**Forward-Looking Behaviour in Singapore's Private Housing Market: The Impact of the North-East Transit Line on the Housing Price Gradient**

# Summary

This paper seeks to investigate the effects of the North-East Line (NEL) Mass Rapid Transit (MRT) extension on neighbouring private housing resale prices. A hedonic price analysis on the Singapore private housing market is conducted using 99-year non-landed resale private houses and Executive Condominiums (EC) transactions located near the NEL from 1st January 1995 to 31st December 2008. The Ordinary Least Squares (OLS) and the spatial expansion method were used to estimate the hedonic price model. After controlling other variables, the estimations show the presence of positive announcement effects and negative construction effects on the non-landed private resale prices located within 800 metres of the NEL development. In particular, the announcement effects from the NEL were so strong that housing prices were higher than the prices levels when the NEL became operational. This suggests that the private resale housing market was over-reactive to market news on the NEL developments.

**Keywords:** Hedonic price. Spatial econometrics. Transport infrastructure. Housing

# Introduction

The construction of the North-East Line (NEL) transit system in 2003 was targeted to serve residents in the North-East, and designed to connect the existing East-West and North-South MRT transit lines. The project’s construction spanned from November 1997 to June 2003, cutting through high population density areas such as Chinatown, Serangoon and Clarke Quay. Land and developed areas made way for its construction, while nearby residential houses and commercial buildings had to endure the heavy construction and tunnelling works from the project during its construction phase.

This paper attempts to identify the effects of the NEL on neighbouring private resale housing prices. A hedonic price analysis is chosen to analyse the transaction prices of the private resale houses located near the NEL project from 1995 to 2008. This allows the investigation of how the announcement, construction and operational phases of the NEL project affected neighbouring housing prices. In addition to the OLS model, Can’s (1992) spatial expansion model is used to estimate the hedonic price model to account for spatial heterogeneity and spatial autocorrelation. Chapter 1 reviews the literature. Chapter 2 provides a brief overview of the NEL project. Chapter 3 explains estimations and empirical results. Chapter 4 concludes the main findings and possible extensions.

# 1. Literature Review

## 1.1 Urban Spatial Structures

Early monocentric urban models suggest that rising land costs in a city’s main central business district (CBD) area will allocate land use according to some left over principle. Monocentric urban models confound that accessibility to central urban areas made these areas highly sought after, and this was reflected through the higher land and rent prices that lead to the negative bid-rent functions (Alonso, 1964; Muth, 1969; Von Thunen, 1826). However, as technological improvements reduced transportation time and costs, cities began to sprawl and they increasingly had spatial layouts that were not predicted by the monocentric spatial models. Since then, polycentric models have considered for dual-workplace households (Madden, 1980), segregation of suburban and urban workers employment locations (Yinger, 1992) and differentiating employment areas with consumption nodes (Brueckner, 1979; Landsberger and Lidgi, 1978).

Developments in the hedonic price model led to its adoption in housing market studies. Following Lancaster’s (1966) work on attribute-based evaluation of consumer goods, the hedonic price model treats the housing quality and price as a composite of its locational and structural attributes**.** Interestingly, hedonic price models have shown both monocentric (Bailey, Muth and Nourse, 1963; Chung and Chan, 2003; McMillen, 2003) and polycentric housing price gradients (Bender and Hwang, 1985; Heikkila, Gordon, Kim, Peiser and Richardson, 1989; Waddell, Berry and Hoch, 1993) across different housing markets.

## 1.2. Hedonic Price Models and Transportation Developments

Hedonic price models are commonly used to isolate the marginal price of transportation infrastructure developments on housing prices. This is because access to transportation services increases the neighbouring household accessibility, and hence, is expected to increase their housing prices. In addition, studies have shown that some transportation infrastructure developments led to positive announcement and anticipatory effects[[1]](#footnote-1) on neighbouring housing prices (Bae, Jun and Park, 2003; Damm, Lerman, Lerner-Lam and Young, 1980; McDonald and Osuji, 1995; McMillen and McDonald, 2004; Wang 2010). For the Southwest Rapid Transit Line in Chicago, which opened in 1993, McDonald and Osuji (1995) and McMillen and McDonald (2004) found positive and statistically significant anticipatory effect on residential land prices in 1990 and 1987 respectively. However, some studies also found non-positive effects. Gatzlaff and Smith (1993) found that the announcement and operations of the Miami Metrorail system had no positive effects on neighbouring housing prices, while the Metrolink in Greater Manchester had a negative impact on neighbouring housing prices (Forrest, Glen and Ward, 1996). The announcement of the Supertram construction in Sheffield also caused neighbouring housing prices to decline, although subsequent increases in housing prices after tram’s completion was suggested as evidence of the gained accessibility by neighbouring households (Heneberry, 1998).

In Singapore, hedonic price models have been used to construct a constant-quality price index for Housing Development Board (HDB) resale flats (Ong, Ho and Lim, 2003), and to estimate how political boundaries (Wei and Wong, 2010), ethnicity (Wong, 2008) and proximity of primary schools (Wong, 2008) effect housing prices. In particular, hedonic price models were used to study the effects of transit developments on housing prices in Singapore. Using the stations Chinese Garden, Chua Chu Kang, Serangoon and Bishan, Lee (2009/2010) found that average housing prices near an underground train station was greater than those located near an above ground station by around 2% to 3%. Lee attributed this difference to the operational noise from the above ground stations. Tan (2009/2010) found that announcement of the Pioneer train station’s construction rose neighbouring HDB resale housing prices by 22.6% above pre-announcement levels. Even during the station’s construction phase, the housing prices were 6.61% higher than pre-announcement levels. However, when the station became operational, housing prices were only 7.14% higher than pre-announcement levels. Ong (2001) found that HDB resale flats nearer to the East-West transit line stations experience a price premium, with those further from the CBD enjoying an even greater premium for locating near an East-West transit line station. Studies have also found that proximity to NEL train stations had a positive effect on the prices on public and private housing prices (Chan 2004/2005; Quek 2004/2005). In particular, Quek (2004/2005) found positive announcement effects from the NEL project that were as high as 34.9% during the 3rd quarter of 1998. However, other studies on the Circle Line development found both positive and negative announcement effects for houses located near different train stations along the Circle Line (Chia, 2008/2009; Wu, 2007/2008).

## 1.3. Non-OLS Hedonic Price Models

Beyond the OLS framework, other estimation methods have been developed to help in the hedonic analysis of housing markets. Meese and Wallace (1991) adapted the non-parametric locally weighted regression (LWR) by Cleveland and Devlin (1988) and Cleveland, Devlin and Grosse (1988) to the construct of the housing price indices for Alameda and San Francisco Counties. Knight, Dombrow and Sirmans (1995) constructed a seeming unrelated regression (SUR) hedonic price model that allows the marginal effects of housing attributes to change over time. Brunsdon et al.’s (1996) geographically weighted regression (GWR) allows spatial variables to be estimated at each observation point, and weight observations by their distance to this point, eliminating the need for *a prior* function form in the estimation.

Spatial econometrics was developed to address the problems of spatial heterogeneity and spatial autocorrelation in analysing spatial data (Cliff and Ord, 1981; Upton and Fingleton, 1985; Anselin, 1988, 2001; Can, 1990, 1992). Spatial heterogeneity occurs when observations exhibit locational differences across a geographical space. Failure to consider for spatial heterogeneity is a specification problem that will affect the accuracy of the model’s estimation. The use of regional dummies can help account for certain location-specific differences, but the discrete nature of regional dummies cannot account for continuous spatial heterogeneity that is common to the spatial structure of housing markets. Spatial autocorrelation is where interactions occur between neighbouring observations across the geographical area. Such interactions violate the independence assumption of variables in the OLS model, and hence, require regression techniques that can ‘incorporate the spatial dependence into the covariance structure either explicitly or implicitly by means of an autoregressive and/or moving-average structure’ (Cliff and Ord, 1982; p.142). Housing realtors that estimate a housing unit’s transaction value commonly factor in the prices of neighbouring houses that were sold recently, and this leads to the problem of spatial autocorrelation.

Due to the inherent geographical characteristics of housing markets, spatial econometrics has been used in some hedonic housing studies. Thériaut, Des, Villeneuve and Kestens (2003) adopted Can’s (1990, 1992) spatial expansion method with the principal factor analysis to investigate the housing market of the Quebec Urban Community, and showed that the spatial expansion method can address some issues of spatial autocorrelation. Bitter, Mulligan and Dall’erba (2007) showed that although the GWR provides greater explanatory powers and predictive accuracy than the spatial expansion method, the latter’s ability to handle a “large number of variables and interactions” (Bitter et al., 2007, p. 23) makes it a better model to investigate the underlying determinants of housing.

1. Announcement effect is the change in housing price when the announcement of the project was made, while anticipatory effect is the housing price changes when the date of the project commencement draws nearer. [↑](#footnote-ref-1)