# Determinants of Singapore Residential Land Value

By

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Bachelor of Science (Estate Management)

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Submitted to the Department of Architecture in Partial Fulfillment of the Requirements for the Degree of

**Master of Science in the Real Estate Development**

at the

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## ABSTRACT

This empirical study investigates the factors that explain the variation in private residential land value in Singapore. In doing so, it determines the impact that land use zoning and plot ratio allowable have on residential land value.

Previous empirical studies in the US and UK have found plot characteristics, accessibility and zoning variables to be important determinants of land value. However, these factors need to be examined within the specific economic, social and political context of different cities. In this study, these variables are employed to investigate whether the traditional determinants have similar significant impacts on the variation in residential land value in the dense and highly regulated Singapore land market.

The data used consist of all residential land transactions from the government land sales program between years 1993 to 2001. Two land use types -- landed and non-landed -- are separately analyzed because of the difference in their density and mean land price per square meter. The study establishes the premium or discount in land price per square meter that developers would factor into a tender bid for each type of housing form allowed. Empirical evidence is provided that confirms the importance of location and accessibility in determining residential land value in Singapore. The study also confirms the presence of plattage (negative relationship between parcel size and price per unit area) in non-landed housing sites. Density or plot ratio is also a primary driver of residential land value and an important tool in land use policies to encourage capital land substitution.

Thesis Supervisor: Henry O. Pollakowski

Title: Visiting Scholar of MIT Center for Real Estate

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Yean Pin Lee
Cambridge, MA
3 Aug 2002

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# 1. Introduction

This empirical study investigates the factors that explained the variations in private residential land values in Singapore. In doing so, it determines if land use zoning and/or plot ratio regulations have significant impacts on private residential land values.

Land is a heterogeneous good that is comprised of a bundle of unique characteristics reflecting not only its location but also other amenities such as the quality of neighborhood and infrastructure. Zoning fixes the supply of land with given attributes for different uses. If the use allocation leads to a fixed supply of land, the equilibrium price would be determined by demand. Such an outcome in a competitive market could reflect how much a developer would pay for the land in a competitive bid, knowing that he/she could yield the highest economic use and density on the site at that particular location. Within a regulated market, this willingness-to-pay price is determined by how much the developer values each of the characteristics of the particular residential land for the proposed type of development. It is in the above context that the empirical research on what makes up the residential land value in Singapore arises.

Escalating residential sales price could also bring about an increase in residential land value as developers are willing to pay more for the land that could potentially give greater profits. At the micro level, land is a key factor of production for housing development. Its cost could contribute to a substantial portion of the project cost and subsequently manifested through residential sales price. Understanding the determinants of land value would help improve the feasibility study of a site acquisition from the developer's point of view. It would also enable more accurate bidding for new vacant site.

At the macro level, the understanding of the determinants of residential land value would enable policy makers such as planners and economists to make land use allocation more efficient. In making decisions, local governments and private utility providers monitor new developments and activities in the land market because of the lead times required to build the complementary infrastructure to accommodate the development. In addition, the study could also help to determine if some of the land use

allocation strategies such as increase allowable density around state land around transit station have indeed "optimized" the land use.

## 1.1 Supply of land in Singapore

Land is a scarce resource in Singapore, a small tropical island with a land area of 647.2 square kilometers (or 250.2 square miles). The city-state of Singapore is just slightly more than 3.5 times the size of Washington, DC and about the same size as the Pacific Island of Guam.

Singapore is one of the most densely populated countries in the world (Figure 1). Its population density has risen from 3,245 per sq. km in 1965 to 6,055 per sq. km in 2001 (Figure 2). It was estimated that by 2001, some 80% of the Singapore population would be staying in residential development with average plot ratio[1] of 2.1. At plot ratio 2.1 on a site of 10,000 square meters, there would be around 120[2] dwelling units in a 16-story[3] apartment.

**Figure 1: How Singapore compared with other cities (1999)**

| | Population in millions | Land area (sq km) | People (per sq km) |
|---|---|---|---|
| Singapore | 4 | 660 | 5,987 |
| Hong Kong | 6 | 1,095 | 5479 |
| London | 7 | 1,579 | 4433.2 |
| Beijing | 11 | 16,800 | 654.8 |
| New York | 20 | 137,304 | 1457 |

1 Plot ratio is equivalent to floor area ratio. It measures the ratio of gross floor area to land area.
2 This is based on 175 sqm per unit (3.11 persons per unit X 56sqm per person) including circulation space.
3 10,000sqm site could yield a building footprint of about 15 -20%.
4 Urban redevelopment Authority

*Source: The Straits Times (Feb 10 1999 & Mar 20 1999)*

**Figure 2: Key Statistics of Singapore**

| Year | Mid year population ('000) | | Land area (sqkm) | Population Density (per sqkm) | Median age #(year) | Dependency Ratio (per '00) |
|---|---|---|---|---|---|---|
| | Total* | residents | | | | |
| 1991 | 3135.8 | 2795.4 | 639.1 | 4907 | 30.2 | 40.9 |
| 1996 | 3670.4 | 3067.8 | 647.5 | 5669 | 32.4 | 41.3 |
| 1997 | 3793.7 | 3121.1 | 647.8 | 5856 | 32.8 | 41.1 |
| 1998 | 3922 | 3174.8 | 648.1 | 6052 | 33.2 | 40.8 |
| 1999 | 3950.9 | 3221.9 | 659.9 | 5987 | 33.7 | 40.6 |
| 2000 | 4017.7 | 3263.2 | 682.7 | 5885 | 34.2 | 40.4 |
| 2001 | 4131.3 | 3319.1 | 682.3 | 6055 | 34.6 | 40.4 |

* Total Population comprises Singapore Residents and foreigners staying in Singapore for at least 1 year
# Residents under 15 and above 65 year divided by residents aged 15-64 years

*Source: Yearbook of Statistics Singapore(http://www.singstat.gov.sg/keystats/annual/yos/yos18.pdf)*

## 1.2 Demand of land

In addition to the limitations posed by the small fixed supply of territorial land area, the supply of land for housing is further reduced by the more restrictive criteria for residential development such as location and neighborhood attributes. As a sovereign nation, other than land for housing, business and economic growth, open spaces and recreation, Singapore also needs land for airports and sea ports, military training grounds and water catchments areas (Figure 3). These uses consume large land areas and also impose development constraints such as building height, usage compatibility and intensity over wide areas around the developments. For example, a 30m expressway noise buffer sterilizes the land adjacent to expressway, making residential use within the buffer unsuitable.

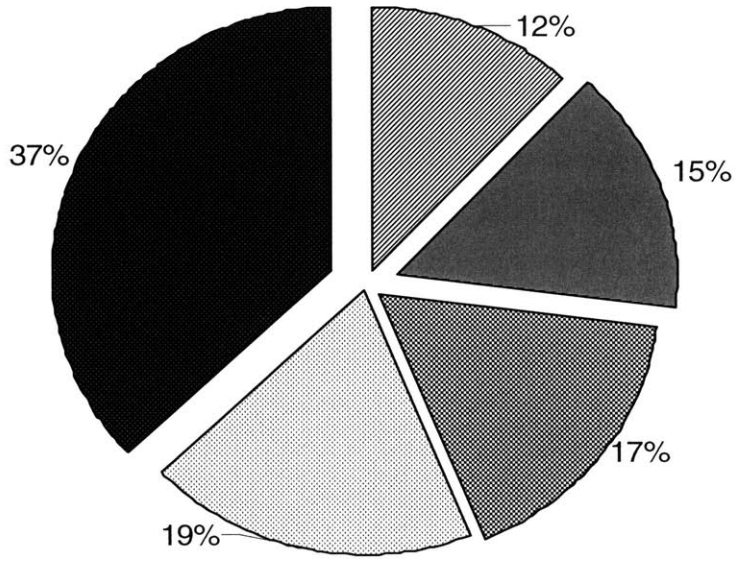
To ensure the best use of scared land, Singapore has a land use blueprint called the Concept Plan. First developed in 1971, the Concept Plan is a long-term strategic

[5] Urban redevelopment Authority

[6] Agence France Presse March 27, 02 SINGAPORE

plan that is reviewed once every ten years to keep up with changing trends and the aspirations of the people. In Concept Plan 1991, it was projected that Singapore's population would reach 4 million only after 2010. However, due to government's immigration policy to attract and embrace foreign talents, Singapore's population has already reached 4 million by mid 1999.

**Figure 3: Land usage in Singapore**

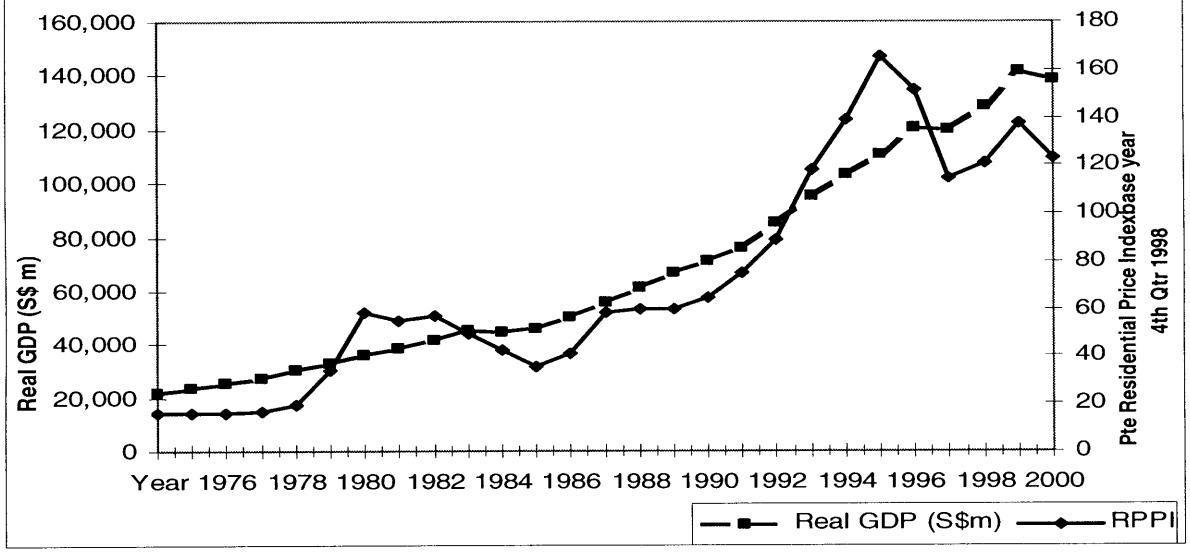



In the most recent Concept Plan Review 2001, URA has projected a total population of 5.5 million as a reasonable growth estimate to evaluate the allocation of land and resources in the next 40 to 50 years. With a larger population, there will be more demand for land resources for various uses. In particular, URA projected that a total of 1.8 million homes will be needed to cater for the 5.5 million resident populations. This is another 800,000 (80%) new homes on top of the existing 1 million homes today. With a fixed supply of land, these new homes would have to be provided by higher density development.

Over the last 30 years, the Singapore economy enjoyed a period of continuous growth. Such growth was also complemented by the escalating real estate property

prices, particularly in the private residential sector (Figure 4). Especially in the last decade, the residential price index has increased by 155%. Over the same period, the real GDP increased by less than 109%. With the continual growth of the economy and the population over the last 3 decades, the demand for land becomes more intense. In land scarce Singapore, the supply of housing is closely intertwined with the factor market for land. With such bullish housing market and land scarcity, builders would pay more for land in anticipation of higher demand and selling residential developments for higher profits or do more capital land substitution that would yield more sellable units. This increase in demand for land could then be translated to high land prices.

**Figure 4: Relationship between Real GDP and private property price index**




As urban economists have suggested, with increase in land cost, there would be a tendency to use less land relative to other labor or capital input (capital land substitution). Take for example: it would be extravagant to build a large home with big garden in the CBD because of high land cost. Rather, developer would substitute land with capital (such as building) and labor to build a higher density apartment. How land use zoning and density would affect residential land value becomes important both to individual developer and to the policy makers in making zoning decisions. The results of our study would help property appraisers, land buyers and sellers, and policy makers evaluate the impact of certain parcel characteristics and also zoning on residential land values.

## 1.3 Purpose of the study:

The objective of the study is:

- To investigate the factors that explain the variations in the private residential land value in Singapore; and
- To determine if land use zoning and/or plot ratio restriction have significant impact on the land value.

## 1.4 Organization of study

The thesis is organized into 8 chapters. Chapter 1 states the research issue and objective of this thesis. Chapter 2 provides the context of this study by reviewing the Singapore residential housing market. This would be followed by Chapter 3 which focuses on an overview of the Singapore land sales market and the relevant government policies. Market jargons that are frequently mentioned in the thesis would also be explained here.

With the background and context of Singapore explained, I proceed with a literature review of the classic economic rationale and determinants of land value in Chapter 4. Then, the various studies and articles relating to possible determinants of residential land value are explored systematically to lead to the formulation of the hypotheses. Chapter 4 also gives details on the formation of the hypotheses of this study while Chapter 5 focuses on the operationalization of the hypotheses.

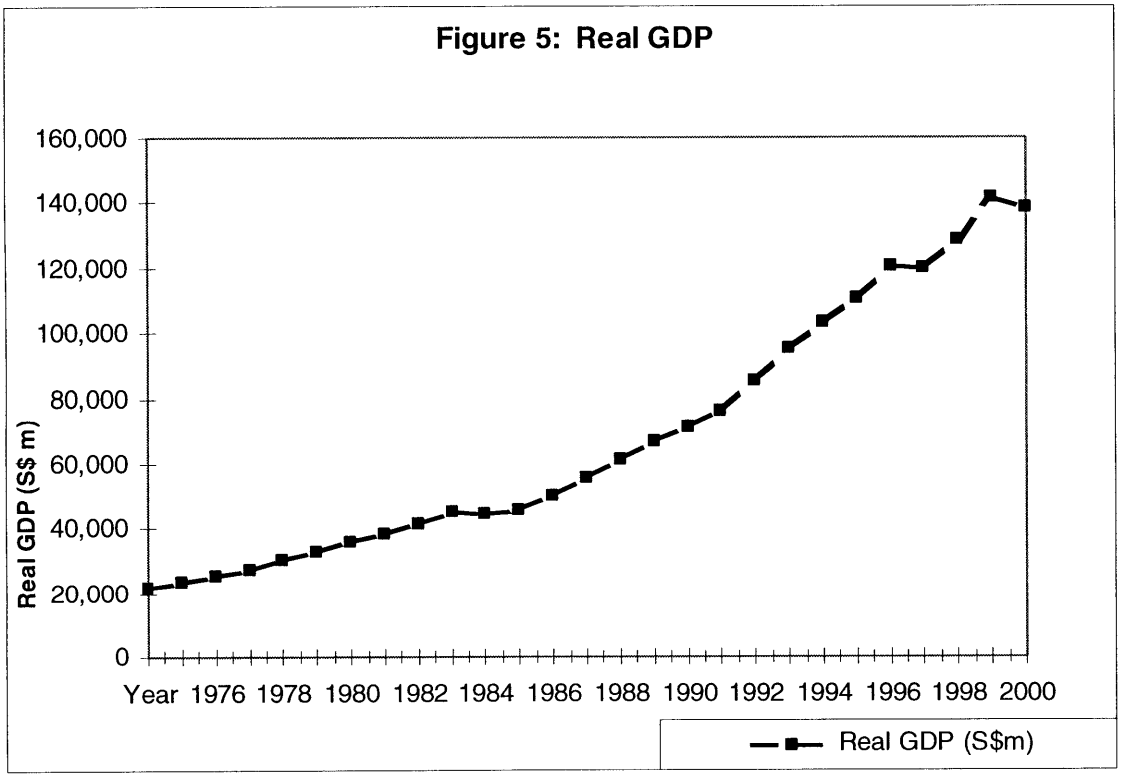
Chapter 6 covers the aspects of data source, collection, methodology and preliminary data exploration. Chapter 7 presents the empirical results based on correlation research using multiple linear regression models. Finally, Chapter 8 summarizes the findings of the study, discusses limitations and suggests key recommendations for future work.

# 2. Overview of Singapore housing market

## 2.1 Social economic context

Singapore is a densely populated city-state with about 4 million people and territorial land area of only 682.3 square kilometers. Over the last four decades, Singapore has achieved tremendous economic advancements. From earning a GDP of S$2.15 billion in 1960 to a GDP of S$141 billion (US $80 billion) (Figure 5) in 2001, the city-state is today a reputable financial centre, a key regional trading centre, the world's busiest port and a top location for investment.

**Figure 5: Real GDP**




Singapore has been ranked one of the best cities for business procurement in Asia based on a number of criteria ranging from political leadership, economic profitability, degree of corruption, risks in investment, and skills in workforce to assess a country's competitiveness as a business location.

Previously a British colony, Singapore became an independent republic in 1965 with People's Action Party being the ruling party. Since the 1960s, the Singapore Government has focused on job creation and housing provision for the nation. Today more than 92% of Singaporeans are homeowners and the unemployment rate has been kept at a low of 4% for the last 15 years.

## 2.2 Key features of Singapore Housing Market

The housing market in Singapore is very much driven and guided by planning and public policy. In response to the deplorable standard of living and acute housing shortage, the Housing and Development Board (HDB) was set up soon after self-government in 1959 as a statutory board to 'provide decent homes equipped with modern amenities for all those who needed them.' According to Census 2001, HDB housed about 86% of the population in affordable public housing by 2000.

- **Public Sector Dominance**

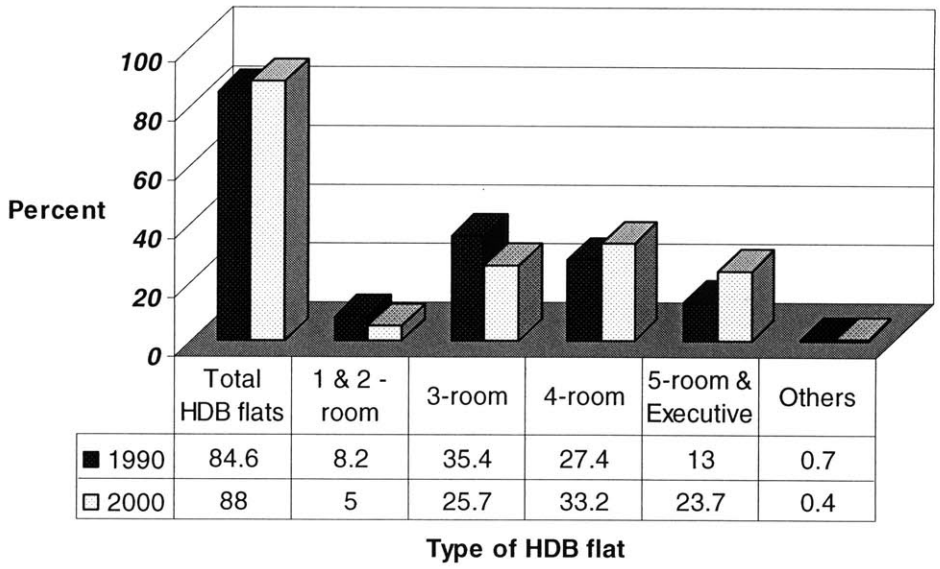
About 80.5% of the dwelling units in Singapore are public housing built by HDB. High-density, high-rise buildings have always been a main feature of all public housing estates in Singapore. They include residential blocks predominantly 10 to 13 story slab blocks, several 4 story blocks and several 20 to 25 story point blocks. These 99-year leasehold apartment units were sold to the eligible household such as a nuclear family with annual household income not exceeding $96,000 (US$53,631).

These apartments are located in housing estates, which are self-contained towns with schools, supermarkets, clinics, as well as sports and recreational facilities. There are three-room, four-room, five-room and executive flats (figure 6). A three-room flat has two bedrooms of about 800 sq ft. An executive apartment, the largest type of apartments built by HDB with typically about 1,600 sq ft of space, has three bedrooms and separate dining and living rooms.

The government supports the public housing program by providing financial assistance for the funding of housing development and other activities. These assistance come in the form of loans such as the housing development loan that covers

development program and operations, and government grants.

**Figure 6: % of Household in each HDB Flats type**




| | Total HDB flats | 1 & 2 - room | 3-room | 4-room | 5-room & Executive | Others |
|---|---|---|---|---|---|---|
| ■ 1990 | 84.6 | 8.2 | 35.4 | 27.4 | 13 | 0.7 |
| □ 2000 | 88 | 5 | 25.7 | 33.2 | 23.7 | 0.4 |

**Type of HDB flat**

*Source: Singapore Census of Population, 2000 Advance Data Release no 6 - Households and Housing*

- **High percentage of Home Ownership**

Singapore public housing program had its early emphasis on homeownership and creation of resale housing market. In 1964, the government introduced the Home Ownership for the People Scheme to give citizens an asset in the country, a means of financial security and to hedge against inflation as it protects against rising rents. This push for home ownership also helped in the overall economic, social and political stability of the country.

- **Predominant medium to high density housing**

Since 1970s, to solve the housing shortage problem, Singapore embarked on medium to high density housing program. With constraints on the availability of land for new development, part of the increase in the much needed housing units are accommodated by gradually building higher and denser developments in areas without height constraints, in order to make full use of available land.

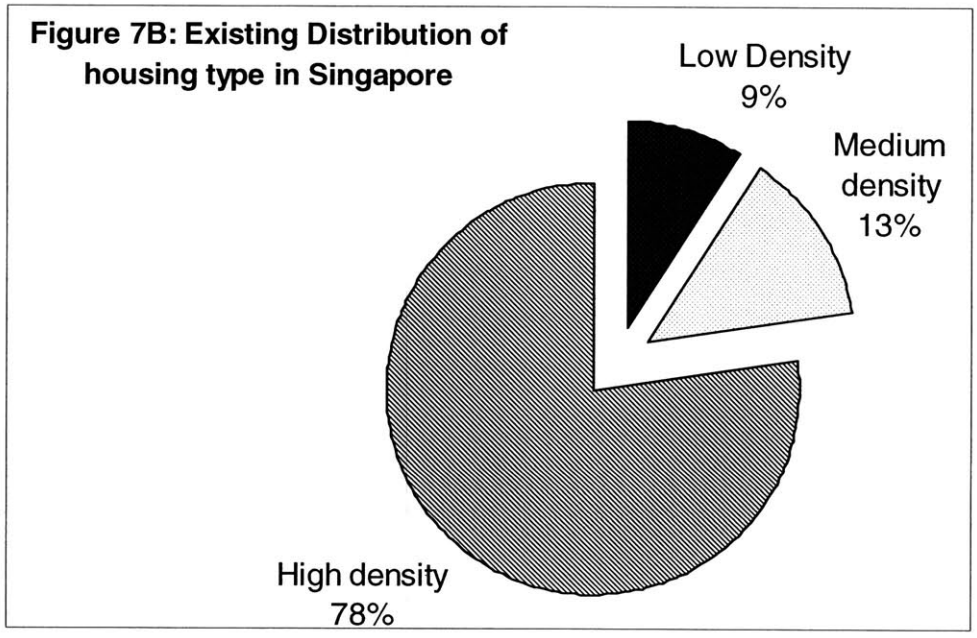
The existing mix of housing typology is summarized in Figure 7A & B. Almost 91 % of the housing stock are of medium to high density housing more than 10-story

high.

| Figure 7A : Existing mix of housing stock (as of year 2001) | | | | |
|---|---|---|---|---|
| **Housing Type** | **Typology** | **Existing Housing Stock** | **Density (Plot ratio)** | **Building Height** |
| Landed | Low Density | 9% | No FAR control | 2-3 story |
| Non-Landed | Low Density | | 1.4 | 4 story |
| | Medium Density | 13% | 1.6 | 10 story |
| | | | 2.1 | 16 storey or technical height control |
| | High Density | 78% | 2.8 | 20 storey or technical height control |
| | | | 3.0 or more | >20 storey or technical height control |

Source: URA 1995

**Figure 7B: Existing Distribution of housing type in Singapore**




To illustrate the difference between landed and non-landed sites, we could look at the typical distribution of residential typology within a typical 'satellite' new town such as Pasir Ris. With a land area of 601 ha (601,000square meter), including 318,000square meter of residential land, Pasir Ris town was developed in 1995 and it currently housed about 44,000 dwelling units. (Figure 8)

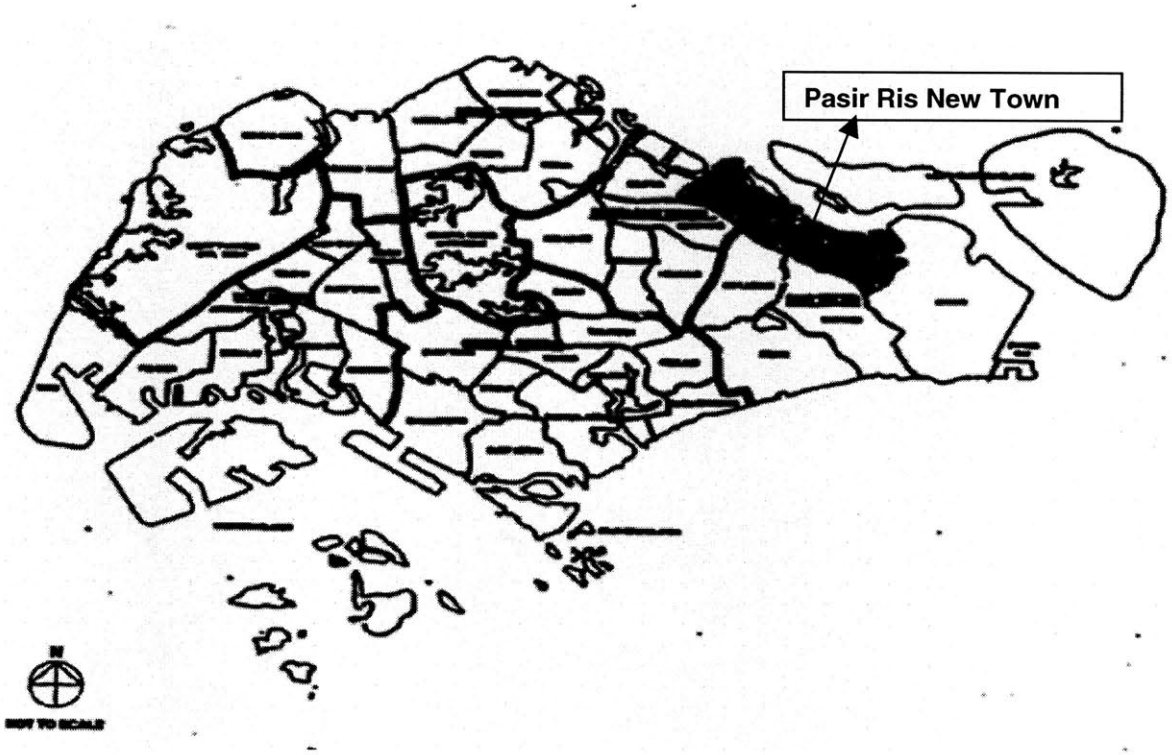



**Figure 8A: Map of Singapore and Pasir Ris New Town.**

Source: URA

| Figure 8B: Distribution of residential typology within Pasir Ris New Town | | | | |
|---|---|---|---|---|
| **Housing Type** | **Density (Plot ratio)** | **Building Height** | **No of units** | **% of Dwelling units** |
| Landed - Low Density | No FAR control | 2-3 story | 1,100 | 4% |
| Non-Landed - Low Density | 1.4 | 4 story | 90 | |
| Non-Landed -Medium Density | 1.6 | 10 story | 3,500 | 25% |
| | 2.1 | 16 storey | 7,900 | |
| Non Landed -high Density | 2.8 | 20 storey | 33,000 | 71% |
| | 3.0 or more | >20 storey | - | |
| Source: URA 1995 | | Total | 46,400 | 100% |

- **Housing Finance Policy**

The predominant 92.3% home ownership rate in public and private market is made possible mainly through the use of Central Provident Fund (CPF) as an instrument of housing finance. (Figure 9) The CPF is essentially a fully-funded, pay-as-you-earn

social security scheme, which requires mandatory contributions by both employees and employers of a percentage of the employee' monthly contractual wage towards his/her personal account in the fund. Contribution rate fluctuates with economic condition and it is currently set at 20% of wages for employees and 16% of wages for employers. In effect, the CPF is a compulsory savings scheme that earns interest and is exempted from taxation.

Since Sep 1968, legislation was enacted to allow CPF members to withdraw their CPF funds to finance the purchase of both HDB and private housing. Eligible members are allowed to use their CPF savings for the 20% down payment for HDB flats and their monthly CPF contributions can be deducted directly for mortgage payments of housing loans for the purchase of HDB and private housing units. This allows purchasers of public and private housing to be able to make provision for home ownership without a resultant decrease in monthly disposable income.

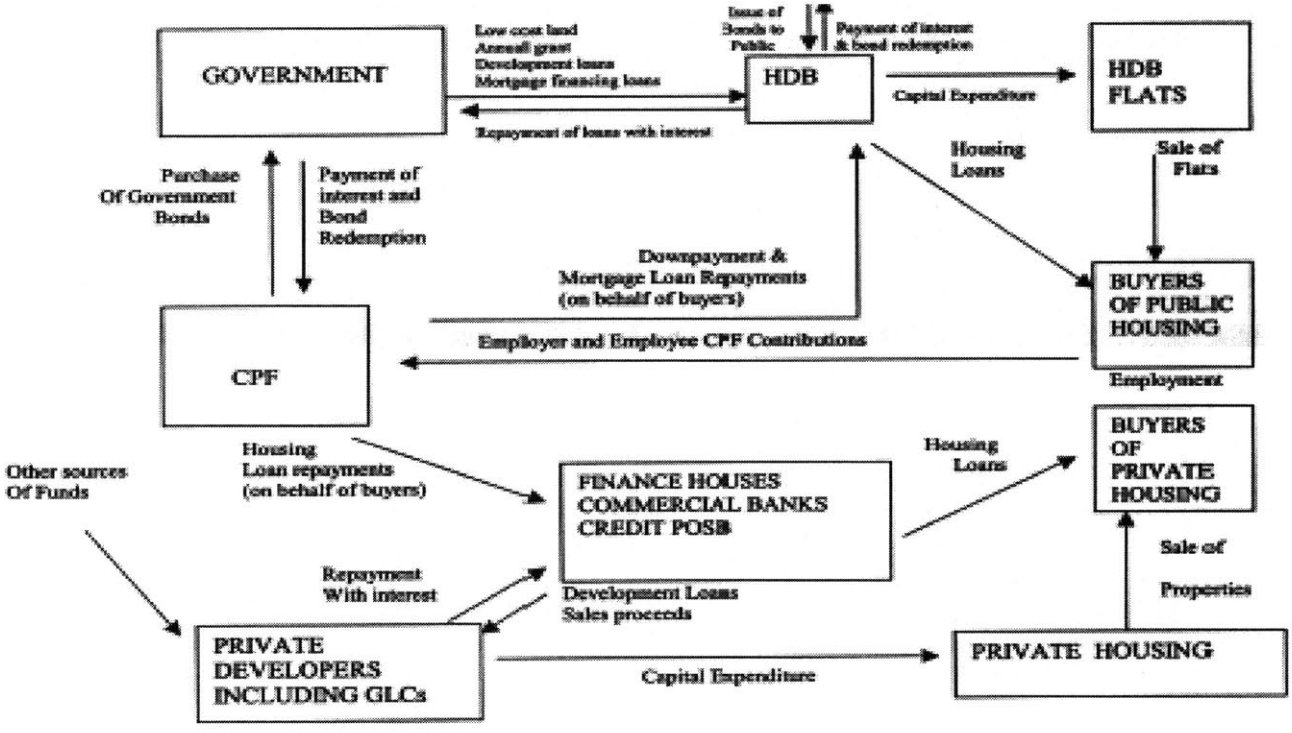



Figure 9: A schematic view of the housing Finance Market in Singapore (Pang 1992)

## 2.3 Housing sub-sectors in Singapore

There are 2 main housing sub-sectors in Singapore, public and private. In each of these markets, there are both sales and rental market. Figure 10 shows the percentage of residential household by dwelling type and also shows the several sub-sectors of the market.

| **Figure 10: Percent of Resident households by dwelling type** | | |
|---|---|---|
| **Dwelling type** | **Yr 1990** | **Yr 2000** |
| Total | 100% | 100% |
| **Public Sector:**<br>**HDB flats** | **84.6%** | **88%** |
| 1 & 2 –room | 8.2 | 5 |
| 3-room | 35.4 | 25.7 |
| 4-room | 27.4 | 33.2 |
| 5-room & Executive | 13 | 23.7 |
| Others | 0.7 | 0.4 |
| **Private Sector:**<br>**Private apartment and condos** | **4.1%** | **6%** |
| **Private Houses** | **7%** | **5.1%** |
| Others | 4.3% | 0.9% |

### 2.3.1 Public Housing

The public owner- occupied housing sector is the largest of the housing market. (Pang 2000) As the HDB has a virtual monopoly over the public housing market, the market does not determine the price of housing. The low price is set by the government, through the Ministry of National Development, taking into account the state of the economy and the levels of affordability of the general public. Demand is regulated by eligible rules such as household income, forming a nucleus family etc. An eligible household is allowed to buy a new flat that is priced almost half that of a similar-size private apartments. (Figure 11) This has worked towards encouraging home ownership among the Singaporean public, even for those in the lowest income brackets.

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[8] Pang Sock-Yong 2000, "The impact of Privatization on State Housing and Housing Policy in Singapore' workshop on 'New Requirements in Housing Policy: The experience of the East and Southeast Asia' seoul, 8-10 Nov 2000.

The rental public sector is very small as its stock only makes up about 7.3% of the 850,000 HDB units in Singapore. This sector is regulated by HDB and provides minimum standard housing for the lowest income families. Some of the rental units are also for 'transitional' families that are waiting for their new HDB flats that are under construction or for foreign workers

**Figure 11: Comparison between the price per square meters of HDB flat and private apartments (as at 4th Quarter 2000)**

| Zone | Town | New HDB Flats | | Private apartment | |
|---|---|---|---|---|---|
| | | 4-Room 90 sqm | 5-Room 110sqm | Mean Price | Difference (%) |
| West | Jurong West | $1,733,330 | $ 2,463,640 | $ 5,485,000 | 55% |
| North East | Sengkang | $ 2,066,670 | $ 2,681.82 | $ 5,199.00 | 48% |

### 2.3.2 Executive Condominiums

The Executive Condominium (EC) sector is a hybrid public-private sector that was introduced in 1995 to meet the increasing demand for private housing at affordable prices. The EC scheme also facilitated the HDB withdrawal of upper-middle-income housing market (previously called executive flats). These ECs are similar to the 99-year leasehold private apartment except for its eligibility conditions (household income below $10,000 per month) and the other regulations governing the minimum 5-year occupancy before sale to Singaporean or Permanent Resident and 10-year before sale to foreigners.

### 2.3.3 Private Housing

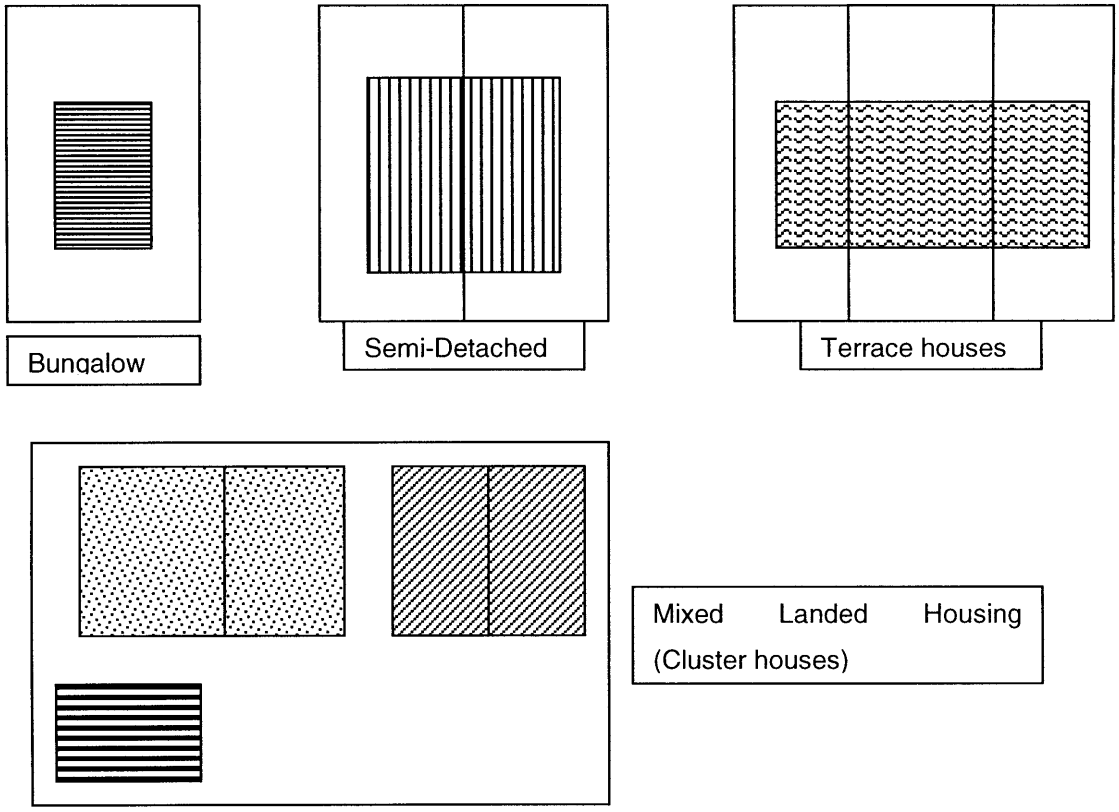
This sector has generally catered to the upper echelons of Singapore society and also the foreigners. Private housing comprises of condominiums and flats as well as landed housing (terrace, semi-detached and detached houses). The former are mostly strata-subdivided housing units, with the common areas owned and managed by a Management Corporation. Hybrid housing forms such as townhouses, cluster housing and strata-bungalows also come under the strata-subdivision arrangement. Landed housing can range from terrace houses on house plots as low as 150 square meters to `good class bungalows' on house plots of minimum 1400 square meters. Figure 12 - 14

gives details on the characteristics of each housing type.

| Figure 12 : Private housing market in Singapore | | | | | | |
|---|---|---|---|---|---|---|
| **Landed residential use** (land titled properties) | | | | **Non-landed residential use** (strata titled multi-family properties) | | |
| **Bungalow[ BG]** | **Semi-detached [SD]** | **Terrace house [TH]** | **Mixed landed [ML]** | **Apartment [APT]** | **Executive condominium [EC]** | **Condominium [CO]** |
| A free-standing house usually with garden. | A pair of houses attached along a common party wall. | Row houses of 3 or more units. | A few houses within a plot that could be combination of any 3 of the other landed housing forms. | Multi-family units that have land area of less than 4,000sq meters. | Hybrid of public and private housing but has regulated eligibility and resale rules. | Multi-family units that has land area of more than 4,000sq meters |
| Usually Restricted to Singaporean and permanent residents only. | | | | | | Foreigners are eligible. |

**Figure 13: Illustration of typical Medium – high density housing**

Figure 14: 2D- Illustration of Landed Housing types




## 2.4 Performance of private residential market since 1975

In Singapore (Ng 2002), the private residential investment accounted for 5.8 per cent of Singapore's real GDP and 17 per cent of gross fixed capital formation between 1990 and 2001. In fact, private sector investment in residential buildings constituted 66 per cent of overall residential building investments (based on 1990 prices) over the same period, despite the fact that 88 per cent of resident households were living in public housing estates in 2000.

Private residential property market is driven primarily by market demand and supply (although it is subjected to government regulations and, to some extent,

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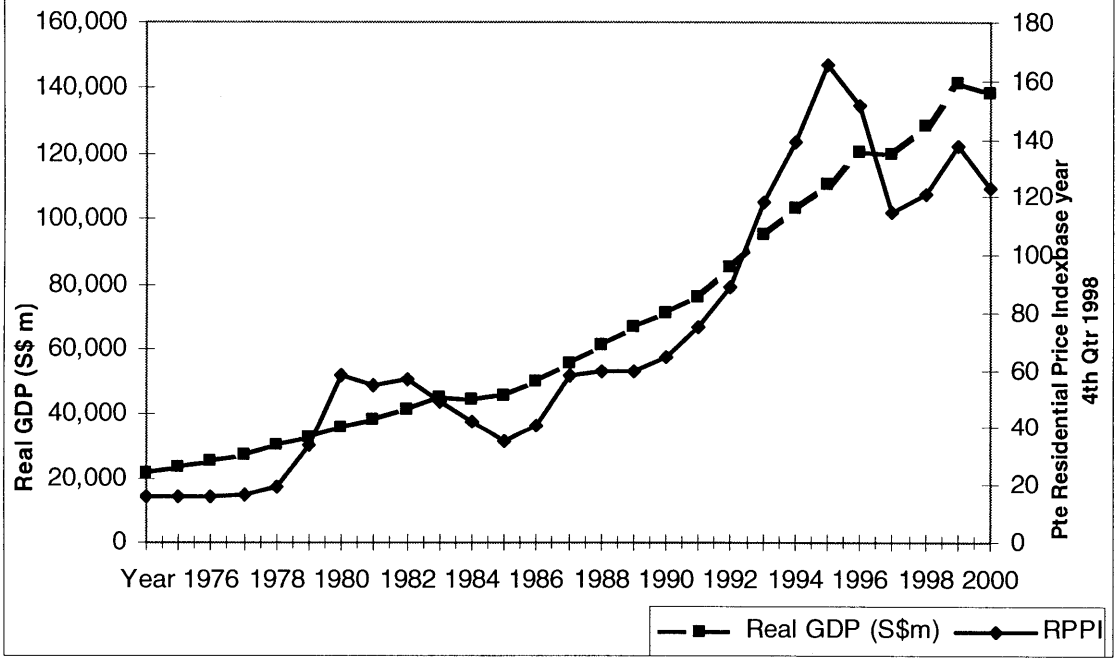
Ng Hui Meng (2002) 'ECONOMIC SURVEY OF SINGAPORE - (FIRST QUARTER 2002)' Ministry of Trade and Industry

competition from public housing). Figure 15 shows that private property prices index have been on an upward trend since 1975, with strong underlying relationship between property prices and real GDP.

However, in the periods 1980-1983 and 1993-1996, property prices had overshot the fundamental trend driven by GDP. Private property prices rose by 24 per cent per annum between 1980 and 1983, due partly to the relaxation of rules in 1981 to allow the use of Central Provident Fund (CPF) savings to purchase private properties. Property prices were also fuelled by a surge in foreign capital inflows, some of which went into property investments. Together with the strong economic growth at the time, these factors led to a rising demand for private residential properties and a shortage of housing units.

**Figure 15: Relationship between Real GDP and private property price index**



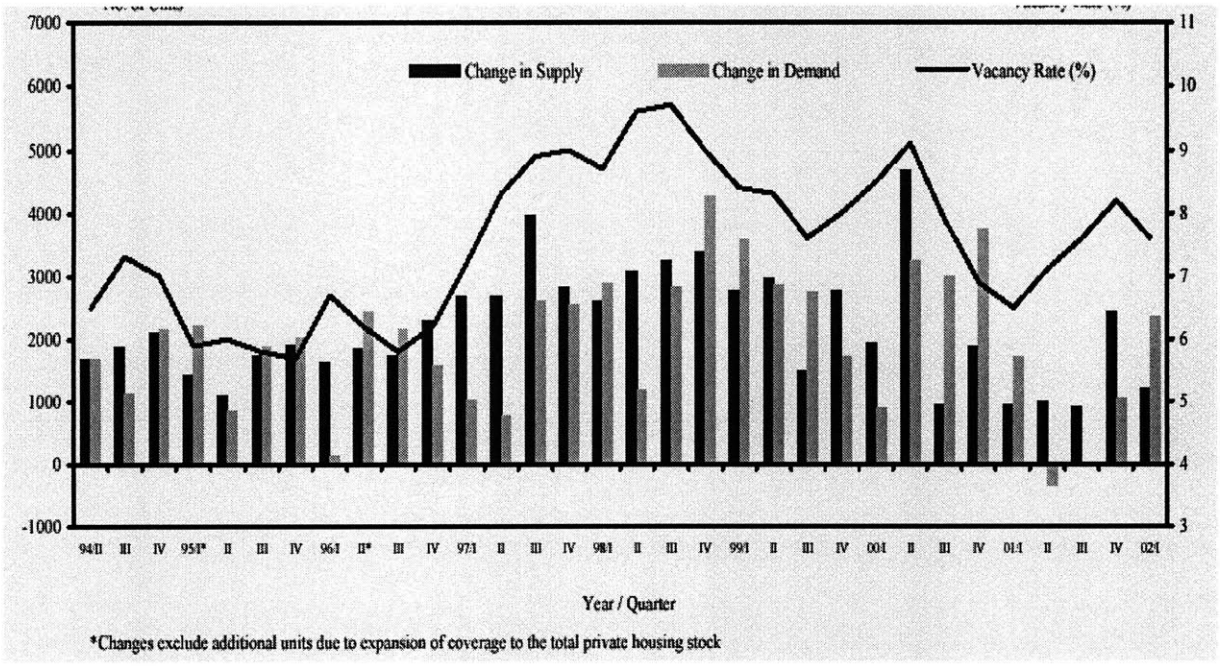

*Source: Residential Property Prices and National Income', Economic Survey of Singapore, First Quarter 2001, pp 49-51*

Fuelled by a demand boom in the residential property market, construction

activities grew by a remarkable 25 per cent per annum in the period 1980-84. This contributed on average 1.8 percentage points to real GDP growth each year. However, the construction frenzy resulted in a property glut between 1983 and 1986, when new supply exceeded new demand. With the slowdown in real GDP growth and the subsequent economic recession, property prices started to collapse in 1984, continuing its decline till 1986. The sudden downturn of the construction sector after several years of high growth was identified as one of the causes of the 1985 recession (Figure 16).

Since the mid-1980s, private residential property prices had been rising steadily. In the boom years of 1993-96, prices in the residential markets escalated, driven by strong income growth, bullish stock market performance, ease of obtaining financing through banks, and property speculation (which was common not only among Singaporeans but also foreign buyers as well).

**Figure 16: Vacancy Rate, change in Supply and Demand of private residential units.**




*Source: URA web site www.ura.gov.sg*

What was most troubling about the property market fever was the sharp increase in housing loans, particularly the easing of financing terms. A survey of banks conducted in the housing loan market found that 55 per cent of housing loans provided more than

80 per cent financing in 1995. Such high level of financing did not provide banks and finance companies sufficient cushion to absorb losses in the event of a decline in property values and the inability of borrowers to service their loans. This affects the quality of loan portfolios and undermines the soundness of Singapore's financial system. In May 1996, the government imposed anti-speculative measures to prick the property price bubble which was mainly supported by speculators and investors, rather than genuine homeowners.

Subsequently, the Asian financial crisis and a recession in 1998 further weakened the property market, as prices bottomed out in 1998 to 1994 levels. A brief period of recovery was experienced between 1999 and early 2000 as the overall economy experienced strong growth. But prices started to drop again in late 2000 with the collapse of the tech bubble, lackluster performance on the local stock market and the global economic malaise.

# 3. Singapore land market

## 3.1 Restrictive Land Supply

Singapore has a restrictive land policy similar to Hong Kong (Wheaton 1994). As a city-state, Singapore has a fixed boundary of territorial land area. Other than this restriction on the eventual land supply, the flow of new land available for residential development is directly controlled by the Singapore government. The government decides when and how much new land will be put on the market as well as the uses allowed on this land. This is done primarily through the sale of state land to private developers by tender or auction process.

With limited territorial land and a shrinking private land bank especially after 1989, Singapore government has directly intervened in the private residential land market. This is most evidence between 1994 and 1997 where the government response to the escalation of private house prices by intensifying the release of residential land parcels for bidding by private sector to stabilize supply of housing units (Lum 1996).

- **Land Acquisition Policy**

Due to the extreme scarcity of land in Singapore, the price of land rises very quickly in the early 70s. To allow the authorities to acquire land quickly and cheaply for housing purposes, the Land Acquisition Act set up in 1967 was passed to enable the government to compulsorily acquire private land for public housing or other development programs. The 1966 Land Acquisition Act enabled the government to acquire any land that is deemed necessary in the interest of national development, with the rate of compensation determined by existing use or zoned value, whichever is lower.

Through this legislature, the state was able to amass substantial amount of close

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[10] Wheaton, C.W and Peng, Ruijue (1994) 'Effect of restrictive Land Supply on Housing In Hong Kong: An Econometric analysis', Journal of Housing Research Vol.5 Issue 2 pg263-291

[11] Lum, Sau Kim (1996) "Housing Market Dynamics in Singapore: The Role of Economic Fundamentals and Restrictive Land Supply", PHD dissertation, UC Berkeley Fall 1996

12 Phang, Sock Yong (1999) "Urban Transportation and Land Regulations in Singapore, World Development report,Second East Asian workshop in Singapore January 12–13, 1999

to 90% of the total land area today (Pang 1999). About three quarter of the acquired land bank has been put into the public housing development while the rest for urban renewal and also public infrastructure project such as the mass transit line, industrial estates, and 99-year leasehold land use rights of these lands were also tendered or auctioned for private residential developments.

- **Land use policy**

The other mechanism that regulates land supply and its price is the strong regulatory control on land use and allowable plot ratio. Urban Redevelopment Authority (URA) carries out strategic planning to ensure the best use of land. Singapore has a total area of 647.5 sq km and the challenge is to ensure the best and optimal use of this limited land. However, planning means more than just safeguarding land for the future. It means having development blueprints to stimulate Singapore's economic growth and improve the quality of life for all Singaporeans.

This is achieved through a two-tier system of plans comprising the Concept Plan, the Development Guide Plans and an efficient development control mechanism.

Concept Plan 1991 and 2001

At the apex of the planning and development process is the Concept Plan, which sets the long-term strategy for Singapore's physical development. The Concept Plan serves as a strategic comprehensive plan to guide the use of land in the long term. The Concept Plan, first developed in 1971 and fine-tuned over the years, has guided Singapore's infrastructural, transportation and economic growth. The latest review of the Concept Plan 2001 has just been completed and it will set the broad development strategy for Singapore for the next 40 to 50 years to meet the needs of a projected long-term population of about 5.5 million.

One of the key strategies to meet this increased housing demand was to increase the density of housing within existing new town. Today, the public housing is generally built at a density of 2.8 plot ratio (ratio of gross floor area to land area) and no more than 30-storeys. More recently, some developments have already been built up to 4.0 plot ratio and 40-storys at selected locations, such as Toa Payoh.

Development Guide Plans (DGPs)

The DGPs form a second layer of plans that translate the broad proposals of the strategic Concept Plan to detailed proposals at the local level. From the Concept Plan, the planning intention for individual plots of land is translated into a detailed Master Plan. The Master Plan is reviewed every 5 years and it is a gazetted, public document backed by the law. As the Master Plan forms the basis for all development control decisions, it provides businesses with the certainty crucial to business ventures and investments. The Master Plan also provides transparency and stability in the planning system.

In total, fifty-five DGPs will be prepared for the entire country, each one setting out the planning vision for the specific area, and providing guidelines on land use, plot ratio allowable (density), building height, road system, open space to guide both public and private sector development. Each DGP addresses housing needs, as well as community, commercial, industrial, transport and recreational facilities for the population of each area. In all, a total of 55 DGPs will combine to form the overall Master Plan, guiding the detailed development of Singapore.

Development control

The detail master plan enables Singapore to execute effective development control system to regulate land use and development. URA is also responsible for granting planning approvals for private, government and statutory board developments.

In the evaluation of development proposal, URA would evaluate the proposal with respect to the Master plan allowable land use, plot ratio, storey height and other control such as setback, road buffer etc to facilitate orderly development according to the planning intentions as stipulated in the Master Plan and the prevailing control parameters. At the development proposal stage, the plot ratio (i.e. floor area ratio) becomes a dominant measure on the intensity of the land usage that is regulated by the Master plan. Development regulation such as capping the maximum allowable plot ratio (i.e. floor area ratio) for a site would have impact on land prices.

## 3.2 Land Tenure

About 90% of the total land area of Singapore is owned by the government and its statutory boards. While some are reserved for the various government ministries to discharge their national functions, e.g. education or defense, the remainder is sold to either the various statutory boards or the private sector on mainly leasehold interests up to 99 years. The various government ministries and organs of State use almost two-thirds of State lands.

As a former British colony, the two main types of property title are freehold and leasehold estates. Freehold estates form a small minority of private land holdings in Singapore and are no longer granted by the government. Leasehold is the primary form of land ownership in the country. Leasehold estates are granted by the government, typically for 99-year terms. All HDB public housing owners in Singapore are on 99-year leasehold. That makes up about almost 90% of the total housing stock. This leasehold arrangement separates the housing unit from the land and allows the government to compensate and resettle any lessee if and when the land may be required for development. All government sales sites are also on 99-year leasehold.

## 3.3 Sales of Sites (SOS) Program

Land sales program provided by the government started in 1967. Since then, it has been the only source of land from the State with dwindling supply of private land. Today, it is the largest source of land supply for all development.

Objective of SOS Program

a) An innovative way of forging partnerships between the Government and the private sector: the Government puts out the land and the private sector provides the financial resources and creative ideas to develop the area;
b) An implementation strategy that ensures that the planning visions are realized since every plot of land is sold with a planning parameters and sometimes urban design requirements. Among the notable examples of redeveloped areas are to sell high density residential sites that converted Tanjong Rhu from a shipyard into a quality waterfront residential area;

c) A means of direct supply to ensure steady release state land supply, and avoid causing big fluctuations in property prices or inefficient speculations.

Currently, there are 3 agents of the SOS program, Housing Development Board (HDB), Urban Redevelopment Authority (URA) and Jurong Town Corporation (JTC). All these agents are appointed by the State to sell state land to private sector. HDB usually sells pockets of land within the HDB new town while JTC sells vacant industrial land to industrialist to build their manufacturing or warehousing plants. URA acts as agent for the State in carrying out land sales for commercial, hotel, private residential and industrial developments. As one of the pioneer and largest land sales agents for the Government, URA releases a steady supply of land for sale to the private sector – a supply which helps to sustain economic growth, and ensures that housing, social, leisure and commercial amenities are provided for. In addition, URA also sells sites for special uses e.g., heavy vehicle parks, conservation shop houses and recreational developments.

Over the past three decades, URA has released 1,345 land parcels, totaling 797 hectares through the Government Land Sales Program. The properties built on these land parcels contributed 35 per cent of Singapore's total commercial space, 39 per cent of the total stock of hotel rooms and 26 per cent of private housing.

## 3.4 Sales Process

State land sites are usually sold on 99-year leases for commercial, hotel and private residential development, whereas leases for industrial sites are usually for 60 years. The lease tenure for other types of sites varies depending on the uses.

All the sales sites were sold with pre-designated land use and allowable plot ratio. They are sold free of encumbrances and are ready for immediate development. The standard caveat on the lease included a pre-committed completion date (usually 3-5 years) whereby penalty would be levied if the development is not completed by then. These caveats prevent land speculation with holding of land and ensure that the development takes place within a specific time frame to coordinate with the development strategy of the area and also the infrastructure provision such as road network and

public utilities.

The usual sale method is through public tender or First-Price Sealed-Bid Auction system where all bidders simultaneously submit confidential bids on pieces of papers. The site is awarded to the highest bidder. However, small residential land parcels and conservation shop houses are also sold by public auction in the recent years.

Since 1 July 2000, a new land sale approach has been adopted - Reserve List method, whereby sites are launched for sale only if developers indicate interest in them. In brief, if a developer is interested in asking for a site on the reserve list to be put up for sale, he could submit a minimum bid price to the land sales agent. The accepted minimum bid will be made public before the site is launched for sale. At the close of tender, the applicant would be awarded the site if he is the highest bidder else.

## 3.5 State Land Pricing Approach

For each sales site, the Chief Valuer at the Inland Revenue Authority of Singapore sets a minimum price called the 'reserve price', based on recent transactions. The site is awarded as long as the bid does not fall below 85 per cent of this figure. The 'reserve price' is maintained as state land is part of the nation's reserves and the government reserves the right not to sell state land at below market value.

Under the present system, the Chief Valuer calculates the market value of state land earmarked for residential use by combining two valuation methods. First, he looks at the sale of small plots of state land located within the neighboring estates to the private sector through public tender. He uses the prices paid in these instances as benchmarks.

Chief Valuer also uses the sale prices of flats in the vicinity and works backwards to get a residual value for the land. Starting with the expected selling prices of all the flats to be built on a certain plot, he then deducts the costs of financing and building them. The figure he is left with is called the residual value for the land.

Since the land supply in Singapore has been strongly influenced by non-market forces, the purpose of our study was to understand the determinants of the market land values in a dense and regulated land market such as Singapore.

# 4. Literature review and synthesis

## 4.1 Definition of land value/ price

Land price has been commonly used interchangeably with land value as price is a reflection of the value of the land that a developer would place on the use the land could be put into. The underlying concept is that a buyer is going to build something that will be sold in the market, and a feasible land price is determined by the difference between the anticipated future proceeds from the sale and the cost of the project and the required profit.

## 4.2 Previous studies

### 4.2.1 Relationship between housing and land price

There were many studies on the end product of residential land –housing. Many authors such as Cao (1997), Pollakowski (1997), Scott (1999) has investigated hedonic, repeat-sales approaches of residential pricing. There is also a wide range of literature that studied various locational, structural, neighborhood, buyers and sellers attributes that influence house prices.

Housing is unlike most other commodities. It is made up of a complex bundle of goods and services that extend well beyond the shelter it provides. Wilkinson (1973) makes the distinction between dwelling specific or structural attributes and location specific attributes. The former pertaining to the physical structure of the property, whilst the latter are concerned with the property's location.

The demand for land is derived from the demand for the output (housing) that

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[13] Cao, Yong & Chee, Meng On (1997) The price structure of private property in Singapore Nanyang Business School, Nanyang Technological University Singapore

[14] Henry O. Pollakowski and S..M Wachter 1997, Frequency of Transaction and House Price Modelling, Journal of Real Estate Finance and Economics, 14,173-187

[15] Scott Orford (1999) Valuing the Built Environment – GIS and house price analysis, Ashgate Publishing Ltd, England

[16] Wilkinson, R.K (1973) "Measuring the determinants of relative house prices", Environment and Planning , Vol 5, pp357-367

can be put on the land. Yu (2001) highlighted that land is an important factor of production as it contributes as much as a 50% to the total project cost in Singapore. Meikle (2001) has found that the price of land in UK, the most significant non-construction element of house prices, has risen at a faster rate than house prices and a much higher rate than construction prices.

The relationship between the land market and the output market is sort of a chicken-and-egg question. Sullivan (1993) concluded that price of a particular piece of land is high because the demand for housing (and the demand for land on which to build housing) is high. The high price of land is the result –not the cause- of high housing prices.

Wheaton (1994) highlighted that empirical research has conclusively established that shortage of urban land supply such as that in Hong Kong will raise metropolitan housing prices. In the absence of legal or zoning restrictions, higher housing prices can induce additional housing output through capital land substitution without increased input of land. In Hong Kong, the shortage of land has caused higher housing prices but not lower housing output. The shortage of land increases the expected higher rents, which is capitalized into higher housing prices. High housing prices then encourages capital land substitution in housing production and result in an increase of housing output. As such, zoning or plot ratio restriction are deemed important characteristics when considering the determinants of land value.

### 4.2.2 Researches on determinants of land value

There have been many studies about the factors that contribute to the changes in land prices. In the case of land, site- (location) specific characteristics predominate in

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17 Yu, Shi Ming & Cheng, Fook Jam (2001) "Determinants of Residential Land Value in Singapore", presented at World Valuation Congress IX(April 2001)

18 Meikle, James( 2001), "A review of recent trends in house construction and land prices in Great Britain Construction Management and Economics" London; Apr/May 2001, vol. 19 (3), pg259-265

19 Sullivan, A.O (1993) "Urban Economics", Richard D Irwin, INC 1993,second edition pg 192-194

20 20 Wheaton, C.W and Peng, Ruijue (1994) "Effect of restrictive Land Supply on Housing In Hong Kong: An Econometric analysis", Journal of Housing Research Vol.5 Issue 2 pg263-291

determining the market price of land. Attiat (1998) shows that pricing land is like pricing goods with mixed attributes. Land is a composite or heterogeneous good. Land has characteristics reflecting not only its location but also other amenities such as the quality of neighborhood and infrastructure. In an exchange economy, the purchase and sale of land parcels of different characteristics establish "implicit" prices for these characteristics.

Earlier research of Adams, Milgram, Green, and Mansfield (1968) developed models to explain residential, commercial and industrial land values (price per acre) as development occurred in Northeast Philadelphia. They tested hypotheses relating to variables for accessibility, state of land (crude proxies for time to expected development), zoning, and plot or property characteristics (size, waterfront location, railroad siding, etc.) They found evidence that several accessibility variables were statistically significant in the residential model, such as distance and travel time to the CBD (negative), distance from a major commercial boulevard (negative) as well as a premium for a location on the commercial boulevard. Distance from public transportation was negatively related to land value. Higher density residential zoning increased land prices relative to single-family zoning.

Guntermann (1997) demonstrated that expectations about the future, as well as many other factors, contribute to changes in land prices. Hushak (1975) identified parcel size, accessibility, zoning, and property taxes as factors explaining variations in the price per acre of urban-rural fringe land surrounding Columbus, Ohio. A follow-up study by Hushak and Sadr (1979) expanded the model and tested it on other land markets with similar results. Chicoine (1981) confirmed the importance of parcel size, accessibility and zoning as well as neighboring land uses on the price of land south of Chicago,

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21 Attiat F Ott; Kamal Desai (1998) Land reform: Restitution and valuation in the Republic of Estonia, Assessment Journal; Chicago; Sep/Oct 1998;

22 Adams, F., G. Milgram, E. Green, and C. Mansfield, Undeveloped Land Prices During Urbanization: A Micro-Empirical Study over Time, Review of Economics and Statistics, 1968, 1:2, 248-58

[23] Karl L Guntermann (1997) "Residential land prices prior to development ", The Journal of Real Estate Research; Sacramento; vol 14, issue 1/ 2, pg1-171997

24 Hushak, L., The Urban Demand for Urban-Rural Fringe Land, Land Economics, 1975, 51:2, 112-23.

25 Hushak, L. and K. Sadr, A Spatial Model of Land Market Behavior, American Journal of Agricultural Economics, November 1979, 61, 697-702.

[26] Chicoine, D., Farmland Values at the Urban Fringe: An Analysis of Sale Prices, Land Economics, 1981, 47:3, 353-62.

Illinois.

Ling (1998) identified several factor that included amount of commercial and industrial land, employment in the urban districts in which the sites are located, density and population density per square kilometer in the respective urban district in which the site is located, site area and distance in kilometers of the site from the Bund (the central business district of Shanghai).

The most recent works of Isakson (1997) concluded that factors influencing land value include plot size, location, date of transaction and zoning. The study also confirms the presence of the plattage effect i.e. the negative relationship between price per unit area and lot size. Bible and Hsieh (1999) uses 150 land sales transacted from 1984 to 1995 to conclude that other than land size, distance to CBD and population size of the region together with zoning could explain variations in land values. Yu (2001) concluded in his paper that in Singapore, the plot ratio and land area are significant factors that explain the variations in residential land prices.

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27 Ling Hin Li (1998) Applying the DCF model in China's transitional market The Appraisal Journal; Chicago; Jan 1998;

[28] Isakson, Hans R, 1997 "An Empirical analysis of the determinants of the value of vacant land", The journal of Real Estate Research, Sacramento, Vol. 12, issue 2 pg 103-114, 1997

[29] Bible D.S and C. Hsieh, 1999 " Determinants of Vacant land values and Implications for Appraisals, The Appraisal Journal , Vol. LXVII no 2, 264-268

[30] Yu, Shi Ming & Cheng, Fook Jam (2001) "Determinants of Residential Land Value in Singapore", presented at World Valuation Congress IX(April 2001)

## 4.3 Synthesis and Hypotheses formation

The hypothesis was formulated in 3 steps:

**Step 1: Housing price determinants**

| Housing price | = | f(structural physical characteristics [i.e. cost of the physical structure such as no of bedrooms, age of building] | + locational characteristics [I.e. cost of the locational attributes the land brought about, such as proximity to expressways] | + neighborhood qualities) [I.e. cost of the neighborhood externality, such as a high class neighborhood] |
|---|---|---|---|---|

Housing price is based on how much one values its structural attributes and locational attributes (Scott Orford 1996). Land price is the greatest cost component in housing pricing and it is indirectly compensated through housing purchases.

**Step 2: Land Price is a residual from housing prices.**

| Land price | = f (plot characteristics + locational characteristics + neighborhood qualities) |
|---|---|

In a competitive market, land prices represent the residual of housing prices and other capital cost. Deducting all the cost of the structural attributes that are intrinsic to the housing unit itself, what is left is the value of the land. Since land price is a residual from housing price, the land will absorb all the anticipated location rent as the city grows. The land price should then be a function of locational and neighborhood characteristics. The plot characteristics such as the plot sizes, topography and configuration of the site also become an important determinant of land value.

[31] Scott Orford (1999) Valuing the Built Environment – GIS and house price analysis, Ashgate Publishing Ltd, England

**Step 3: Land Price should also include expected growth in locational value.**

| | |
|---|---|
| Land price | = f (plot characteristics + locational characteristics + neighborhood qualities + expected growth in locational value) |

The 3 component of land prices (Wheaton 1996) is made up of

- The agriculture value i.e. discounted value of the perpetual agriculture rent value; Not applicable to urban land market in Singapore with less than 2% agriculture land.
- The current location value i.e. the discounted value of the current commuting cost saved;

And

- The future growth in location value i.e. the discounted value of expected increases in location rent on sites already developed - the development potential of the land.

For the third component, the development potential of the land in Singapore is reflected on the Master Plan. In Singapore, development rights in land are regulated with little room for the private housing developer to vary the timing and/or the intensity of development. The allowable zoning and density have been pre-destined in the public plan for transparency. Rarely does the planning authority allow variance from the plan as the plans are tightly coordinated with infrastructural planning.

Also state land are sold to private developer with a predetermined completion date of about 2-3 years from the date of sale at designated maximum plot ratio and land use. Any increase in plot ratio or changes in land use from the lease caveat would be subjected to the payment of differential premium (i.e. additional land premium for the enhancement of land value). Once the site has been sold and building permission granted, construction would commenced and expected to be completed within the specified period. Also all these state lands sold are on 99-year leasehold and developers would have no advantage from waiting for additional information before deciding the specifications of the residential project. As such, this component of land price

[32] Wheaton, William & Dipasquale (1996)" Urban Economics and Real Estate Markets" Prentice Hall 1996, chp 3, pp53-56

(development potential) could be attributed to the allowable zoning and density parameters.

**Summary**

| | |
|---|---|
| Land price | = f (plot characteristics + locational characteristics + neighborhood qualities + zoning and plot ratio entitlement) |

Most studies draw similar conclusion that variables relating to the plot characteristics (size etc), accessibility and zoning were possible determinants of residential land values. Most of these empirical studies were based on US or UK context. But these factors need to be examined within the specific economic, social and political context in the area of study. Different political or institutional system would have significant bearing on the determinants of residential land value in different cities. In a dense and highly regulated land market as Singapore, the impact of the zoning and plot ratio and all other traditional determinants would be important variables in determination of the residential land value. It is the purpose of this study to model these variables to investigate if they have similar significant impact on the variations of the residential land value in Singapore.

# 5. Operationalization of hypotheses

The purpose of this study is to test various hypotheses relating to accessibility, zoning and plot characteristics and their capitalization into land prices. Since the dependent variable is the individual land values, the independent variables that may be reflected in land values would include those factors that have a more limited or micro geographic effect. These independent variables presumably could explain much of the difference observed across residential land prices within Singapore at any point in time. In order to test the hypotheses, measurable variables would be used to operationalize the hypotheses. The independent variables chosen are categorized into

- Locational Variables
- Zoning Variables
- Plot variables

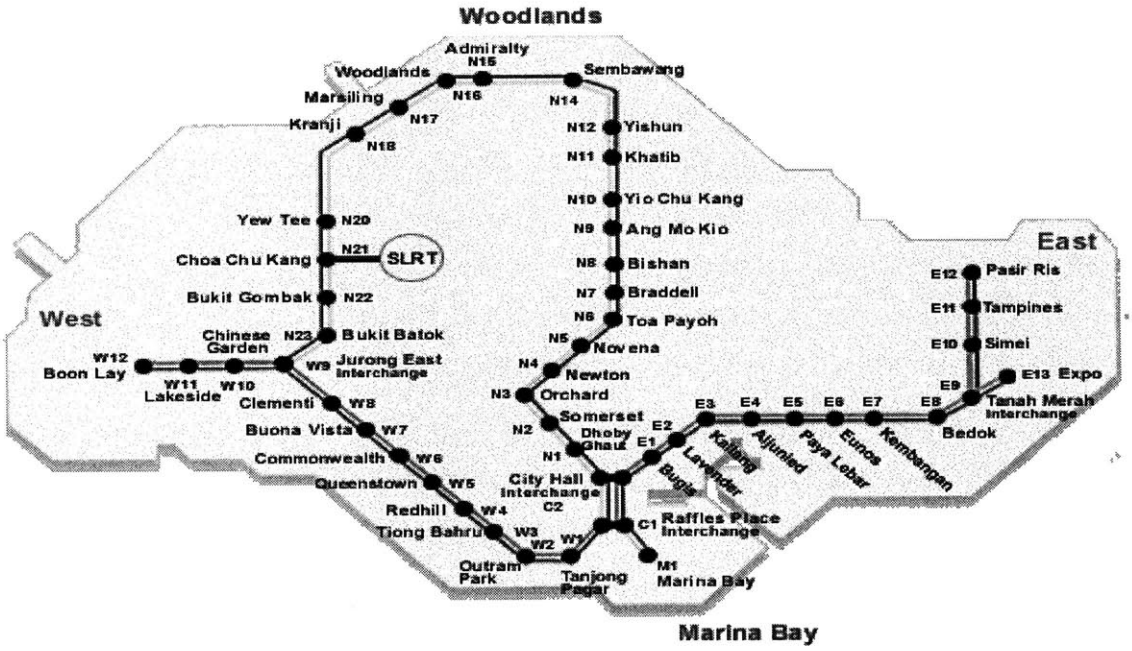
## 5.1 Locational variables

These accessibility variables represent the most important measure of location in the hedonic models. Traditionally, it represented the measurement of bid-rent curve proposed in micro-economics literature. For the purpose of this study, the locational variables are measured by the distance from three nodes – Mass Rapid Transit (MRT) Station, access ramp to the nearest expressway and Central Business District.

- **Walking Distance to the nearest Mass Rapid Transit Station**

In Singapore, the mass rapid transit is a popular mode of public transportation. Figure 17 gives an overview of the comprehensive MRT network. It is the predominant mode of transport with a modal split (public transport usage – bus and MRT) of 65% for work trips and 51% for all trips. The mass rapid transit stations are usually at the centers of satellite town and they are also amenity nodes where neighborhood shops, bus terminals, schools, recreational facilities and eating establishments congregate. This variable is a proxy for accessibility to public transport and public amenities. As a pull factor, **the distance from MRT is expected to have a negative relationship with land prices.**

**Figure 17 for an overview of the comprehensive MRT network**

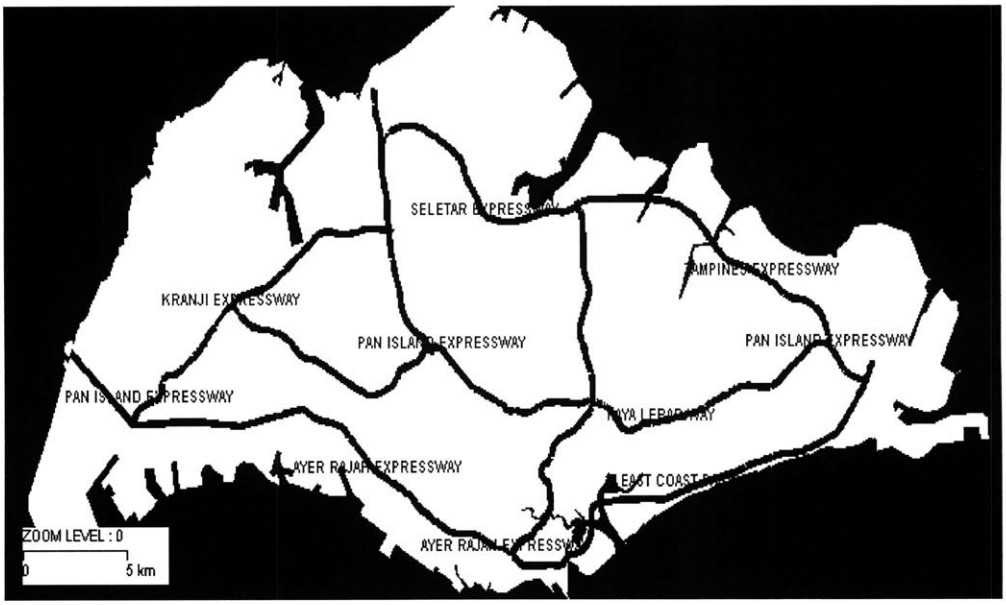



- **Driving distance to the access ramp of the nearest expressway**

Singapore is served by eight inter-connected expressways - Pan Island Expressway (PIE), Ayer Rajah Expressway (AYE), East Coast Parkway (ECP), Central Expressway (CTE), Tampines Expressway (TPE), Seletar Expressway (SLE), Bukit Timah Expressway (BKE) and Kranji Expressway (KJE). Figure 18 shows the alignment and coverage of these expressways. With a total distance of 148km, the expressways provide uninterrupted high-speed travel for motorists.

As the home owners of these private landed or non-landed housing units typically have higher incomes, percentage of car ownership would be higher. Knowing these buyers characteristics, developers placed a premium on land that is near enough to the access ramp. It is hypothesized that **proximity to the access ramps of these expressways will increase the residential land value** due to the decrease in transportation time and cost. On the other hand, expressway could generate negative externalities such as noise, air pollution and congestion which could eliminate the locational advantages of proximity (Sanchez 1993).Waddell et al (1993) demonstrated that highway proximity gradient was non-linear due to the negative externalities depressing property values close to a highway, but land value increase a short distance away once these externalities had become minimal.

**Figure 18: Overview of the expressway system**




- **Linear distance to central business district (DCBD)**

This measure is consistent with the monocentric models of Alonso (1964) and later Evans (1973). Many researches on land price models have been theoretically underpinned by this model, which proposes the existence of a negative land price gradient from the city centre reflecting the trade-off between and price and declining accessibility. The node used is the OUB building (with address "1 Raffles Place") at the heart of the CBD, Singapore's largest employment centre. Straight line distance to the CBD would be used to deduce the relative location of the site to the employment centre. The **linear distance from CBD is expected to have a negative relationship with land prices.**

## 5.2 Zoning variables

Zoning takes three general forms: constraints on density, lot size and allowable

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[33] Sanchez TW 1993, "Measuring the impact of highways and roads on residential property values with GIS: An empirical analysis of Atlanta, in Klosterman, RE and French, S.P(eds), Third International Conference on Computers for Urban Planning and Management. vol 2.

[34] Waddell, P an dBerry , B.J.L and Hoch, I. (1993) "Residential Property values in multimodal urban area: New Evidence on the implicit price of location', Journal of real estate Finance and Economics. Vol 7,pp117-141

[35] Alonso W 1964 "location & land use" Harvard University Press, Cambridge, MA

[36] Evans A W 1973 " The Economics of residential Location", London: Macmillian

use. In Singapore, the zoning regulations are a combination of these three general restrictions. In Singapore, the primary purpose of zoning in Singapore is to ensure that adequate land is safeguarded for various needs, such as commercial, industrial, housing, institutions, etc. Zoning indicates what use can be supported on a site and is usually assigned based on considerations such as geographical distribution, impact/ compatibility with surrounding uses, transportation and infrastructure, site constraints and opportunities, etc. In our study, only residential lands are included. Residential land could be sold for landed or non-landed residential use. For sites zoned for landed housing, only forms such as bungalow, semi-detached, terrace houses and mixed landed houses could be allowed; no apartment or any multi-family units would be allowed.

- **Types of housing form allowed**

The effect of designating the type of housing form allowed is a type of zoning control within the residential land use as it restricts the quantity of land available for certain housing form (Figure 19, 13, 14). The types of housing form are categorized into the following:

**Figure 19 :Type of Housing Form Allowed**

| **Landed residential use** (land titled properties) | | | | **Non-landed residential use** (strata titled multi-family properties) | | |
|---|---|---|---|---|---|---|
| **Bungalows** (400sqm) | **Semi-detached** (200sqm) | **Terrace house** (150sqm) | **Mixed landed** (>9,000 sqm) | **Apartment** (>1,000sqm) | **Executive condominium** (>4,000sqm) | **Condominium** (>4,000sqm) |
| A free-standing house usually with garden. | A pair of houses attached along a common party wall. | Row houses of 3 or more units. | A few houses on 1 plot that could be combination of any 3 of the other landed housing forms. | Multi-family units that have land area of less than 4,000sq meters. | Hybrid of public and private housing but it has regulated eligibility and resale rules. | Multi-family units that has land area of more than 4,000sq meters |
| Usually Restricted to Singaporean and permanent residents only. (..) represents site area norm | | | | | | Foreigners are eligible. |

Implicitly, the landed residential use is categorized according to the relative intensity of the development, ranging from one bungalow on one lot to three terrace houses on one lot. The non-landed residential category is segregated based on its tenure and legality in ownership rather than density. Landed uses are subjected to a combination of minimum lot size and allowable form restriction while non-landed uses are subjected to both allowable form restrictions and density control. For landed housing, it is expected that **mixed landed housing form will command a premium over terrace, semi-detached and bungalow form** since it is able to yield more dwelling units than the rest (Figure 19).

**Figure 20: Characteristics of each housing type**

| Housing Type | Typology | Plot ratio | Building Height | Housing yield (unit per hectare) |
|---|---|---|---|---|
| Landed | Low Density | No plot ratio control | 2-3 story | 30-50 |
| Non-Landed | Low Density | 1.4 | 4 story | 80 |
| | Medium Density | 1.6 | 0 story | 91 |
| | | 2.1 | 16 storey | 120 |
| | High Density | 2.8 | 20 storey | 160 |
| | | 3.0 or more | >20 storey | >171 |

- **Density or plot ratio allowed**

In Singapore, density allowed on a site is represented by the gross plot ratio (PR) specified on the master plan. Plot ratio (i.e. floor area ratio) is the dominant measure on the intensity of the land usage that is regulated by the Master plan. Plot ratio is defined as the ratio of the gross floor area to the gross land area. It simply means that a 2-storey house with 50% coverage has a plot ratio of 2.0. While the non-landed sites are subjected to a maximum permissible plot ratio, the landed sites are only subjected to storey height cap, setback and site coverage control and have no density restriction (Figure 21). **Plot ratio variable is expected to have a positive effect on land value of non-landed use and would have no impact on landed use.** The 'density' of landed housing use is implicit in the housing form control.

| Figure 21: Summary of the bulk and pseudo intensity control for landed housing | | | | | |
|---|---|---|---|---|---|
| **Type** | **Minimum Plot Size ($M^2$)** | **Minimum Width(m)** | **Building Coverage** | **Setback Control (m)** | **Roof Eaves Clearance (m)** |
| **Detached** | 400 > 800 | 10 | 40%, 35% | Front : 7.5, Side & rear : 2, *For 3rd story,* Side & Rear : 3 | Front patio: 2.4<br>Carporch: 2.4<br>Side/Rear: 1 |
| **Semi – detached & corner terrace** | 200 | 8 | No control | | |
| **Terrace - intermediate** | 150 | 6 | | Front : 7.5, Rear : 2 ,*For 3rd story,*Rear: 3 | |

## 5.3 Plot Variables

- **Site area[ISA]**

To study the relationship between land value and parcel size, site area would be used as one of the independent variable. Other plot variables such as configuration and topography are not included since almost all the sites in the data are regularly shaped with the topography ready for development. Similar studies of the relationship between parcel size and land value (Thorsnes and McMillen (1998), Brownstone 1991) used typical equation of

$$\text{Ln(Value of land or Value per acre)} = \beta_0 + \beta_1 (\text{ Site area}) + \beta_i (\text{other determinants})$$

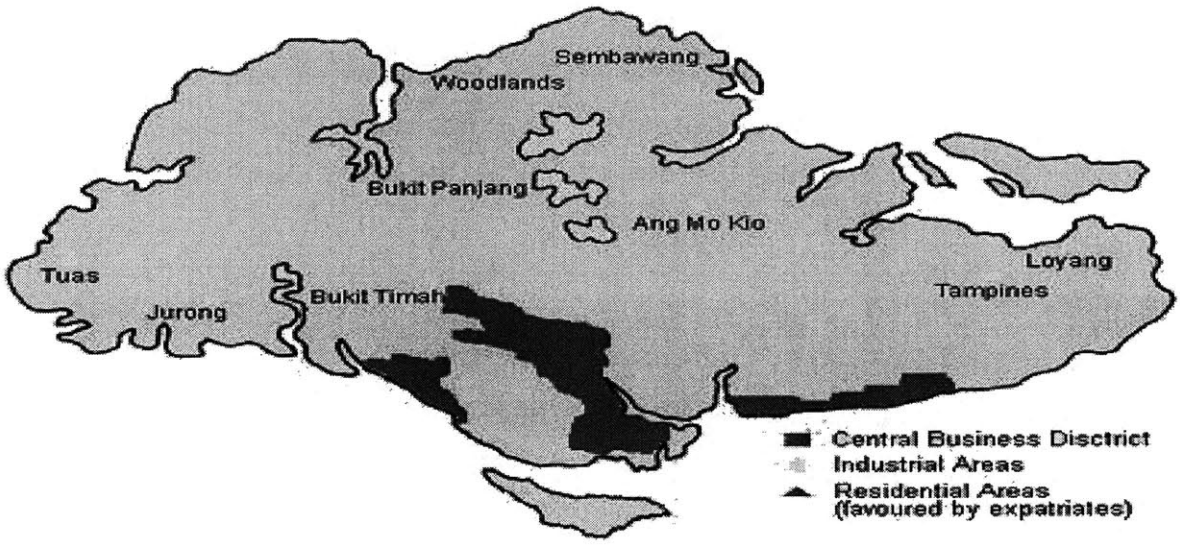
Thorsnes' 1998 s study supported all previous research where there is a concave value-size relationship. **Site area is expected to have a positive effect on total tender price but it is unclear if there is the plattage effect.** Plattage is the presence of negative relationship between parcel size and price per unit area. Attempt would be made to test the presence of plattage.

- **Prime District(PRIME)**

In Singapore, district 9, 10, 11 are traditionally considered the prime residential district, primarily because the area's proximity to the Orchard Road shopping and entertainment district, CBD, prestigious schools and also recreational area like the Bukit

Timah Hill. These districts have excellent neighborhood and accessibility qualities that are desired by households in Singapore. Another group of emerging prime district include waterfront housing at Tanjong Rhu (district 15), Hill View housing next to district 10 (district 21 and 23). These areas are popular and highly sought after, as seen from its high sales transaction volume. The underlying demand for these prime districts is often seen in the high private sale prices transactions reported in the local newspaper. It is expected that a **premium should be put on the sites within the prime district.**

Figure 22: Location of Prime District shown in dark shades




## 5.4 Dependent variable: LnTPSA (tender price per square meter)

In Singapore, the market value of residential land will be best indicated by the highest land price that a developer would pay for the land in a competitive bid such as a tender or auction, knowing that he/she could yield the highest economic use on the site at that particular location. With this definition, arms-length land tender prices from the government land sales program are used as the dependent variable.

To rationalize the difference in the site areas of all the data point, the tender price is adjusted with the land area to obtain price per square meter of land area (TPSA). For the private residential market in Singapore, the tender price per square meter for each site in the government land sales program between years 1993 to 2001 would be used as the dependent variable in the regression. The natural log of the price of the land per square meter **(lnTPSA)** is used as the dependent variable in our model.

## 5.5 Summary of the variables used

The variables included the following:

| **Figure 23 : Summary of Variables Used** | Abbreviations |
|---|---|
| DEPENDENT VARIABLE<br>Natural Log of the Tender Price per square meter of land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Types of housing form allowed: (DUMMY VARIBLES):<br><u>Landed Housing Sites:</u><br>Bungalow ,Semi-detached, Terrace house, Mixed landed zone<br><u>Non-Landed Housing sites:</u><br>Apartments, Executive Condominiums, Condominiums zone | <br><br>BG ,SD,TH,ML<br><br>AP,EC,CO |
| Plot ratio for non-landed | PR |
| Site area ('000) | SA |
| District: Prime & Others (dummy Variable) | PRIME |
| Year 1994 ...Year 2001 where the transaction occur. (Dummy Variables) | Year 94..Year 01 |

[37] Kowalski JG and PF Colwell 1986 " Market versus assessed values of industrial land,AREUEA Journal, 1986,14:2, pp361-73

# 6. Data Collection and Research Methodology

## 6.1 Data Source and collection

The 386 residential land transactions from the government land sales program between years 1993 to 2001 were used in the study. The information was collected from the government websites, press releases, circulars and also tender package of each site provided by URA or HDB. The government land sales program has been the monopoly in housing land supply since state land accounts for more than 90 per cent of Singapore since the 1990s. Using transactions of state land as research data is sufficient since it supplies almost 90% of the new land supply in the housing market.

The public housing HDB land transactions are not made public and thus unavailable for study. Complete information of privately owned land transactions is not available and it represents a small sample since only 10% of the land is owned by private entity.

The only anomaly about the sale transaction data is that there was no government land sales transaction in year 1998 and 1999. In November 1997 (Budget Y98), the government suspended land sales program to avoid aggravating the excess supply in the market. The sale of sites for new supply and some 2,000 units from the 1997 Government Land Sales (GLS) program was also deferred until year 2000.

From each of the sale transaction and tender package, information on its tender price, zoning entitlement, plot ratio allowable, site area and address are obtained. Sites that are zoned for either 'condominium use or mixed landed use' would be classified under condominium use since it is a higher use that the developer would price the site for.

With the address and location map gathered, the distance to the various nodes was obtained through digital computation on a Geographical Information System (GIS) based electronic street directory. GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data

identified according to their locations. Driving distance and walking distances were measured via the main arterial roads while distance to CBD was measured as a linear distance, regardless of access or topography. With the location map and the address of some of the completed development on the land, we are able to use another GIS system to identify the district code of each site.

## 6.2 Data Exploration

### 6.2.1 Descriptive Statistics

A summary of the descriptive statistics of the landed and non-landed use data are as follows:

**Figure 24: Descriptive Statistics (Landed Housing Sites)**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Y93 | 296 | 0 | 1 | .13 | .34 |
| Y94 | 296 | 0 | 1 | .38 | .49 |
| Y95 | 296 | 0 | 1 | .26 | .44 |
| Y96 | 296 | 0 | 1 | .034 | .18 |
| Y97 | 296 | 0 | 1 | .095 | .29 |
| Y100 | 296 | 0 | 1 | .068 | .25 |
| Y101 | 296 | 0 | 1 | .034 | .18 |
| DMRT(km) | 296 | .33 | 4.25 | 1.44 | .43 |
| DEXP(km) | 296 | .30 | 4.50 | 1.88 | .39 |
| DCBD | 296 | 4.44 | 17.81 | 11.34 | 1.72 |
| BG | 296 | 0 | 1 | .18 | .38 |
| SD | 296 | 0 | 1 | .47 | .50 |
| TH | 296 | 0 | 1 | .25 | .43 |
| ML | 296 | 0 | 1 | .10 | .31 |
| SA('000) | 296 | .40 | 41.88 | 2.28 | 5.32 |
| TPSA | 296 | $839.53 | $4,555.64 | $3,289.89 | $691 |
| LNTPSA | 296 | 6.73 | 8.42 | 8.07 | .24 |
| Valid N (listwise) | 296 | | | | |

| Variable Definition | Abbreviations |
|---|---|
| DEPENDENT VARIABLE :Natural Log of the Tender Price per square meter land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXP |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Landed Housing Sites: Bungalow ,Semi-detached, Terrace house, Mixed landed | BG ,SD,TH,ML |
| Site area (000) | SA |
| Year 1994 ...Year 2001 where the transaction occurs. (Dummy Variables) | Year 94..Year 01 |

**Chart 25 :Descriptive Statistics (Non Landed Housing Sites)**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Y93 | 90 | 0 | 0 | .00 | .00 |
| Y94 | 90 | 0 | 1 | .06 | .23 |
| Y95 | 90 | 0 | 1 | .10 | .30 |
| Y96 | 90 | 0 | 1 | .23 | .43 |
| Y97 | 90 | 0 | 1 | .31 | .47 |
| Y100 | 90 | 0 | 1 | .20 | .40 |
| Y101 | 90 | 0 | 1 | .10 | .30 |
| DMRT(km) | 90 | .05 | 4.00 | 1.29 | .88 |
| DEXP(km) | 90 | .30 | 4.50 | 1.72 | 1.04 |
| DCBD | 90 | .78 | 18.65 | 10.81 | 4.08 |
| APT | 90 | 0 | 1 | .20 | .40 |
| CO | 90 | 0 | 1 | .68 | .47 |
| EC | 90 | 0 | 1 | .12 | .33 |
| SA('000) | 90 | 1.06 | 42.83 | 17.38 | 10.47 |
| PR | 90 | 1.40 | 4.20 | 2.30 | .71 |
| PR1.4 | 90 | .00 | 1.00 | .32 | .47 |
| PR3MORE | 90 | .00 | 1.00 | .13 | .34 |
| PR2.1 | 90 | .00 | 1.00 | .20 | .40 |
| PR2.8 | 90 | .00 | 1.00 | .34 | .48 |
| TPSA | 90 | $2,271.00 | $14,200 | $6,034 | $2,349 |
| LNTPSA | 90 | 7.73 | 9.56 | 8.63 | .41 |
| PRIME | 90 | 0 | 1 | .23 | .43 |
| OTHERD | 90 | 0 | 1 | .77 | .43 |
| Valid N (listwise) | 90 | | | | |

| Variable Definition | Abbreviations |
|---|---|
| DEPENDENT VARIABLE :Natural Log of the Tender Price per square meter land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Non- Landed Housing Sites :<br>Apartments, Executive Condo, Condo | APT,EC, CO |
| Site area ('000) | SA |
| Plot Ratio | PR |
| Plot ratio category of 1.4,2.1, 2.8 and 3 or more | PR 1.4, PR 2.1,PR2.8, PR 3more |
| District : Prime district or other district(Dummy Variables) | PRIME ,OTHERD |
| Year 1994 ...2001 where the transaction occur. (Dummy Variables) | Year 94..Year 01 |

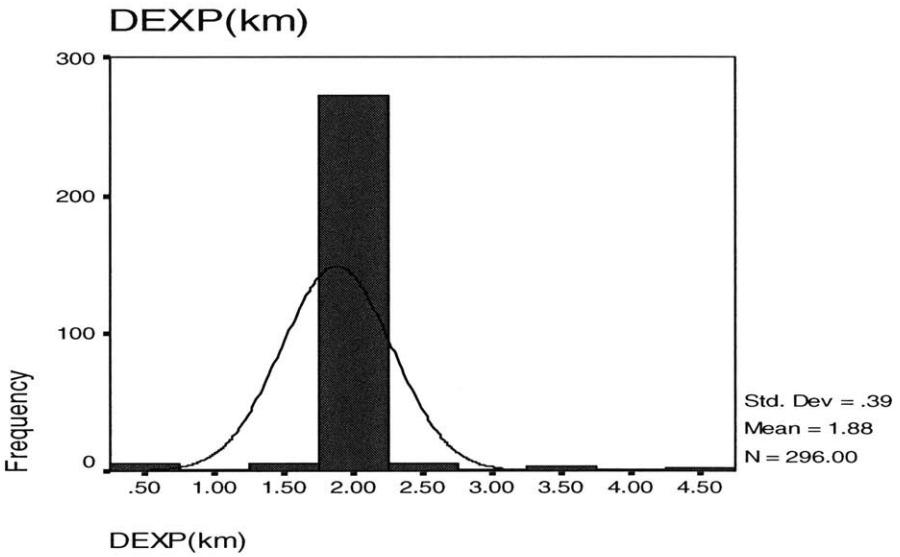
**Figure 26 : Tabulation of Data**

| Non-Landed housing sites | | | | Landed housing sites | |
|---|---|---|---|---|---|
| Year | Frequency | | | Year | Frequency |
| 1994 | 5 | | | 1993 | 38 |
| 1995 | 9 | | | 1994 | 113 |
| 1996 | 21 | | | 1995 | 77 |
| 1997 | 28 | | | 1996 | 10 |
| 2000 | 18 | | | 1997 | 28 |
| 2001 | 9 | | | 2000 | 20 |
| Total | 90 | | | 2001 | 10 |
| | | | | Total | 296 |
| USE | Frequency | Plot ratio | Frequency | USE | Frequency |
| Apartment | 18 | PR 1.4 | 29 | Bungalow | 52 |
| Condominium | 61 | PR 2.1 | 18 | Mixed Landed | 31 |
| Exec Condo | 11 | PR 2.8 | 31 | Semi-detached | 140 |
| Total | 90 | PR 3 or more | 12 | Terrace house | 73 |
| | | Total | 90 | Total | 296 |

### 6.2.2 Location variables

All the location variables are relatively normally distributed except distance from expressway for landed sites (Figure 27).

**Figure 27: Histogram of Distance to access ramp of expressway (landed sites)**




Upon further investigation, 91% of the 296 landed data points fall within 1.75 to 2 kilometers of the access ramp to the expressway and within 1 to 2 kilometers from the MRT. These data points were mainly within 3 new landed housing areas that the planning authority had opened up as new landed housing estate. Even removing the

data points beyond the 1.75- 2km range does not affect the result. However, there were not enough variations in the data for landed housing to test the land price effect with varied distance to the expressway. We could probably only use it to test if it is a negative relationship with land price.

### 6.2.3 Zoning Variable - Housing form allowed

From Figure 28, the difference between the tender price and price per square meter for landed and non-landed housing sites is very substantial. The premium for per square meter of non-housing land could be as high 69% compared to landed sites. This price distinction shows the impact of landed housing zoning on land value.

**Figure 28 on the Price distinction between landed and non-landed**

| | NON-LANDED SITES | | | LANDED SITES | | | |
|---|---|---|---|---|---|---|---|
| Mean tender price | $110.99 m | | | $5.785 m | | | |
| Mean tender price per sqm land | $6,115 | | | $3,290 | | | |
| Median tender price | $96.72 m | | | $1.99 m | | | |
| Median tender price per sqm land | $5,757 (69% higher than that of landed sites) | | | $3,389 | | | |
| Type of use allowed (site area norm) | Apartment (>1,000sqm) | Exec. Condo (>4,000sqm) | Condo (>4,000sqm) | Bungalow (400sqm) | semi-detached( 200sqm) | terrace hse (150sqm) | mixed landed (>9,000 sqm) |
| Mean tender price | $53.30 m | $115.72 m | $126.40 m | $1.98 m | $1.88 m | $4.33 m | $33.22 m |
| Mean tender price per sqm land | $4,998 | $5,134 | $6,597 | $3,222 | $3,611 | $3,163 | $2,254 |
| Median tender price | $25.44 m | $114.89 m | $110.68 m | $1.69 m | $1.85 m | $4.43 m | $29.39 m |
| Median tender price per sqm land | $4,558 | $4,831 | $6,158 | $3,010 | $3,636 | $3,063 | $2,280 |

There are about 90 non-landed sites and 296 landed sites. Typically, site areas for non-landed housing are relatively larger than that for landed housing, ranging from 1,057 to 40,000 square meters and allowing for 16 to 1,015 dwelling units. The majority of the landed housing sites is about 400 square meters and sold for semi-detached (2 units per plot) development. As these 2 types of zoning have distinctly different density,

pricing and site area, separate models are constructed for landed and non-landed housing (Figure 19, 28, 31 & 32). As these 2 zonings have distinctly different density and site area, they would be evaluated with two separate regression models to further investigate the impact of the "sub-zoning" within landed and non-landed sites.

### 6.2.4 Plot ratio allowed

In Singapore, density allowed on a site is represented by the gross plot ratio (PR) specified on the master plan. Plot ratio is defined as the ratio of the gross floor area to the gross land area. Plot ratio variables are not used for landed housing sites as they are not applicable. From the histogram (Figure 29) of the frequency of the plot ratio for non landed sites, it was found that there is a banding of plot ratio entitlement at around 1.4, 2.1,2,8 and 3.0.

As understood from URA, the Master Plans before 1998 represented density entitlement in persons per hectare (pp/ha). Prior to 1998, there were 125 pp/ha, 250pp/ha, 375pp/ha and 495ppha over the entire island. In 1989, the density control concept changed from pp/ha to Gross Plot ratio (GPR). A conversion factor of 0.0056 was adopted, taking into account the average unit size and a 40% circulation area. Another way to express this is 56 square meter per person per hectare land area.

Using this conversion factor to multiply the pp/ha to obtain gross plot ratio,

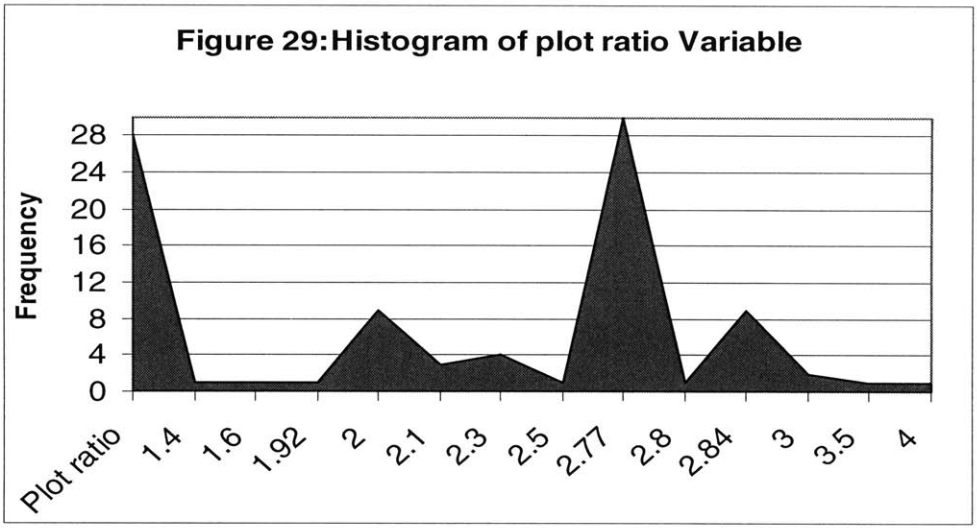
125x0.0056 = GPR 0.7

250x0.0056 = GPR 1.4

375x 0.0056 = GPR 2.1

495x 0.0056 = GPR 2.772 (rounded up to GPR 2.8).

These plot ratios of 0.7, 1.4, 2.1 & 2.8 were then used as planning controls since then. For the purpose of this study to investigate the variation of land values due to the planning control, the plot ratios are categorized into these various bands as shown in Figure 30.




| Figure 30 : Category of plot ratio | | | |
|---|---|---|---|
| Plot ratio | Frequency | Data content | Story height |
| 1.4 | 29 | Includes all between 1.4-1.6 | 4 story |
| 2.1 | 18 | Includes all between 1.92-2.5 | 10 story |
| 2.8 | 32 | Includes all between 2.74-2.84 | 16 story |
| 3.0 or more | 13 | Includes all between 3 –4.2 | >16 story |

### 6.2.5 District

From the data, there are only 6 out of the 296 sales records of the landed sites within the prime district. This could be because these districts are usually in the low density housing area with very little state land. Since there are not enough variations in the data for landed sites, district variables cannot be used in landed site model. However, there is sufficient distribution of data for the non landed sites to test the hypothesis.

## 6.3 Methodology

From the literature review, the possible determinants of land value are deduced and hypotheses formed. The data is then collected and investigated. With a multiple regression analysis using SPSS (Statistical Package for Social Science), the form of the hedonic model is hypothesized and model coefficients estimated using the method of ordinary least squares. After the utility of the model is checked and deemed useful, it could be used to explain the variation in the land prices.

A hedonic regression model incorporating time variable is used to identify the significant factors that affects land prices and to quantify the contribution of each of these factors on land prices. With the coefficient of the hedonic model, we can obtain information on the implicit value of the individual characteristics of the land. Since land price is an equilibrium point as a result of the interactions between demand and supply, it need not be linear. As such the semi-logarithmic form provided the best fit to our data. The hedonic models for landed and non-landed sites are summarized in Figure 31 and 32.

**Figure 31 :Hedonic Model used for landed housing site**

$$\text{Ln (TPSA)} = \beta_0 + \beta_1 (\text{DMRT}) + \beta_2 (\text{DEXP}) + \beta_3 (\text{DCBD}) + \beta_4 (\text{BG,SD,TH,ML}) + \beta_5(\text{year 94}) + \beta_6(\text{year 95}) + \beta_7(\text{year 96}) + \beta_8 (\text{year 97}) + \beta_9(\text{year 00}) + \beta_{10}(\text{year 01}) + \varepsilon_i$$

*(Holding year 1993 constant and Bungalow as base case)*

| Variables Definition | Abbreviations |
|---|---|
| Log of the Tender Price per square meter of land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Types of housing form allowed: (Dummy Variables) | |
| Bungalow ,Semi-detached, Terrace house, Mixed landed | BG ,SD,TH,ML |
| Year 1994 ...Year 2001 where the transaction occur.(Dummy Variables) | Year 94..Year 01 |

**Figure 32 :Hedonic Model used for landed housing site**

$$\text{Ln (TPSA)} = \beta_0 + \beta_1 (\text{DMRT}) + \beta_2 (\text{DEXP}) + \beta_3 (\text{DCBD}) + \beta_4 (\text{CO, EC, Apt}) + \beta_5 (\text{PR 2.1}) + \beta_6 (\text{PR 2.8}) + \beta_7 (\text{PR 3more}) + \beta_8 (\text{year 95}) + \beta_9(\text{year 96}) + \beta_{10} (\text{year 97}) + \beta_{11}(\text{year 00}) + \beta_{12}(\text{year 01}) + \beta_{13}(\text{Prime}) + \beta_{14}(\text{SA}) + \varepsilon_i$$

*(Holding year 1994 constant, Apartment and Plot ratio 1.4 as base case)*

| Variables Definition | Abbreviations |
|---|---|
| Log of the Tender Price per square meter of land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Non- Landed Housing Sites :Apartments, Executive Condo, Condo (Dummy Variables) | APT,EC, CO |

| | |
|---|---|
| Plot ratio category of 1.4,2.1, 2.8 and 3 or more (Dummy Variables) | PR 1.4, PR 2.1,PR2.8, PR 3more |
| District : Prime district or other district (Dummy Variables) | PRIME ,OTHERD |
| Site area ('000) | SA |
| Year 1994 ...Year 2001 where the transaction occur. (Dummy Variables) | Year 94..Year 01 |

About **17** data points were removed from the original data set of 403 transactions. These outliers were removed as they were either far too big or too small with the rest of the data values for each variable. Examples of outliers would be one that has walking distance from MRT of more than 6 kilometers, too far to walk or another tender price that is above $14,000 per square meter for a rare prime site. Two non-landed housing data points were also removed as there is insufficient data for that particular year 1993.

Other variables that were initially used in the model include the following:

- Assessed value within the geographical sector where the site is located at the time of transactions; and
- Regions where the land are located, namely, central, east, west, north and northeast.

All these variables were discarded due to the mutli-collinearity where these explanatory variables are too similar and result in the individual regression coefficient being poorly estimated. Some of the above variables duplicate information already available in other variables. Also categorizing into regions is arbitrary and based on market norm.

Dummy variable are used in the study to represent subgroups of the sample in the study as they enable us to use a single regression equation to represent multiple groups. The dummy variables act like 'switches' that turn various parameters on and off in an equation. For our study, we used dummy variables for the year of transaction, type of housing form, plot ratios and to identify the sites within the prime district.

# 7. Empirical result

## 7.1 The Models

Typically, site areas for non-landed housing are relatively larger than that for landed housing, ranging from 1,057 to 40,000 square meters and allowing for 16 to 1,015 dwelling units. The majority of the landed housing sites are about 400 square meters and sold for semi-detached (2 units per plot) development. The median price per square meter for non-landed sites is more than 60% greater than that of landed sites. As these 2 types of zoning have distinctly different density, pricing and site area, separate models are constructed for landed and non-landed housing (Figure 19, 28, 31 & 32). Different combinations of variables are also used in modeling the tender price per square meter. Only the best results with relatively uncorrelated variables are discussed.

| Extract from Figure 19 :Type of Housing Form Allowed | | | | | | |
|---|---|---|---|---|---|---|
| Landed residential use (land titled properties) | | | | Non-landed residential use (strata titled multi-family properties) | | |
| **Bungalows** (400sqm) | **Semi-detached** (200sqm) | **Terrace house** (150sqm) | **Mixed landed** (>9,000 sqm) | **Apartment** (>1,000sqm) | **Executive condominium** (>4,000sqm) | **Condominium** (>4,000sqm) |

## 7.2 Landed Housing Model

The hedonic model for landed housing is generally a good fit with low standard error and an R-Square of 69%. Estimated coefficients are generally statistically significant with the expected signs and reasonable magnitude. The results of the hedonic model for landed housing are as follows:

**Figure 33: Model Summary for Landed Housing sites**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .831 | .690 | .677 | .139205 |

*a Predictors: (Constant),, Y97, Y101, Y100, DEXP(km), Y95, SD, Y96, TH,ML, DMRT(km), Y94, DCBD*
*b Dependent Variable: LNTPSA Holding Y93 and Bungalow as 'base case'*

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 8.596 | .161 | | 53.455 | .000 |
| | Y94 | .267 | .028 | .532 | 9.652 | .000 |
| | Y95 | .279 | .030 | .501 | 9.439 | .000 |
| | Y96 | .006 | .063 | .005 | .099 | .921 |
| | Y97 | -.038 | .052 | -.045 | -.723 | .470 |
| | Y100 | -.127 | .058 | -.130 | -2.194 | .029 |
| | Y101 | -.382 | .064 | -.282 | -5.927 | .000 |
| | DMRT(km) | -.062 | .029 | -.109 | -2.173 | .031 |
| | DEXP(km) | -.078 | .025 | -.125 | -3.058 | .002 |
| | DCBD | -.045 | .011 | -.314 | -4.152 | .000 |
| | SD | .147 | .024 | .300 | 6.241 | .000 |
| | TH | .121 | .030 | .212 | 3.952 | .000 |
| | ML | -.301 | .040 | -.377 | -7.567 | .000 |

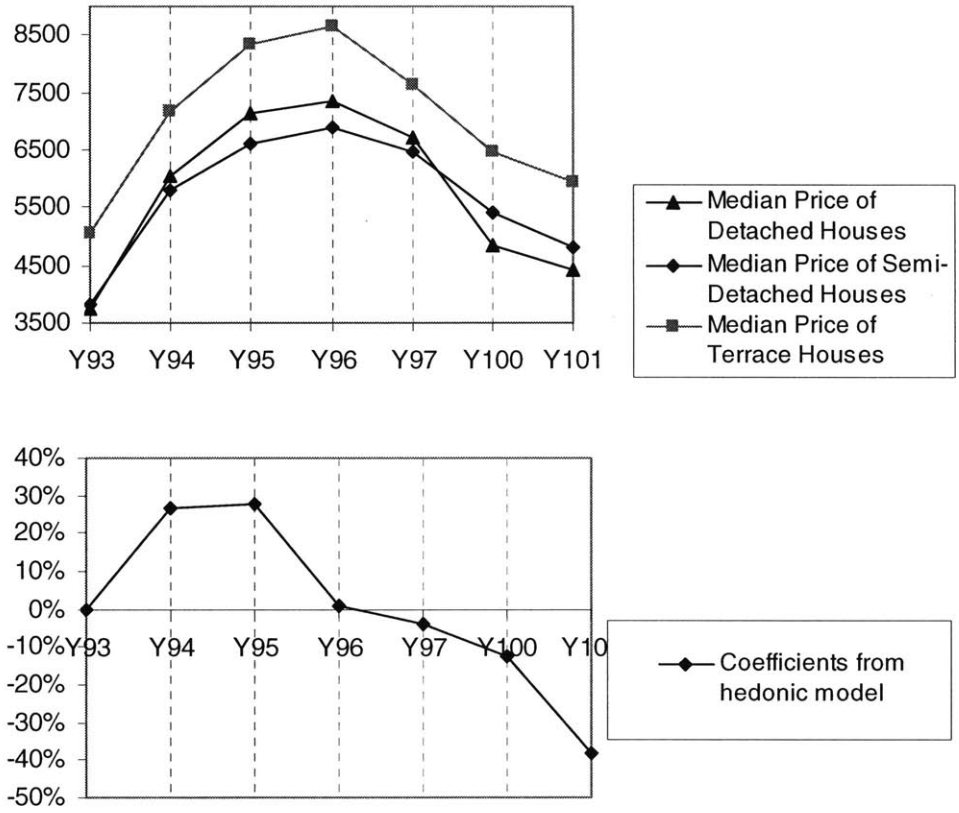
a. Dependent Variable: LNTPSA

| Variables Definition | Abbreviations |
|---|---|
| Log of the Tender Price per square meter of land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Types of housing form allowed: (Dummy Variables) | |
| Bungalow ,Semi-detached, Terrace house, Mixed landed | BG ,SD,TH,ML |
| Year 1994 ...Year 2001 where the transaction occur.(Dummy Variables) | Year 94..Year 01 |

### 7.2.1 Discussion

With 1993 as the control variable, the hedonic model shows that the landed residential land value increased up to 1995 before declining thereafter. Note that somewhat similar trends in terms of rising and falling values were observed in the median price of landed housing over the same period of time (Figure 34). Though there are too few years of data to conclude if the land price per square meter does move together with the prices of the residential units, we attempt to offer a possible explanation.

**Figure 34 :Price Trends of landed housing**




The trend could be explained by looking at the corresponding price trend of houses in the same period. Between 1993 and 1995, there had been an overheating in the residential market driven by strong income growth, bullish stock market performance, ease of obtaining financing through banks and property speculation. In the light of the strong demand, developers aggressively bought land and built more housing units. The decline of land value as seen in the coefficient for year 1996 could be attributed to the anti-speculative measures imposed by the government in May 1996. With these measures in place, developers subsequently exercised more caution in bidding for new land.

With the excess supply of housing units, construction activities slowed down from 1997 and land values started to fall while housing price declined. By the end of 1997, the government had also ceased all "sales of sites" program. With the onset of the 1998 Asia financial crisis, the suspension of the program was prolonged till 2000. Meanwhile,

the residential market was still consuming the excess supply as Singapore started to experience a slow economic growth and then recession by second quarter of 2001.

For landed housing, all the three accessibility variables have a negative relationship with land price per square meter as hypothesized. With these variables as independent variables being held constant, the impact of the zoning variables can then be studied.

Linear distance to CBD is the most important variable. For every kilometer closer to the CBD, developer would pay 4.5% more in terms of land price per square meter. This is a significant premium since the range of distances to the CBD could be as high as 17.8 km. A site that is 5 km from CBD could command a premium of 22.5% per square meter over one that is 10km away. This result validates the traditional bid-rent function in a monocentric city since the CBD is the largest employment center in Singapore. The importance of this variable also shows that residential use nearer to the city is preferred. Like all other city centers, residential uses are usually outbid by other uses such as commercial uses.

Walking distance to the Mass Rapid Transit Train (MRT) is the next most significant variable in explaining the variation in land values for landed housing. For every kilometer away from the MRT, developers would bid 6% less per square meter of land. The reasonable walking distance from a MRT station should not exceed 1 kilometer (25 minutes) for the MRT to be an attractive mode of transportation. Within distance of 1 kilometer or less, the variation in land price attributed to this variable is small. For example between 0.2 to 0.3 kilometers, the variation in land price per square meter is only about 0.5%.

The relationship between land value and walking distance to MRT station is unlikely to be attributed to landed homeowners' reliance on MRT because there is a high percentage of car ownership among these high-income landed homeowners. Nonetheless, these mass rapid transit stations are usually located at the center of satellite towns, and they are also amenity nodes where neighborhood shops, bus terminals, schools, recreational facilities and eating establishments congregate. Thus, this variable represents not only accessibility but also the availability of public amenities.

The proximity to the train station is a pull factor and thus warrants a premium from the developers.

Driving distance to the access ramp of the nearest expressway is another significant variable. For every kilometer of driving distance closer to the access ramp, a developer would pay 7.8% more in terms of land price per square meter. As mentioned in section 6.2, the clustering of the data between 1.75km and 2km may make this an unreliable variable to explain land price variations outside this range. These data points were mainly within 3 new landed housing areas that the planning authority opened up as new landed housing estates. There is just not enough variation in the data for landed housing to test the land price effect with varied distance to access ramps of expressways.

Attempts were made to study the relationship between site area and land value (Figure 35). However, the correlation matrix shows the presence of pair-wise collinearity (between site areas, semi-detached use and mixed landed housing use). This is because the type of landed housing form (e.g. bungalow, semi-detached etc.) has no plot ratio control. The number of units that can be build on a site depends on the minimum plot size requirement for each type of housing form (see extract of Figure 21 below). An 800 square meter land could only build 2 bungalows but could build 4 semi-detached houses. In regressing against price per square meter of land, including both site area and types of landed housing form could be 'double counting' the effect of the parcel size. As such, site area would not be used as an independent variable for landed housing model.

| Type | Minimum Plot Size ($M^2$) | Minimum Width(m) | Building Coverage |
|---|---|---|---|
| **Detached** | 400 > 800 | 10 | 40%, 35% |
| **Semi – detached & corner terrace** | 200 | 8 | No control |
| **Terrace - intermediate** | 150 | 6 | |

**Extract from Figure 21: Summary of the bulk control for landed housing**

**Figure 35 : Correlations Matrix between the independent zoning variables**

| | | LNTPSA | LNSA | ML | BG | SD | TH | SA('000) |
|---|---|---|---|---|---|---|---|---|
| LNTPSA | Pearson Correlati | 1.000 | -.613** | -.552** | -.027 | .424** | -.075 | -.521** |
| | Sig. (2-tailed) | . | .000 | .000 | .644 | .000 | .196 | .000 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| LNSA | Pearson Correlati | -.613** | 1.000 | .850** | -.228** | -.520** | .200** | .870** |
| | Sig. (2-tailed) | .000 | . | .000 | .000 | .000 | .001 | .000 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| ML | Pearson Correlati | -.552** | .850** | 1.000 | -.158** | -.324** | -.196** | .826** |
| | Sig. (2-tailed) | .000 | .000 | . | .006 | .000 | .001 | .000 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| BG | Pearson Correlati | -.027 | -.228** | -.158** | 1.000 | -.437** | -.264** | -.141* |
| | Sig. (2-tailed) | .644 | .000 | .006 | . | .000 | .000 | .015 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| SD | Pearson Correlati | .424** | -.520** | -.324** | -.437** | 1.000 | -.542** | -.314** |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | . | .000 | .000 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| TH | Pearson Correlati | -.075 | .200** | -.196** | -.264** | -.542** | 1.000 | -.099 |
| | Sig. (2-tailed) | .196 | .001 | .001 | .000 | .000 | . | .089 |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |
| SA('000) | Pearson Correlati | -.521** | .870** | .826** | -.141* | -.314** | -.099 | 1.000 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .015 | .000 | .089 | . |
| | N | 296 | 296 | 296 | 296 | 296 | 296 | 296 |

**.Correlation is significant at the 0.01 level (2-tailed).

*.Correlation is significant at the 0.05 level (2-tailed).

In Singapore, zoning are defined as restrictions on the allowable use. In our study, only residential land is included. Residential land could be sold for landed or non-landed residential use. For sites zoned for landed housing, only forms such as bungalow, semi-detached, terrace houses and mixed landed houses could be allowed; no apartment or any multi-family units would be allowed. The effect of designating the type of housing form allowed is a type of zoning control within the residential land use as it restricts the quantity of land available for certain housing form.

Zoning effects within the landed housing sites can be seen by studying the coefficient and sign while holding all other variables constant. Holding bungalow form as the 'base case', land zoned for semi-detached commands a 14.7% premium per square meter and slightly lower at 12% premium per square meter for terrace house sites. Without plot ratio control, this zoning variable determines the maximum number of units that could be developed on each parcel. On an 850 square meter land, it could yield

either 2 bungalows, 4 semi-detached or 5 units of terrace house based on their plot size requirements. Both semi-detached houses and terrace houses are deemed 'higher' density than bungalow and thus would fetch a premium in land price compared to bungalow sites.

Another reason for the higher bidding prices for semi-detached and terraces land could be because of their larger volume of sales transaction. The higher volume of sale transaction reflects a higher demand for such housing form. The higher demand could be because semi-detached and terrace houses have the lower price range of landed housing. These forms are attractive to new high-income 'upgraders' who want to live in a landed house. A typical sale price for a terrace house is only around $900,000 as compared to a bungalow of $1.7 million. As semi-detached and terrace houses are the more popular landed housing choices, developers tend to bid for the land at a premium.

| Median transacted price of landed housing unit | | | |
|---|---|---|---|
| **Year** | **For a typical 400sqm bungalow plot** | **For a typical 200sqm semi-detached plot** | **For a typical 150sqm terrace house plot** |
| 1993 | $ 1,492,933 | $ 766,950 | $ 755,850 |
| 1994 | $ 2,414,200 | $ 1,161,500 | $ 1,075,988 |
| 1995 | $ 2,847,100 | $ 1,320,150 | $ 1,248,113 |
| 1996 | $ 2,942,800 | $ 1,376,050 | $ 1,298,963 |
| 1997 | $ 2,690,300 | $ 1,293,250 | $ 1,143,300 |
| 1998 | $ 1,815,700 | $ 957,600 | $ 848,550 |
| 1999 | $ 1,744,200 | $ 944,050 | $ 875,513 |
| 2000 | $ 1,932,700 | $ 1,078,900 | $ 968,925 |
| 2001 | $ 1,767,100 | $ 962,300 | $ 891,450 |
| Source: URA 2001 | | | |

The relationship between mixed landed housing zone and land price did not turn out as expected. Developers bid at 30% discount of the land price per square meter as compared to bungalow sites. Though mixed landed housing is denser than any other landed housing form, the mixed landed housing is a relatively new housing form – hybrid of landed houses and apartment form implemented in 1993. The developments within these sites are also called strata landed housing. It typically comprises 4 to 170 units of 'strata bungalow, townhouse and various forms' within a community. Such new development may be perceived to be lacking in the 'prestige' and 'privacy' of a landed

house, yet subject to eligibility restrictions and limited amenities compared to a condominium with pools, gyms, lounges etc. The discount could be attributed to developers exercising caution when bidding for such land to account for the possible risk of an uncertain housing market.

## 7.3 Non-Landed Housing Model

Non-landed housing model was studied separately since it has distinctly different density, pricing and site area from the landed housing. The hedonic model for non-landed housing is also a relatively a good fit with an R Square of 70.3%.The results of the hedonic model for non-landed housing are in Figure 36.

**Figure 36: Model Summary for non-landed housing sites**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .838[a] | .703 | .643 | .2467 |

a. Predictors: (Constant), PRIME, DEXP(km), Y100, SA('000), DMRT(km), PR2.8, Y95, Y101, EC, PR2.1, Y96, DCBD, PR3MORE, CO, Y97

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 8.545 | .161 | | 53.130 | .000 |
| | Y95 | -.066 | .144 | -.048 | -.456 | .650 |
| | Y96 | -.021 | .132 | -.022 | -.162 | .872 |
| | Y97 | -.208 | .142 | -.235 | -1.465 | .147 |
| | Y100 | -.302 | .147 | -.295 | -2.062 | .043 |
| | Y101 | -.455 | .159 | -.332 | -2.856 | .006 |
| | DMRT(km) | -.044 | .034 | -.095 | -1.308 | .195 |
| | DEXP(km) | -.018 | .027 | -.046 | -.677 | .500 |
| | DCBD | -.021 | .008 | -.210 | -2.652 | .010 |
| | CO | .271 | .091 | .309 | 2.976 | .004 |
| | EC | .097 | .123 | .078 | .794 | .430 |
| | SA('000) | -.006 | .003 | -.144 | -1.729 | .088 |
| | PR3MORE | .824 | .104 | .683 | 7.953 | .000 |
| | PR2.1 | .571 | .085 | .556 | 6.718 | .000 |
| | PR2.8 | .696 | .084 | .807 | 8.318 | .000 |
| | PRIME | .088 | .070 | .091 | 1.254 | .214 |

a. Dependent Variable: LNTPSA

*b Holding Y94, Apt and PR1.4 as base case*

| Variables Definition | Abbreviations |
|---|---|
| Log of the Tender Price per square meter of land | Ln(TPSA) |
| Distance to the nearest mass rapid transit station in kilometers | DMRT |
| Distance to the nearest access ramp into the express way in kilometers | DEXPRESS |
| Distance to central Business District (CBD) in kilometers | DCBD |
| Non- Landed Housing Sites :Apartments, Executive Condo, Condo (Dummy Variables) | APT,EC, CO |
| Plot ratio category of 1.4,2.1, 2.8 and 3 or more (Dummy Variables) | PR 1.4, PR 2.1,PR2.8, PR 3 more |
| District : Prime district or other district (Dummy Variables) | PRIME ,OTHERD |
| Site area ('000) | SA |
| Year 1994 ...Year 2001 where the transaction occur. (Dummy Variables) | Year 94..Year 01 |

### 7.3.1 Discussion

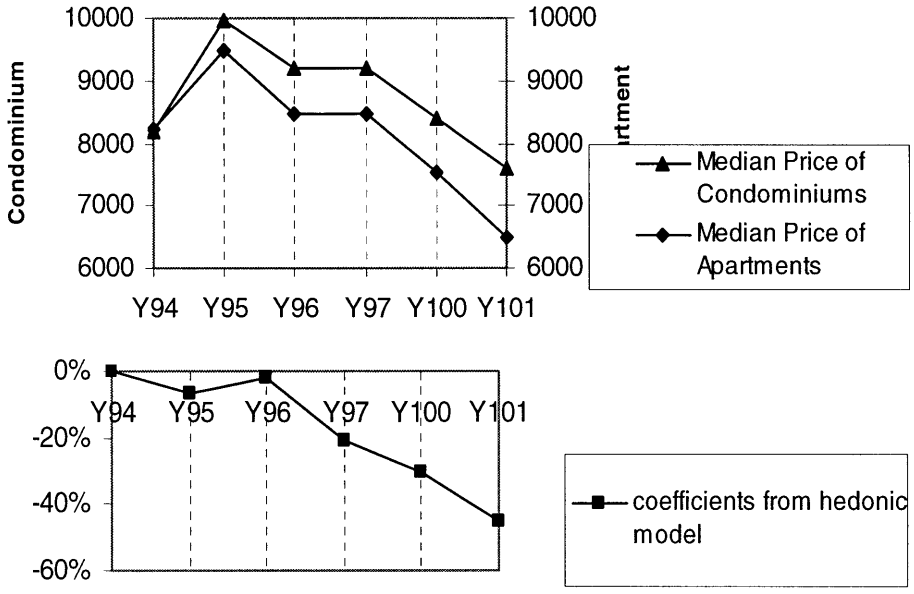
In the non-landed model, similar price movements are observed between the median housing price and the coefficients over the same period of time (Figure 37). Compared to landed housing sites, the non-landed housing price seems to show a more volatile market with sharp decline over the last 8 years.

For non-landed housing, all the 3 accessibility variables also have a negative relationship with land price per square meter as hypothesized. Similar to landed housing model, the linear distance to CBD is the most important variable. With every kilometer closer to the CBD, developer would bid about 2.1% more land price per square meter. This is a significant premium since the range of distances to the CBD could be as high as 17.8 km and a site that is 5 km from CBD could command a premium of 10% per square meter over one that is 10km away.

For non-landed housing model, the coefficients of the distances to access ramp of expressway and to MRT station are very small and are statistically insignificant to variation in land prices. For every kilometer nearer to the MRT, developers would bid 4% more per square meter of land. For every kilometer of driving distance closer to the access ramp, a developer would pay 2% more in terms of land price per square meter. These results highlighted that proximity to CBD plays a more important role in

determining the land value than the accessibility to other transportation node.

**Figure 37 :Price Trends of non-landed housing**




The zoning effect among non-landed housing sites was studied holding apartment as the 'base case' and all other variables constant. Land sold for executive condominium (EC) command a premium of about 13% premium per square meter over apartment. Condominium sites, on the other hand, commanded a 31% premium per square meter over apartment sites. The difference could be because foreigners are not allowed to purchase the new executive condominium, making these sites less attractive to developers. Condominium sites command a higher premium because of its larger customer base, including foreigners. Also, these sites are usually larger with more flexibility in design and could yield higher number of units.

The most significant driver of non-landed sites is the allowable plot ratio (PR). Allowable plot ratio is defined as the ratio of the gross floor area to the gross land area prescribed on the master plan. With an increase in the PR from 1.4 to 2.1, developers would be willing to pay a premium of 57% per square meter of land. This premium is due to the multiplied number of housing units that can be derived from the site (from 80 to 120 units). With every increase in 1 band of plot ratio, the developer would be able to develop 40 more units of identical size.

With higher density, there would be more flexibility in creating even more units with varied sizes at a higher plot ratio. As the plot ratio entitlement increases, the site would command a high premium of up to 70% per square meter of land with plot ratio exceeding 3.0. With limited supply of land for residential use, increase in plot ratio would be a good method to provide more housing units on the limited land area. A higher density also enables more efficient use of the infrastructure such as utility or transportation infrastructure.

| Extract from Figure 7A : Housing Typology (non-landed) | | | | |
|---|---|---|---|---|
| **Housing Type** | **Typology** | **Housing unit per 10,000square meter land** | **Density (Plot ratio)** | **Building Height** |
| Non-Landed | Low Density | 80 | 1.4 | 4 story |
| | Medium Density | 120 | 2.1 | 16 storey |
| | High Density | 160 | 2.8 | 20 storey |
| | | 171 -200 | 3.0 – 3.5 | >20 storey |

Source: URA 1995 based on 3.11 persons per unit and gross unit size of 175sqm

Contrary to popular belief that sites within prime district should command a higher premium, this study shows that proximity to prime district is not significant to land prices. A developer would put in about 9% premium for a prime site compared to other site.

In testing the effect of site area on land value, various transformations of the site area variable were studied. From the correlation matrix, site area was found to be the least significantly correlated to price per square meter and used as an independent variable for non-landed sites. This is consistent with the example of equations used in other similar studies to test the effect of parcel size on land values such as Thorsnes and McMillen (1998).

The presence of plattage for non–landed housing was detected as seen from the negative relationship. With every 1,000 square meter increase in site area, the price per square meter land would decrease by 0.6%. This implies that the difference in bid price for a 5,000 and 10,000 square meter site is about 3% per square meter.

## 7.4 Inferences

Our study concluded that both zoning and allowable plot ratio are the main determinants of land value in Singapore. This clearly shows the intention of the policy makers to use zoning and allowable plot ratio as tools to achieving the planning goals for housing. From Concept plan 1991 and 2001, the 2 planning goals for housing has been

- to provide sufficient housing with the least land-take to meet the growing demand and
- to provide a wide choice of housing options to meet the growing aspiration of both Singaporeans and foreigners working in Singapore.

Understanding the determinants of land value would enable us to allocate the land resource to meet housing needs and aspirations as outlined by the planning goal.

### 7.4.1 Landed housing zone

In Singapore, the primary purpose of zoning is to ensure that adequate land is safeguarded for various needs, such as commercial, industrial, housing, institutions, etc. Zoning indicates what use can be supported on a site and is usually assigned based on considerations such as geographical distribution, impact/ compatibility with surrounding uses, transportation and infrastructure, site constraints and opportunities, etc. Zoning is thus mainly driven by planning objectives and not land price, which is market dependent.

Residential land could be zoned for landed or non-landed residential use. For sites zoned for landed housing, only forms such as bungalow, semi-detached, terrace houses and mixed landed houses could be allowed; no apartment or any multi-family units would be allowed. The effect of designating the type of housing form allowed restricts the quantity of land available for a given housing form. From Figure 28, you can see the extreme price difference between landed and non-landed zoning. This demonstrated the negative impact on land value for sites zoned for landed housing use only. It also reflects developers' preference for non-landed zoning.

In early 1990s when Singapore was a fast growing economy and there was a redevelopment frenzy to intensify land use, the planning authority realized the need to safeguard the established landed housing estate. With a safeguarding plan, some 1,670

hectares of existing matured and established landed housing estates was kept for landed housing only. These plans protect the character and ambience of the landed areas and ensure that non-conforming building type such as apartments and condominium will not occur in these protected estates.

**Housing Density Mix**

| Housing Density | Low | Medium | High |
|---|---|---|---|
| Existing Mix | 9% | 13% | 78% |
| Concept Plan 2001 | 8% | 13% | 79% |

Other than ensuring sufficient housing for the population, planning strategies have to meet the nation's expectations for an improved quality of life. A way of enhancing quality of life is to provide greater choice and variety of housing to meet the housing aspiration of a better educated population. Though the land value per square meter is much lower than what it would fetch if it is has high allowable plot ratio, it is through planning effort that low density housing was safeguarded to maintain a good mix of housing. Landed housing is one of such housing options to meet the desire of the affluent households.

### 7.4.2 Types of housing allowed

From our study, it can be seen that the type of housing forms allowed for the land affects its value. For landed housing, the effect of different housing types demonstrated the premium / discount on land value due to bulk control or an indirect form of density control. For non landed housing sites, the differences in housing form showed the effect on land value was largely due to its purchase eligibility condition and its market size (Singaporean or Foreigner).

### 7.4.3 Plattage effect

From the site area analysis, the study confirms conventional theory that the price per square meter of land decreases with increase in land area. Such information would be useful to developers as they consider the profitability of subdividing large tracts of land into smaller ones. The land sales agency could also decide on the optimal

parcellation and size of land to sell in order to maximize return on the land.

### 7.4.4 Distance from CBD

In both models, distance from CBD plays an important role in deciding the land value. This suggests that the developer or even the subsequent home buyer would pay a premium for sites close to CBD. People prefer to live in the CBD as they would be closer to their place of work and it would be convenient to commute to work. As in other cities, land in Singapore CBD is often outbid by other competitive uses such as offices and retail. Today, only about 3% of the population (30,000 housing units) is living in the city.

In Singapore's context, the planning authority has already started an initiative to provide another type of housing option – inner city living. With the new downtown (adjacent to the current CBD) planned for in Concept plan 2001, URA is looking to increase the live-in population in the city area by about four times the current population. That is about 90,000 more units for 7% of the population, thus providing more housing opportunities for all in the city. With conscious planning efforts to zone existing residential land within the city to higher plot ratio, our study shows that capital land substitution will enable the land value for residential use within the city to be higher and compatible with other uses. In this way, inner city living in the CBD could be made possible. The premium in the land value for a site closer to CBD shows that such planning policies is likely to be welcomed by both by developers and home buyers.

### 7.4.5 Plot ratio allowed

Plot ratio allowed is a tool to regulate the maximum density of the development on a site. In order to meet varied aspirations of Singaporeans and residents in Singapore, different plot ratio bands were prescribed for different parts of Singapore, taking into considerations impact with surrounding uses, height constraints, traffic and infrastructure. The table below shows the existing and target housing density mix. Since 1991 Concept plan, there was already conscious planning efforts to maintain some low density housing and also provide medium and high density housing.

**Housing Density Mix**

| Housing Density | Low | Medium | High |
|---|---|---|---|
| Existing Mix | 9% | 13% | 78% |
| Concept Plan 2001 | 8% | 13% | 79% |

Unlike the US and UK, higher density housing is not deemed as a less preferred choice of housing in Singapore. Living in a high-rise building of 10 stories and above has been a way of life for 80% of Singaporeans for the last 20 years. To maximize the use of scarce land through high-density housing is a logical decision since it reduces infrastructure and transportation costs, as well as minimizing environmental impacts.

Since Concept plan 1991, the planning policy to meet increasing housing demand was by increasing the density of land to make best use of available land. The two main planning strategies include:

- developing substantial pockets of high density area where there is no technical height constraints; and
- Making the best use of land by maximizing development potential around MRT stations.

Increased plot ratio has been a planning tool to increase the number of housing units to accommodate a growing population. Varied density housing is seen as providing different housing choices for Singaporeans. From a planner's perspective, with less land consumption but higher density, we would be able to produce more housing units. An example of how an increase in density would help increase housing output can be seen in the Duxton Plain project. This project is within the CBD and comprised a new 50-story public housing project to be completed by 2007. On Duxton Plain's 2-hectare (20,000 square meters) site, it could yield up to 1,500 homes at a plot ratio of 7.4 compared to 600 homes at plot ratio of 2.8. From this recent example, it can be seen that policy makers are emphasizing capital land substitution as a means to increase housing output and also encourage inner city living.

In line with the implementation of the mass transit system over the last 10 years, there was a conscious policy to maximize the development potential around MRT

stations (Figure 39). From our data, it was also found that sites with good accessibility were correspondingly zoned for much higher density. For both hedonic models, density (represented by type of landed housing allowed or the allowable plot ratio) is the main driver of land value. The premium paid on plot ratio increases for non-landed housing is so prominent that planners should pay special attention to the power of this tool. With a stroke of the planner's pen, the land value could be changed considerably. The increase in land value with every upgrade of plot ratio band shows developer's demand for higher density. This indicates a positive response from the market on the planning policy to increase plot ratio for increased housing output.

Figure 39: Mean and median of accessibility variables based on plot ratio

| Plot ratio | Median Distance from MRT | Mean Distance from MRT | Median Distance from Access ramp | Median Distance from Access ramp | Median Distance from CBD | Median Distance from CBD |
|---|---|---|---|---|---|---|
| Plot ratio 1.4 | 1.50 | 1.62 | 1.75 | 1.58 | 11.37 | 10.88 |
| Plot ratio 2.1 | 1.33 | 1.44 | 1.00 | 1.52 | 11.31 | 11.89 |
| Plot ratio 2.8 | 0.75 | 1.13 | 1.83 | 1.91 | 10.36 | 10.16 |
| Plot ratio 3 or more | 0.65 | 0.71 | 2.07 | 1.90 | 11.29 | 10.71 |

# 8. Conclusion

## 8.1 Summary of Findings

Land is a heterogeneous good. Land has characteristics reflecting not only its location but also other amenities such as the quality of neighborhood and infrastructure. In an exchange economy, the purchase and sale of land parcels of different characteristics establish "implicit" prices for these characteristics. Using a hedonic model, the study has confirmed the significance of the traditional determinants of land, namely plot characteristics, accessibility and zoning variables in the dense and highly regulated Singapore land market.

Most of the findings have turned out to be as hypothesized. The study provides empirical evidence that confirms the importance of location and accessibility in determining residential land value in Singapore. Landed and non-landed housing sites are separately analyzed because of the difference in their density and mean land price per square meter. The study then establishes the premium or discount in land price per square meter that developers would factor into a tender bid for each type of housing form allowed. The study also confirms the presence of plattage (negative relationship between parcel size and price per unit area) in non-landed housing sites. Density or plot ratio is also a primary driver of residential land value and an important tool in land use policies to encourage capital land substitution. Figure 40 summarizes the main findings.

| Figure 40 :Impact of zoning and plot ratio on per square meter of land | | | | | | |
|---|---|---|---|---|---|---|
| **Landed residential use** (land titled properties) | | | | **Non-landed residential use** (strata titled multi-family properties) | | |
| Significant discount below non-landed zone (based on median price per sqm land) | | | | Significant premium above landed zone (based on median price per sqm land) | | |
| Bungalow (400sqm) | Semi-detached (200sqm) | Terrace house (150sqm) | Mixed landed (>10,000 sqm) | Apartment (>1,000sqm) | Executive condominium (>4,000sqm) | Condominium (>4,000sqm) |
| Base case | Premium above bungalow sites. | Premium above bungalow sites, less in magnitude compared to semi-detached. | Discount off base case. | Base case | No significant difference from base case. | Premium above apartments and executive condo sites. |

## 8.2 Limitations of the study

The main limitation of the study is the data set available. Without the information of the private land transactions that comprises of about 10% of the total land area in Singapore, a comprehensive study of the pricing behavior of developers cannot be conducted. If more data over a longer period could be collected, the study could be more complete.

## 8.3 Recommendation for further studies

Such studies should be extended to non-residential land uses if data could be assembled. This is especially important for industrial land where land price makes up a significant part of the cost of production. Also, the study could be further improved to include variables such as presence of top schools within 1km that represent the neighborhood quality.

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