.7	2.7	3.0	11.4	3.5	0.2	0.7

Source: Authors' Calculation from Census of India 2011 tables

Table 6: Gender-wise Distribution of Transport Mode & Distance Travelled: Census 2011

a) Distribution of Transport Mode

	No travel	On foot	Bicycle	Moped/Scooter/Motor Cycle	Car/Jeep/Van	Tempo/Auto rickshaw/Taxi	Bus	Train	Water transport	Any other
Person	30.00	22.60	13.10	12.70	2.70	3.00	11.40	3.50	0.20	0.70
Male	25.90	20.50	16.00	15.00	2.90	3.10	11.60	3.90	0.30	0.70
Female	44.70	29.90	2.60	4.50	2.10	2.80	10.90	2.10	0.10	0.30

b) Distribution of Distance travelled

	Less than 1 km	1-2km	2-5km	6-10km	11-20km	21-30km	31-50	51+	Distance not stated
Person	30.00	16.30	22.80	13.70	6.60	3.70	2.40	2.60	1.70
Male	25.90	15.80	24.20	14.70	7.40	4.30	2.70	3.00	1.90
Female	44.70	18.00	17.90	10.00	3.90	1.90	1.30	1.10	1.00

Source: Authors' Calculation from Census of India 2011 tables

Table 7: Correlation between key variables and commuting mode choice

Mode of Transport (Proportion of Workers in the District)	Share of workers in the District Living in Census Towns	Population Density of the District	Proportion of elderly in the district	Median Night Luminosity of the District	Share of Rural Households in the District with Monthly Income >Rs 5000
No travel	-0.3732*	-0.2016*	-0.2408*	-0.3202*	-0.0894*
Foot	0.0472	-0.1047*	-0.3210*	-0.2134*	-0.1766*
Bicycle	-0.1025*	-0.031	0.0428	-0.0398	-0.2007*
Motorcycle	0.0841	0.0713	0.3102*	0.2202*	0.1570*
Auto	0.0604	0.0148	-0.0073	0.0619	0.2102*
Car	0.3131*	0.2943*	-0.1494*	0.5035*	0.3599*
Bus	0.3492*	0.1814*	0.4416*	0.3276*	0.2866*
Train	0.0516	0.2663*	0.0272	0.0984*	0.0316

*Significant at 5 percent

Table 8: SUR Estimates of Factors Associated with Mode of Transport in Rural India

	Foot	Bus	Train	Taxi	Car	Motorcycle	Bicycle	No Travel
Urban Quartile2	0.005	0.004	0.001	0.000	-0.000	-0.004	-0.007	0.001
	(0.64)	(0.95)	(0.55)	(0.06)	(0.33)	(1.34)	(1.41)	(0.16)
Urban Quartile3	-0.011	0.004	0.001	0.001	-0.004	-0.001	-0.007	0.016
	(1.20)	(0.78)	(0.35)	(0.49)	(1.92)	(0.18)	(1.16)	(1.69)
Urban Quartile4	-0.335	0.015	-0.003	0.005	-0.001	0.005	-0.013	0.026
	(2.63)**	(1.89)	(1.14)	(1.69)	(0.50)	(1.06)	(1.58)	(2.06)*
Log Population	-0.010	0.014	0.001	0.000	-0.002	0.001	0.008	-0.010
	(1.91)	(4.51)**	(0.85)	(0.08)	(1.59)	(0.39)	(2.22)*	(1.90)
Log Population Density	-0.036	0.007	0.005	0.002	0.000	0.014	0.026	-0.017
	(6.94)**	(2.10)*	(3.49)**	(1.69)	(0.08)	(7.21)**	(7.39)**	(3.32)**
Share Workers with less than Matriculation education	0.088	-0.033	-0.016	-0.030	-0.011	0.056	0.224	-0.267
	(1.12)	(0.68)	(0.79)	(1.64)	(0.71)	(1.86)	(4.19)**	(3.40)**
Share Workers with more than Matriculation education	-0.786	0.157	0.097	-0.052	0.164	0.105	0.020	0.315
	(6.43)**	(2.06)*	(2.99)**	(1.83)	(6.57)**	(2.22)*	(0.24)	(2.56)*
Worker Sex Ratio	0.133	-0.049	-0.029	-0.022	0.017	-0.070	-0.127	0.163
	(6.12)**	(3.62)**	(5.01)**	(4.39)**	(3.82)**	(8.26)**	(8.57)**	(7.46)**
Share SC	-0.089	-0.086	0.003	-0.002	-0.017	-0.021	0.028	0.201
	(1.79)	(2.78)**	(0.22)	(0.17)	(1.64)	(1.11)	(0.81)	(4.03)**
Share ST	-0.043	-0.015	0.014	0.007	-0.013	0.038	0.035	-0.008
	(1.19)	(0.66)	(1.47)	(0.88)	(1.81)	(2.72)**	(1.43)	(0.22)
Share HH- Income > 5000	-0.167	0.006	-0.003	0.010	0.035	0.017	-0.065	0.175
	(4.11)**	(0.26)	(0.33)	(1.09)	(4.26)**	(1.08)	(2.36)*	(4.28)**

Table 8: SUR Estimates of Factors Associated with Mode of Transport in Rural India

	Foot	Bus	Train	Taxi	Car	Motorcycle	Bicycle	No Travel
Share HH- Salaried	0.102	0.073	0.006	-0.006	-0.017	0.030	-0.052	-0.132
	(1.87)	(2.13)*	(0.39)	(0.46)	(1.51)	(1.41)	(1.40)	(2.39)*
Occupational Concentration	0.064	0.000	-0.007	-0.022	-0.004	-0.008	-0.121	0.120
	(1.41)	(0.01)	(0.60)	(2.05)*	(0.44)	(0.48)	(3.93)**	(2.66)**
Share Elderly	-0.149	0.503	-0.033	-0.072	-0.124	0.319	-0.047	-0.506
	(0.61)	(3.31)**	(0.52)	(1.27)	(2.49)*	(3.37)**	(0.28)	(2.06)*

N = 631 * p< 0.05; ** p<0.01
(t-statistics in the parenthesis)

Table 9: SUR Estimates of Factors Associated with Mode of Transport in Urban India

	Foot	Bus	Train	Taxi	Car	Motorcycle	Bicycle	No Travel
Urban Quartile2	0.032	0.001	-0.001	0.001	-0.001	-0.016	-0.011	-0.006
	(4.17)**	(0.12)	(0.28)	(0.53)	(0.35)	(2.96)**	(1.90)	(0.79)
Urban Quartile3	0.032	-0.003	0.002	0.004	-0.002	-0.021	-0.001	-0.014
	(3.27)**	(0.44)	(0.50)	(1.38)	(0.65)	(3.14)**	(0.13)	(1.34)
Urban Quartile4	0.022	0.004	-0.009	0.006	-0.002	-0.009	-0.001	-0.024
	(1.60)	(0.55)	(1.59)	(1.69)	(0.57)	(0.11)	(0.08)	(1.78)
Log population	-0.023	0.001	0.001	0.002	0.001	0.019	0.008	-0.007
	(5.36)**	(0.23)	(0.58)	(1.82)	(0.83)	(6.27)**	(2.47)*	(1.67)
Log population density	-0.004	-0.000	0.012	-0.001	-0.003	-0.003	0.007	-0.008
	(0.85)	(0.06)	(6.05)**	(0.42)	(2.45)*	(0.95)	(1.97)*	(1.79)
Share Workers with less than Matriculation education	0.360	-0.328	0.136	-0.101	-0.229	-0.208	0.517	-0.156
	(3.09)**	(4.62)**	(2.76)**	(3.07)**	(7.24)**	(2.62)**	(5.82)**	(1.32)
Share Workers with more than Matriculation education	-0.751	0.006	0.001	0.021	0.122	0.089	-0.304	0.844
	(8.64)**	(0.12)	(0.03)	(0.87)	(5.16)**	(1.50)	(4.58)**	(9.59)**
Worker Sex Ratio	0.145	0.112	-0.028	0.029	0.101	-0.019	-0.217	-0.114
	(3.34)**	(4.24)**	(1.51)	(2.39)*	(8.56)**	(0.63)	(6.53)**	(2.58)**
Share SC	0.105	-0.028	0.004	-0.005	-0.034	-0.151	-0.107	0.228
	(1.75)	(0.76)	(0.18)	(0.27)	(2.06)*	(3.66)**	(2.34)*	(3.74)**
Share ST	-0.102	-0.011	0.017	0.003	-0.029	0.002	-0.099	0.226
	(2.40)*	(0.42)	(0.96)	(0.27)	(2.51)*	(0.08)	(3.06)**	(5.25)**
Share elderly	-0.560	0.310	-0.143	-0.095	-0.079	0.351	0.154	0.072
	(2.79)**	(2.53)*	(1.68)	(1.69)	(1.44)	(2.56)*	(1.01)	(0.35)

Table 9: SUR Estimates of Factors Associated with Mode of Transport in Urban India

	Foot	**Bus**	**Train**	**Taxi**	**Car**	**Motorcycle**	**Bicycle**	**No Travel**
Mixed Land Use	0.054	0.096	0.026	-0.017	-0.012	-0.075	-0.186	0.131
	(1.04)	(3.00)**	(1.17)	(1.18)	(0.87)	(2.10)*	(4.64)**	(2.46)*

N= 637 * p < 0.05; **p < 0.01
(t-statistics in the parenthesis)

Table 10: SUR Estimates of Factors Associated with Modes of Transport: Motorized vs Non-Motorized

	Rural		Urban	
	Non-motorized	**Motorized**	**Non-motorized**	**Motorized**
Urban Quartile2	-0.001 (0.20)	0.001 (0.21)	0.013 (1.83)	-0.014 (2.07)*
Urban Quartile3	-0.003 (0.37)	0.002 (0.30)	0.017 (1.88)	-0.020 (2.16)*
Urban Quartile4	-0.02 (2.08)*	0.02 (2.03)*	0.001 (0.10)	-0.002 (0.20)
Log Population	-0.012 (2.92)**	0.015 (3.71)**	-0.021 (5.01)**	0.021 (5.16)**
Log Population Density	-0.027 (6.63)**	0.028 (7.00)**	-0.008 (1.49)	0.007 (1.40)
Share Workers with less than Matriculation education	0.044 (0.72)	-0.034 (0.56)	0.456 (3.94)**	-0.491 (4.26)**
Share Workers with more than Matriculation education	-0.451 (4.68)**	0.471 (4.96)**	-0.484 (4.97)**	0.505 (5.20)**
Worker Sex Ratio	0.168 (9.84)**	-0.152 (9.05)**	-0.095 (2.20)*	0.102 (2.35)*
Share SC	0.140 (3.56)**	-0.123 (3.19)**	0.195 (3.47)**	-0.177 (3.16)**
Share ST	-0.016 (0.55)	0.032 (1.12)	0.011 (0.27)	-0.000 (0.00)
Share of individuals with income more than Rs. 5000	-0.058 (1.80)	0.066 (2.09)*		
Share of workers with salaried jobs	-0.082 (1.89)	0.086 (2.02)*		
Median Luminosity			-0.072 (0.98)	0.073 (1.00)
Occupational Concentration	0.063 (1.77)	-0.041 (1.17)	-0.003 (0.08)	0.001 (0.03)
Share Elderly	-0.702 (3.64)**	0.593 (3.13)**	-0.257 (1.33)	0.235 (1.22)
	N= 631		**N= 637**	
* $p<0.05$; ** $p<0.01$	(t-statistics in the parenthesis)			