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Phone call elasticity of city travel in Ahmedabad

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ABSTRACT

The new era of Information and Communication Technologies ICT enables people to communicate and interact with each other in different manner, changing the way they conduct their lives. This change has significant implications on their physical travels. The relationship between ICTs and travel is complex and sometimes indirect. This paper aims to better understand this complex relationship by empirically analyzing the substitution versus additive effects of phone calls on physical distance traveled by individuals. This is done by analyzing the phone call elasticity of physical travel. The analysis also studies the relevance of social ties in Ahmedabad, India, as a source of explanation of social activity, thus travel, undertaken by individuals. Social Network Analysis (SNA) allows capturing social determinants that affect travel in a way socio-demographics do not capture. The phone call elasticities show a variation among different people which can be connected to the type of trips that are substituted. The substituted trips are related to the social networks of individuals. Decision makers can use this tool to designing their travel and ICT policies in a novel way.

Introduction

This paper considers the role that Information and Communication Technologies (ICT) play in the physical travel of people. It is well-known that ICTs are fundamentally altering the organization and travel of households, firms and other actors in cities. The basis of these alterations is the increasing availability, power and use of mobile ICT (Aguiléra et al., 2012; Yuan et al., 2012). Although the relationship between ICTs and travel is complex and sometimes indirect, this makes it no less real and no less significant (Carrasco et al., 2008). This paper seeks to better understand this complex relationship by empirically analyzing the substitution versus additive effects of phone calls on physical distance traveled by individuals. ICT makes it easier (than physical travel) for some people to change their social activities on impulse thereby affecting their travel patterns. The effects of such changes are either an amplification or reduction of physical travel (Lenz and Nobis, 2007).

The earliest studies by transportation researchers focus largely on the effect of telecommuting on travel behavior. They observed a significant reduction in work-related travel and a contraction of activity space as a result of telecommuting. Koenig et al. (1996) observed a significant reduction in the number of trips and vehicle-miles travelled (VMT) for telecommuters. Charlot and Duranton (2006) found that ICT improvement can mean that face-to-face contact is necessary for only the most complex interactions, bringing about a relative decrease in business travel, particularly when the participants are located very far from each other.

Other studies suggest that ICT use at home may lead to an increase in non-work trips and activities. For instance Hodge and Koski (1997) observed a considerable reduction in commute-related travel and a slight increase in non-work travel as a result of center-based telecommuting. Kwan (2002) concluded that telecommuters undertook a significantly higher number of return home, eat meal, shopping, and social/recreation trips on telecommuting days when compared to non-telecommuting days. The results of other studies (Sasaki and Nishii, 2003) also support this tendency for non-work activities and trips to increase as a result of higher level of ICT use. Schwanen et al. (2006) observed a

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predominant effect of generation – which occurs when the use of one mode increases the use of another. They found that increasing use of ICT is unlikely to reduce travel significantly.

The study reported in this paper has a case study in the city of Ahmedabad, in India. While in most studies the term ICT refers to the use of laptops, smart phones, tablets, we limit ICT use in this paper to mobile and landline phones, because of two reasons. Firstly, the low internet penetration in India (only 8% internet penetration as compared to 76% mobile penetration (TRAI, 2010) and (consequently) lack of computer literacy amongst many people. Secondly, people are probably better in remembering their daily phone calls than their emails sent since synchronous types of communication, like the telephone, are used for exchanging the most important and urgent information (Tillema et al., 2010). Furthermore, since the phone is primarily used for social activities (communicating) Carrasco and Miller, 2009, it is expected that phone calls mainly substitute or complement physical face-to-face meetings, e.g. no shopping trips are performed by phone. Hence the use of the terms e-communication and e-commuters in this study.

A main difficulty in explaining the impacts of ICT on travel is in identifying the likely activities in which individuals will choose to engage. For example, it is easy to roughly assess how someone who begins to e-commute may reduce his or her physical travel. But what other types of travel that person may engage in, or perhaps even increase given the newly saved time is difficult to assess (Choo and Mokhtarian, 2007). However, if a closer look is taken into the social networks of the individuals it is possible to empirically generate data which can be used to calculate whether travel is being substituted or complemented by ICT (Axhausen, 2008). This is because through social networks we can explain why travel is generated and how, through so-called social ties, travel is maintained. Axhausen (Axhausen and K., 2002) connects travel with social networks, arguing that daily life revolves around family, colleagues and friends. Societies today have moved from being based upon strong co-location membership of social groups to a system of 'networks' where connections are spatially dispersed (Axhausen and K., 2002). Participation in these networks then leads to adaptation of preferences and diffusion of knowledge, triggering new communication-travel bundles. A number of studies have identified the potential relationships between ICT and travel and social Networks. First, the use of mobile communications affects people's use of time and increases the spatial and temporal flexibility of their daily activities and travel (Kwan, 2002). For instance, mobile phones increase flexibility not only in terms of the place where work can be performed, but also in terms of working hours and with whom one communicates. Second, people's increased geographical mobility associated with the use of mobile communications has an impact on their travel and trip making behavior (Black, 2001). Third, depending on their binding element, social networks also evolve and change, leading to changing patterns of ICT usage (Arentze and Timmermans, 2008). Fourth, social network characteristics determine to a large extent the ratio of e-communication use and travel. This e-communication/travel balance can actually be used to profile individuals travel behavior (Roy et al., 2012).

The above mentioned body of literature substantially outlines the relation between ICT, travel and social networks. ICT gives greater flexibility to an individual, who may then decide either to physically travel or use ICT for any particular activity. This decision is thought to be affected by the social network of the individual, which might consequently increase or decrease the physical travel of the individual. However, empirical studies encompassing ICT, travel and social networks are not easily available. To better understand this multifaceted phenomenon we, in this paper, look into the substitution and complementary effects of ICT on physical travel using social networks. To achieve this we use the concept of 'elasticity' on physical travel. To incorporate the social network perspective, we place the research in the social network context of an Indian city and examine how or if at all social network ties have any effect on the elasticity.

ICT, travel and Ahmedabad

Ahmedabad is the largest city in Gujarat, India. It is the seventh largest city and seventh largest metropolitan area of India, with a population of 5.5 million (Census, 2011). With the city's population, the telecom industry of Ahmedabad also has grown over the years. A large population, low telephony penetration levels, and a rise in consumer spending power have led to Ahmedabad being one of the fastest-growing telecom markets in India. The number of mobile connections grew from a little over 4 hundred in 1997 to over 3 million in 2010. However, compared to mobile phones, internet penetration has not been very fast. As mentioned earlier Ahmedabad has only 8% internet penetration as compared to 76% mobile penetration (TRAI, 2010), which justifies looking at phone use only.

Ahmedabad has a wide range of transport modes ranging from private cars to two wheelers (two wheeled motorized vehicles that are gasoline-powered scooters and motorcycles (El, 2009) to government-run public transport. The number of registered vehicles in Ahmedabad grew from 1.1 million in 1999, to 2.8 million in 2010. Among the number of registered vehicles two-wheelers account to around 70–72% of total vehicles registered. This is an indirect indication of the derelict state of bus services in Ahmedabad (GoG, 2010). Only 0.9 million commuters use public transport everyday, which is amounts to 0.8% of traffic on the roads. Like many other countries, which has seen a shift from the publicly owned public transport services to privately owned systems, (Sohail et al., 2006) Ahmedabad faces the same problems. With the decrease in the famous "Red Bus" (Ahmedabad Municipal Transport Service (AMTS)) and a population of nearly 6 million spread over 446 sqr km it is probably going to worsen the already existing high levels of traffic congestion. The more the buses lie idle, the larger the gap in public transport supply in the city, eventually leading to increasing usage of personal vehicles, hence traffic congestion (Dav, 2014).

Present mean trip lengths in Ahmedabad are low compared to some other metropolitan cities, namely, Bengaluru, Hyderabad and Pune (Pai, 2008), mainly due to a large share of captive walking and bicycle-mode users (Munshi, 2013). However, the city is developing fast and is facing a rapid rise in motorized vehicle ownership and use.

Primarily Ahmedabad has a mixed land use. Nearly 50% of total area of Ahmedabad is built up. Water bodies and wastelands cover 12% and 17% of area respectively. Industries cover 9% of the area (http, 2013). More than one third (36%) of the total area is under residential use, followed by 15% of the area used by industries. Though in the late 1990s, a slow and steady change from residential to commercial land use has taken place along the major roads and sub-arterial roads resulting in new commercial establishments in the west, while the industrial development has continued to grow towards the east. This might be because of the influence of agglomeration effects and scales of economies along major roads (Fig. 1).

Due to its high industrialization rate the city has attracted people from all over the central and western region of India. Ahmedabad is therefore home to a large cosmopolitan population from all over India. A distinct feature of Ahmedabad is its co-existence of the old walled city and the new city. The city is like any other Indian city with distinct characteristics of its own. The Guajarati's believe in strong kinship ties. Slightly less than half of all real