



# Tailoring empirical research on transit access premiums for planning applications



Tao Xu<sup>a</sup>, Ming Zhang<sup>a,b,\*</sup>

<sup>a</sup> Wuhan University, 8 Donghu Road South, Wuhan 430072, China

<sup>b</sup> The University of Texas at Austin, 310 Inner Campus Dr., B7500, Austin, TX 78712, USA

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## ABSTRACT

Existing studies on transit access premiums focus primarily on hypothesis testing and methodological sophistication. There is a disconnect between the study efforts and the practice of transit-oriented planning and policy making. This paper aims at building this connection through a case study of Wuhan, China. The study applies established conceptual frameworks and analytical procedures in the field to 1) examine the spatial extent of rail transit impacts on housing market; 2) estimate transit access premiums and their spatial distribution in the station area; and 3) simulate revenue streams to illustrate the potential of transit value capture. The empirical results show that in Wuhan the influence area extends to 700 m for light rail transit (LRT Line 1), 900–1000 m for metro rail (MRT Lines 2 and 4). The distance ranges differ from the conventionally accepted value of 400 m and the value of 500–600 m currently considered by Wuhan local planning agencies. This empirical knowledge enables transit planners to modify transit catchment areas for the interest of enhancing ridership forecasting and service planning.

The Wuhan case study reports average transit capitalization rates of 2.87%, 3.71%, and 4.37% for LRT Line 1, MRT Line 2, and MRT Line 4, respectively. These capitalization rates translate to average premium values of 318.14, 383.02, and 400.23 yuan per-square meter within the corresponding influence areas for the respective three lines. This location-specific knowledge on housing market responses to transit access supports the local government to formulate and fine-tune location-specific plans and policies; for example, the density bonus regulation currently practiced by Wuhan municipal government. The simulation shows that a 0.5% capture rate could generate more than 153 million yuan from the existing housing stock (in year 2013) inside the influence areas of the three transit lines in Wuhan. In the full build-out scenario under Wuhan's current TOD density regulation, the captured value is 222 million yuan. The captured value could help reduce transit operation deficits. Planning practice and policy making should move from being experience-driven to evidence-based. Empirical research is essential to identify and provide the needed evidence for more efficient TOD regulation and value capture.

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## 1. Introduction

Rail transit is booming in China. In the past 15 years, nearly 3000 km of track length were constructed in Chinese cities. Another 3000 km (km) will be added to the existing urban rail network in the forthcoming 15 years (China Business Information Network, 2015). Major coastal cities such as Beijing, Shanghai, and Guangzhou have developed multi-line metro networks that carry billions of riders annually. Cities in the hinterland are catching up amid the next wave of urbanization. For example, Wuhan, the largest city in central China, is set to expand its rail transit network

from its current length of 129–400 km by 2021 and 533 km by 2049 (WHTPI, 2015). City planners and policy makers are observing rail transit success in improving urban mobility. They are also deliberating ways to best take advantage of development opportunities brought by the rail investments and to better prepare for challenges associated with rail operations. It is widely believed that transit system expansions offer great opportunities to guide urban growth around stations along transit corridors, helping avoid sprawl. Yet many cities have not kept up with the pace of rapid rail growth to accomplish transit-oriented development (TOD). Extended rail transit services have led to growing operating deficits that increasingly burden municipal finance. In Beijing, for instance, the municipal government has to subsidize its metro services more than 10 billion yuan per year (Sina, 2013). Researchers and policy makers are exploring transit-based value capture strategies; yet there has not been much progress in

\* Corresponding author at: The University of Texas at Austin, 310 Inner Campus Dr., B7500, Austin, TX 78712, USA.

E-mail addresses: [xutaowhu@126.com](mailto:xutaowhu@126.com) (T. Xu), [zhangming@whu.edu.cn](mailto:zhangming@whu.edu.cn), [zhangm@austin.utexas.edu](mailto:zhangm@austin.utexas.edu) (M. Zhang).

practice (Zheng et al., 2014).

Empirical knowledge is critical to support TOD practice and transit-based value capture strategies suitable to the Chinese local context. Effective TOD zoning and plans demand sufficient knowledge on the spatial scope, functional composition, and development intensity of transit impacts. Efficient location-specific value-capture initiatives rely on good understanding of factors contributing to the capitalization of transit access. International experience has generated a large volume of studies in the subject area (Debrezion et al., 2007; Mohammad et al., 2013; Wardrip, 2010); but these study findings are not directly transferable to the Chinese setting. Evidence from inside China is accumulating. Relative to the scale of China's rail transit development, however, the current research remains inadequate. Furthermore, there is a disconnect between research and practice. Most studies, while scholarly valuable, are focused more on hypothesis testing and less on the feasibility of implementing the study findings. In China where there has been a strong planning tradition, evidence-based or research-supported practice is critically important and urgently needed. This study makes efforts to connect research with practice, acquiring empirical knowledge directly applicable to and supportive of TOD planning practice and policy making. The effort is demonstrated through a case study of Wuhan, China.

Wuhan offers a typical case of Chinese cities that have invested heavily in urban rail transit systems but received little attention from scholarly and practical research. The City of Wuhan, located in the heart of China, ranks fifth nationwide in population size. It is known for being the transportation hub of the country. The municipal government of Wuhan plans to extend the urban rail network from 3 lines to 17 lines by 2030. Recently, the government has launched an initiative of planning Wuhan as a "Metro Metropolis." This initiative aims at integrating regional spatial development with the rail-based transit network. In early 2015, the Wuhan Land Resources and Planning Bureau (WLRPB, 2015) posted a policy regulation for public comment. The regulation provides a density bonus of 20% in floor area ratio (FAR) for residential land within 400 m of the station. The policy incentive originated from conscious TOD practice but was not backed by empirical research. Many cities in China are in need of evidence-based planning and policy making, just like Wuhan. Wuhan's geographical and demographic prominence calls for particular research attention. Empirical documentation on Wuhan's past and current experience in property-rail transit development offers insights that will better inform the city's Metro Metropolis planning and policy making. Lessons learned from the Wuhan case are valuable to other cities as well.

## 2. Review of related studies

In the international context, especially in North America, there has been a long lasting debate around the efficacy of rail transit investments. One land economics-based justification of transit development is that transit improves access to the properties around stations; the improved access leads to property value gains, generating tax revenue and other economic benefits. Whether and to what extent transit access increases property values requires empirical verification, which motivates much of the research efforts in the Western world. In the past four decades there have been numerous studies documenting the evidence of transit impacts on housing, commercial, office and other properties. Debrezion et al. (2007), Wardrip (2010) and Mohammad et al. (2013) reviewed nearly 200 publications in the topical area. Their review reveals that reported transit impacts as measured by the price premiums of transit access vary significantly. Some studies found small or even negative effects associated with transit

proximity, whereas others accounted for high positive values. It is commonly agreed upon that market responses to rail transit services are very much context dependent. To support planning and policy making, local knowledge is essential. New reports continue to arrive from cases around the world. Examples of recent studies include those by Hewitt and Hewitt (2012) on Ottawa, Pan (2012) on Houston, Ko and Cao (2013), Kim and Lahr (2014) on New Jersey, Hurst and West (2014) on Minneapolis, Dziauddin et al. (2014) on Kuala Lumpur, Macfarlane et al. (2015) on Atlanta. While the Western study findings are not directly applicable to other countries in practice, the shared experiences are informative and the analytical procedures advanced by the studies are transferable to different country/city settings.

Studies on rail transit impacts on property markets in China have been growing rapidly despite a relatively short history of rail transit development. A quick keyword search generated nearly 100 related publications. Below we summarize findings from a number of studies appearing in English publications.

The most studied city is Beijing. An early study by Wang et al. (2004) reported that home price decreased by 246 yuan (per square meter or psqm) for every km increase in distance from the LRT Line 13 stations. However, studies of other LRT lines in Beijing did not find the same strong positive evidence as shown with Line 13. Gu and Guo (2008) studied housing sales near LRT Line 8T and found no significant market impacts system-wide. Zheng and Kahn (2008) treated access to mass transit as a local public good and measured its valuation along with other public amenities, finding price elasticity of distance to Metro station and LRT station being estimated at  $-0.16$  and  $-0.04$ , respectively. Zhang et al. (2014) looked at Beijing's multiple transit lines and identified consistent, positive effects of MRT lines but mixed effects of LRT lines on housing prices. Sun et al. (2015) made efforts to improve premium measurement by applying a repeated-rentals model to a large sample in Beijing to quantify the proximity premium associated with subway stations.

Evidence reported from the Shanghai case has been positive. Pan and Zhang (2008) reported a unit price increase by 158 yuan psqm for every hundred meters closer to the metro station. The finding was reconfirmed by an updated study by Pan et al. (2014), who measured transit premiums by urban rings as market segmentations. The results show that, in the inner ring of Shanghai, property value increases by 1.5% for each 100 m closer to rail station, while the premiums are 1.9% for middle ring and 2.0% for the outer ring. Tian (2006) estimated a hedonic price model for Guangzhou, and reported that prices increased by 5449 yuan per housing unit for every minute decrease in walking time to Guangzhou's metro station (approximately 68 yuan psqm for every hundred meters closer to the station). Zheng and Liu (2005) studied the Shenzhen case with a very rich sample of 4993 sales records from 29 real estate blocks. They found that the average housing price within a 400-m distance from the station was 23% higher than those in the reference zone of 800–1200 m from the station. In a distance of 600 m, the average price was also 19% higher.

There is a large number of studies from other cities as well, including Wuhan, Nanjing, Chongqing, Shenyang, Xian, Zhengzhou, Kunming, Chengdu, Hangzhou, and Dalian; these studies appear in Chinese academic and professional journals not accessible to non-Chinese speaking readers. In general, these studies exhibit increasingly high academic rigor and methodological soundness. Many of these studies applied a three-section framework, considering building structural characteristics, neighborhood/environmental features, and locational factors. They applied hedonic price modeling (HPM) to control for the influence of these factors in order to better estimate the effect of transit proximity. Some rigorously tested and corrected spatial autocorrelation bias

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