



Determinants of urban mobility in India: Lessons for promoting sustainable and inclusive urban transportation in developing countries



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ABSTRACT

Studies from developed economies have analyzed the key factors for understanding urban mobility, which are important to design appropriate interventions to reduce the volume of transport needs and to promote more sustainable modes of transportation. However, there are limited studies in urban areas of developing economies, which can hinder our capacity to formulate sustainable transport policies that are fit for the reality of those countries. In order to fill this gap, this study quantifies the influence of city features and socio-economic and socio-cultural variables on mobility patterns to identify evidence-based policy interventions for promoting more inclusive and sustainable transportation paths. The research estimates the amount of public and private transport (proxied by out-of-pocket travel expenditure) and modal choices, employing multivariate analyses, using a nationally representative household survey from the 98 largest Indian cities. Findings reveal that densification in Indian cities reduces the amount of transport as well as enhances the probability of using public transport. Small and medium sized cities predominantly use private transport, whereas large cities prefer public transport but lack non-motorized transportation. Moreover, income is the most important determinant of the amount of transport and the use of motorized and private transport. The top quintile is the only with positive income elasticity of transport demand. Results show that public and non-motorized transport infrastructures will provide sustainable and inclusive development, besides other co-benefits, such as energy security. Based on these findings, several policy recommendations are proposed to improve the sustainability and inclusivity of urban mobility in Indian cities.

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1. Introduction

Sustainable urban mobility is a major challenge in rapidly urbanizing medium- and low-income cities causing serious health, economic, social and environmental problems. This can be best addressed through appropriate transportation policies and programs using evidence-based interventions, which require thorough understanding of patterns of urban mobility. Broadly, mobility patterns depend, among other things, upon urban form, socio-economic and socio-cultural attributes of urban dwellers. Unlike well documented studies in developed economies (Creutzig, 2014; Gordon and

Richardson, 1989; Makido, Dhakal, and Yamagata, 2012; Mindali, Raveh, and Salomon, 2004; Naess, 1995; Newman and Kenworthy, 1989), limited studies assess patterns of mobility in cities of developing economies, including India. These cities cannot rely only on the evidence of those in developed economies, given large differences between them, such as infrastructure, socio-economic conditions and administrative capacities. Thus, this study identifies the main determinants of urban mobility in India and draws lessons for promoting effective transportation policies fit for Indian and other cities in developing countries.

On the one hand, cities in developing countries are facing an acute urban transport crisis (Pucher et al., 2005; Sudhakara et al., 2012). On the other hand, these cities are expected to contribute up to 89% of the increase in CO₂ emissions from urban areas until 2030 (IEA, 2008), in large part from the urban transport sector. Transport is responsible for about 23% of total energy-related CO₂

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emissions worldwide and projected to double by 2050 (Sims et al., 2014). However, emissions from the transport sector could be reduced to half by mid-century if policy-makers use the full suite of policies at their disposal (Creutzig et al., 2015). Carbon dioxide emissions per capita is more strongly correlated to urbanization than to per capita income (Sethi and Puppim de Oliveira, 2015).

One of the Sustainable Development Goals (SDGs) adopted by the United Nations is to “Make cities and human settlements inclusive, safe, resilient and sustainable” (Goal 11). This goal sets as one of its targets that “by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons” (United Nations, 2015). There is also a growing trend to decentralize government decisions to local and other sub-national governments, increasing the need to further improve their capacity to properly manage public urban demands (Puppim de Oliveira et al., 2015). Moreover, there is a huge potential for innovative interventions in Indian cities that can bring climate co-benefits and facilitate a more sustainable urbanization (Sethi and Puppim de Oliveira, 2016 forthcoming).

In India, the growing urban population further demands transport infrastructures, but cities lack proper roads, public transport and non-motorized transport (NMT) infrastructures. Often the provisions of transport infrastructures are not demand-driven or evidence-based, but ticket projects based on political decisions. As a result, even at lower vehicular ownership compared to developed and other developing economies, Indian cities face severe congestion and air pollution leading to health problems and economic losses.

The High Powered Expert Committee of the Ministry of Urban Development estimated urban infrastructure investments to the tune of ₹39.2 Billion¹ (at 2009–10 prices), over the next 20 years (Ministry of Urban Development, 2011). Out of these investments, urban roads need 44%, and transport and traffic need 14%. Recently the central government introduced the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) for 500 cities with an outlay of ₹500 Billion over the next five years (2015–2019), which will improve, among others, pedestrian, non-motorized and public transport facilities, and parking spaces. Additionally, the government also approved the Smart Cities Mission with an outlay of ₹480 Billion.

In this context, this study estimates determinants of urban transport (public and private) and modal choice (motorized versus non-motorized, and public versus private), using multivariate regressions, particularly focusing on the city features and socio-economic and socio-cultural variables. Based on a nationally representative household survey from 98 Indian cities, this empirical study reveals that densification reduces mobility needs and enhances the use of public transportation, *ceteris paribus*. Additionally, the amount of transport increases with city size (by population). Moreover, small- and medium-sized cities predominantly use private transport, whereas large cities use more public transport but lack non-motorized transport. Based on these empirical findings, among others, we suggest evidence-based interventions to achieve sustainable urban mobility in Indian cities. Thus, this empirical investigation contributes to the urban transport literature in India as well as to the global policy discussions on sustainable urbanization.

The remaining part of this section discusses urbanization and transportation scenarios in India and gives a brief literature review

of the factors explaining variation in urban transportation. Section 2 presents methods and data, Section 3 presents empirical results and discussion, and Section 4, the final section, concludes with spatial policy interventions vital for inclusive and sustainable development in Indian cities.

1.1. Urbanization and transportation scenario in India

Despite the lower level of urbanization² (32%), India has the second largest urban population (377 million) in the world after China (Census of India, 2011b), and India's urban population is growing at a faster pace. In the last decade (2001–11), cities added 91 million inhabitants, approximately 44% from natural growth, and the remaining 56% from net rural-urban classification and rural-to-urban migration (Bhagat, 2011). About 50% of urban population live in urban centres of fewer than 0.5 M inhabitants. The remaining are distributed as following: 7% in 0.5–1 M; 17% in 1–5 M; 9% in 5–10 M; and 17% in over 10 M inhabitants. An estimate from the United Nations reveals that the population shares will decrease in small-sized cities and increase in large-sized cities (UNDESA, 2014, See also Fig. 1). Cities have large variations in growth rates among themselves, with two distinct features: the growth rate of cities over 1 M is higher than cities with less than 1 M inhabitants; and the growth rate is negatively associated with the size of town or city (Bhagat, 2004). Over the last decade, the number of census towns has increased dramatically 2532, from 1362 to 3894, out of a total increase in 2774 towns and Urban Agglomerations(UAs),³ having core characteristics of urban areas, without appropriate governance mechanism and infrastructures (Census of India, 2011b).

In Indian cities, a major share of population travels with non-motorized modes (number of trips), such as walking and cycling (about 40%), while 15% uses public transport, 36% uses private transport (20% two-wheelers and 16% four-wheelers) and 5% uses intermediate public transit⁴ (MOUD, 2008). On an average, household spent about ₹279 on public and ₹347 on private conveyance per month (NSSO, 2010b). Estimate reveals shares of private and informal public transport will increase and public transport will decrease in the coming decades (MOUD, 2008). Even large cities have significant variation in transport modes. With city size, shares of public transport increase and non-motorized transport decrease, particularly among cities over 0.5–1 M inhabitants (Fig. 2). Thus, understanding the influence of city features in urban transport choices in India could shed more light on the best way to promote sustainable transportation and achieving the SDGs.

1.2. Factors explaining variation in urban mobility

Previous studies reveal urban form, socio-economic and socio-cultural variables, among others, explain the variation in urban mobility. Urban form is the spatial pattern of human settlements and activities at a particular point of time. Varieties of urban forms, including physical and non-physical features (Huang et al.,

² Urban area is defined as (1) “All places with a municipality, corporation, cantonment board or notified town area committee, etc.”; and (2) “all other places which satisfies the following three criteria: (i) A minimum population of 5000; (ii) At least 75% of the male main working population engaged in non-agricultural pursuits; and (iii) A density of population of at least 400 persons per sq km” (Census of India, 2011a). The first category of urban units is known as Statutory Towns, whereas the second category of Towns (as in item 2) is known as Census Town.

³ An Urban Agglomeration (UA) is “a continuous urban spread constituting a town and its adjoining outgrowths (OGs), or two or more physically contiguous towns together with or without outgrowths of such towns. An UA must consist of at least a statutory town and its total population (i.e. all the constituents put together) should not be less than 20,000 as per the 2001 Census” (Census of India, 2011a).

⁴ Auto rickshaw (three wheeler).

¹ ₹ = Indian rupee (US\$ 1 was approximately ₹60 in 01/2015, and \$ PPP conversion rate is expected to be 19.38 ₹ per US\$ in 2015).

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