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Does urban rail increase land value in emerging cities? Value uplift from Bangalore Metro

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ABSTRACT

This paper seeks to understand how urban rail can influence land value uplift, especially in emerging cities which are largely unstudied. It examines the Bangalore Metro and shows that the uplift from the metro rail was substantial in the 'catchment area' and 'across the city'. The analysis was based on the panel data hedonic price model for around 160,000 apartments over the period 2012–16 and a cross-sectional data hedonic price model for 314,000 apartments in 2016. The panel data resulted in a stronger model and show significant land value increases, even beyond the traditional 500 m catchment. A 'before' and 'after' from the commencement of the metro rail operations shows a price uplift of 4.5% across the whole city and indicates a major agglomeration economic event resulting in substantial willingness to pay of USD 306 million from the metro rail accessibility. Emerging cities can expect metro rail to substantially improve their economies and other co-benefits as long as finance can be obtained by capturing this value.

1. Introduction

In the latter half of the 20th century, governments favoured urban road systems and failed to allocate substantial public funds for urban rail projects. This approach contributed to removal of urban rail across most of the cities around the globe in the 1950s and 1960s. Those that remained like London and New York's subway were significantly underfunded (Black, 2007; Green, 2016; Sharma and Newman, 2017).

Urban rail is back on the urban development agenda. It is thriving in densely populated cities of Asia, Europe and the Middle East and in the American and Australian cities which are heavily reliant on cars. Over the last two decades, China and India introduced over 25 high capacity urban rail systems (metro rail) with another 25 currently under construction.[1] This surge is driven largely by rapidly growing demand for rail in cities due to increasing travel time differentials between urban rail and urban traffic as well as a growing need for dense urban centers that are facilitated by urban rail. However, financing remains a constant struggle with the conventional model of government grants and fare-box revenue proving to be inadequate to meet the increasing rail demand. An alternative is the need to realize the economic benefits of urban rail and use it for its financing (Debrezion et al., 2007; Newman et al., 2013; Newman and Kenworthy, 2015; Sharma, 2018).

Land value capture (LVC) mechanisms have shown significant potential as a sustainable source of finance for urban rail projects. This financing alternative emerges from the potential of urban rail to increase the land value in transit catchments. Most of the LVC studies have been done on cities in developed nations. This paper seeks to enable a better understanding of LVC in emerging cities as

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[1] In addition to urban rail, China has constructed over 20,000 km of high-speed rail to support its growing economy (Chen, 2012; Gao and Newman, 2018).

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the need for alternative funding is even more significant in emerging cities where there is a high deficit in social infrastructure as well as lean budgets.

It is speculated that urban rail (metro rail) has increased real estate value in Indian cities (Jillella and Newman, 2016; Ministry of Urban Development [MoUD], 2012; Shankar, 2015) but there are unanswered questions on how to quantify the value uplift and willingness to pay (WTP) for accessibility. This paper attempts to answer these questions in stages. It begins by examining the relevance of location theory, land rent and demand, and WTP for transit infrastructure in any city including emerging cities to see how metro rail influences land value. The subsequent section discusses prominent studies on residential land value uplift due to metro rail in developing and developed countries based on the hedonic price model (HPM) method. Following this, a methodology is proposed to evaluate the impact of metro rail (as a property attribute) on the residential property market using HPM to estimate user's WTP. The methodology is applied to the Indian case of Bangalore.[2] The case study uses cross sectional and panel data to prepare HPM's for calculating WTP for different property attributes, particularly metro rail accessibility. The estimated HPM's are used to capture the increase along the metro rail catchment land market and at city-level. The latter is rarely done in LVC studies.

In the next sections, theory is used to show (a) why particular HPM variables were chosen to evaluate land value in Bangalore and (b) how the land value uplift can be explained.

2. Literature review

2.1. Urban rail and real estate

Table 1 shows that urban rail uplifts residential real estate (land and property) value in cities around the globe. This value appreciation could be captured to finance urban rail (Anantsuksomsri and Tontisirin, 2015; Armstrong and Rodriguez, 2006; Cervero, 2003; Du and Mulley, 2007; Garrett, 2004; Iacono et al., 2009; McIntosh et al., 2014; Medda and Modelewska, 2009; Sharma and Newman, 2018; Yankaya, 2004).

Value capture requires that the extent of impact in a city be quantified, followed by analyzing if urban rail generates sufficient value (demand – WTP) to be captured. Econometric models have been extensively used to assess the impact of urban rail on real estate. The most popular among these models is the hedonic price model (HPM).

2.2. Hedonic price model (HPM)

The HPM is a regression model with its basis in economic thinking of the early 20th century. It involves the application of least squares regression analysis which requires a linear relationship between the dependent variable (eg. property value) and independent (explanatory) variables (eg. characteristics of property). It estimates separately the contribution of each independent variable price to the total estimated (hedonic) price. The HPM functional forms include linear, linear-log, log-linear and log-log. Eq. (1) represents the equation for the observed dependent variable (D) (McIntosh et al., 2014; Rosen, 1974; Sopranzetti, 2015).

Parametric Land Price Equation

$$D_i = f(X_j; \beta_j) + \varepsilon_i \quad (1)$$

where D_i is the estimated land price of the i^{th} observation, X_j is a vector of quantitative and qualitative property attributes, β_j is the unknown hedonic price of the property for attribute j, and ε_i is the stochastic error term.

2.3. Location theory

Von Thunen's (1826) classic location theory analyzed the spatial division of different production activities to minimize transportation expenses between production area and marketplace (Fischer and Nijkamp, 2014). His concepts were applied to urban activities by Hurd (1903), Haig (1926) and Ratcliff (1949) to suggest that urban activities reflect rent competition for locations that minimize movement. On the other hand, Park (1929) theorized that improvement in transportation and population growth augments benefits of the city center. Alonso (1964) built his location theory based on earlier pioneering studies (Isard, 1956; Wingo, 1961) to suggest that minimization of transportation cost (spatial friction) between residence and work increases land rent in urban settings, as high accessibility to central areas activates competition for locations closer to the central business district (CBD) (Capello, 2011).

The above location theories when applied to an urban context, essentially explain the economic rationale of choosing to situate a firm or household at a specific location in an urban space to minimize transportation costs in the context of agglomeration economies (Capello, 2011). The primary consideration in selecting the location for an urban household is to ensure efficient access to the benefits of agglomeration viz. urban resources, services and workplaces. Thus, location theories highlight the significance of activity centers and travel time in a city.

Saving on travel time is economically significant in a city as it contributes to decreases in transportation and opportunity cost. Over the last decade travel time by car has exceeded that by urban rail in cities across the globe (Newman and Kenworthy, 2015). The importance of saving on travel time is driving the demand for urban rail that is further catering to the urban knowledge economy and the culture of people-centered urban form to support this process (Matan and Newman, 2016; Glaeser, 2011; Glazebrook and

[2] The name of the city is officially Bengaluru since 2014, but the old name is used for convenience with references.