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Abstract:

Affordable homeownership is a policy that is often accorded a great deal of policy attention by governments of many countries. In this paper, we examine the market implications of setting a housing price to income ratio target for a market segment by the government. The policy requires active intervention by the government with regard to the targeted sector. We use a simple model of the housing market with a homeownership affordability target to derive the market implications of such targets. In the presence of uncertainty and resource constraints, the objective of homeownership affordability is achieved for the targeted group at the expense of greater volatility in residential construction activity. When the size of the targeted sector is significant in size, there are spillover price and crowding out effects on the non-targeted housing market segment. This results in political pressure on the government to expand homeownership affordability targets to increasing segments of the population. Housing price to income ratios tend to be fairly constant over time and across targeted groups, the housing supply is relatively price inelastic and the income elasticity of housing demand is less than one. The Singapore government intervenes extensively in the housing sector to ensure homeownership affordability, with a resulting homeownership rate of 91 percent for the resident population. The above hypotheses regarding the implications of setting housing price to income ratio targets are tested using the Singapore housing market. The experience and data for Singapore were found to support the above hypotheses.

Keywords: Affordable homeownership policy, market implications, Singapore

Introduction: homeownership as policy objective

The promotion of homeownership is often accorded a great deal of policy attention by governments of many countries. The benefits as well as the costs of home ownership have been the subject of many studies. Atterhog (2005) classifies the advantages as those relating to (i) the dwelling itself – ownership dwellings are typically larger and of higher quality; (ii) accumulation of wealth as home ownership is often regarded as a long term investment; and (iii) the non-tangible benefits many of which constitute positive externalities for society and local community. Coulson (2002) describes three aspects of positive externalities from ownership that have been studied empirically. These include (i) better maintenance of property (Harding, Miceli and Sirmans, 2000), (ii) being better citizens (DiPasquale and Glaeser, 1999), and (iii) children of owners having higher levels of cognition and fewer behavioral problems (Haurin, Parcel and Haurin, 2002).   These positive attributes are by no means universal. A study by Quigley and Raphael (2004) concludes that the evidence of externalities from homeownership is not overwhelming.

With regard to negatives, homeownership is also associated with residential immobility, differentiation and fragmentation, and is increasingly viewed as more risky that in the past. Homeownership results in over-concentration of household investment in one asset as well as exposes the household to uncertainty from housing price and interest rate fluctuations (Atterhog, 2005). Moreover, the benefits and problems of low-income homeownership differ from that of high income homeownership. Shiller (2003) advocated creating insurance on market values of individual homes; recently, market initiatives to insure housing equity or hedge against price risk have been introduced in the UK and the USA (Iacoviello and Ortalo-Magne, 2003; de Jong, Driessen and Van Hemert, 2007).

Not surprisingly, therefore, homeownership rates vary widely across countries as well as regionally within a country. While Hungary, India, Mexico, Spain, Singapore, Greece and Italy have rates of 80% or more, high income countries such as Germany and Switzerland have rates below 45%. UK, USA and Canada have homeownership rates in the 65% to 69% range (Proxenos, 2003). Mass privatization of the housing sector in UK,

Eastern Europe and in China have also resulted in significant increases in homeownership rates over a short period of time.

Recent studies that have tried to study the determinants of home ownership rates internationally include Fisher and Jaffe (2003), Earley (2004), Gwin and Ong (2004) and Atterhog (2005). Using multivariate analysis of macro-level data from 106 countries, Fisher and Jaffe (2003) found that it was not possible to provide a single equation model for homeownership variations globally. They concluded that legal, economic, political and cultural institutions matter more as compared to income, ethnicity and demographic variables. The study by Gwin and Ong (2004) provides international evidence to support the theory that homeownership is sensitive to price of ownership relative to rental costs, and postulated that higher ownership rates in some countries could be attributed to government assistance programs and subsidies.

Chiuri and Jappelli (2002), using microeconomic data on 14 OECD countries, find strong evidence that availability of mortgage finance (as measured by down payment ratios) affects home ownership rates across age groups, especially at the younger end. Proxenos (2003) however argues that homeownership rates alone are an incomplete measure of the quality of a country's housing finance system and emphasizes the importance of government policy on homeownership. Earley (2004) categorizes the various reasons for the wide variation in homeownership rates into factors on the supply side, demand side, transactions costs, government policies and cultural issues (p. 30). Atterhog (2005) surveyed housing researchers in 23 countries to collect information on government support for homeownership and concluded that 'government incentives may matter for homeownership rates.'

Government policies favoring homeownership as a tenure choice are widespread and take various forms in different countries. These include mortgage interest payments that are tax deductible, special treatment of capital gains from housing, tenant protection laws that negatively impact the value of investment properties, mass privatization, supply-side subsidies for state agencies and developers of housing for sale, mortgage interest subsidies, mandatory housing finance contributions, direct grants for housing purchase, property tax subsidies, planning laws, limitations on the supply of rental housing, etc.

In countries where homeownership is accorded policy attention, the affordability of homeownership is likely to be closely tracked. In Section II, we review the literature on homeownership affordability indicators. Section III analyses the market implications of setting a homeownership affordability target for a market segment by the government. In Section IV, we use Singapore as case study to test for the validity of the hypotheses derived in Section III. Section V concludes.

Indicators of housing affordability

Bogdon and Can (1997) provide a review of indicators of rental affordability. The share of income spent on housing or rental expenditure-to-income ratio is widely used, with 25 to 30 percent of income representing the upper limit of affordability (Hulchanski, 1995).

For the majority of households in countries with high homeownership rates as well as for policy makers tracking homeownership affordability, housing affordability is about homeownership affordability. Robinson, Scobie and Hallinan (2006) provide a comprehensive review of the concepts and measurement of housing affordability. A variety of organizations monitor homeownership affordability using the following indicators:

(i)   House price to income ratio (UN-HABITAT);

(ii)   Mortgage payment to household income ratio (US National Association of Realtors);

(iii)   Ratio of median family income to the income required to qualify for a conventional mortgage on the median valued house sold (US Department of Housing and Urban Development).

Rather than using income-based ability to pay as a benchmark, Glaeser and Gyourko (2003) advocate focusing on housing price relative to its fundamental costs of production as a measure of housing affordability. Quigley and Raphael (2004) estimate the user cost of housing capital, with and without capital gains, as an indicator of the change in homeownership affordability over time. Krainer and Wei (2004) advocate using the price-rent ratio as an indicator of market deviations from the fundamental value

of housing. Gwin and Ong (2004) find international variations in homeownership rates to be highly sensitive to the price-to-rent ratio.

Each of the above measures of affordability has its benefits and limitations. The most widely used and cited indicator of homeownership affordability is the median house price to median income ratio, due to its simplicity and ease of understanding. Its use is recommended by the World Bank and the United Nations; the ratio is available on the UN-HABITAT database and it is also tracked for 265 metropolitan markets in six countries by the *Demographia International Housing Affordability Survey* (Performance Urban Planning, 2009). Its shortcomings include its failure to include mortgage interest rates, banks' lending practices such as loan to value ratios, capital gains, and amounts of taxes and repairs. No one measure of affordability is adequate on it is own and Robinson et.al. (2006) advocate using a basket of measures to obtain a complete picture of affordability trends.

Market implications of a house price to income ratio target

In this section, we examine the market implications of setting a homeownership affordability target for a market segment by the government using a non-formal theoretical framework.   We then use the Malpezzi and Mayo (1997) formulation of the housing market to study the implications for housing demand and supply elasticities.

Setting such a house price to income ratio would require the government to intervene in the housing market to determine prices paid by households in the targeted sector. Countries where forms of selective homeownership affordability targets and policies exist include Norway, Singapore, Hong Kong, and South Korea (Aarland and Nordvik, 2009; Groves, et.al., 2007). These and European countries such as the Sweden and the Netherlands (where the emphasis is more on affordable rental housing) have housing allocation policies and levels of housing market intervention that contrast with the market-oriented US housing model.

The literature on the market impact of housing policies is rather thin.   As reviewed in Nordvik (2006), the literature on how selective housing programs affect housing market equilibrium outcomes include the analyses of Malpezzi and Vandell

(2002), Sinai and Waldfogel (2005) and Murray (1983, 1999) for the US, and Nordvik (1997, 2006) for Norway. This article contributes to the existing literature by considering the market impacts of housing targets in an Asian context, and where the scale of intervention is at a much higher level than in market oriented housing models.

Consider a housing market in which the household in a targeted group is not expected to pay more than x times the median household income for the median dwelling in the targeted group. This policy may be achieved through supply side and/or demand side policies. On the supply side, the government may choose to build or subsidize the building of housing that is sold to the targeted group at a price that is consistent with the price affordability target. It could also subsidize the household through the use of housing grants the amount of which allows the household to purchase a housing unit at a price net of grant subsidy that is consistent with the price affordability target. Here, we analyze the market implications of supply side housing programs.

Housing policy determines the desired ratio x*, the quality of the housing unit for the targeted group, as well as maximum income measure as a cut-off point to exclude higher income households from non-universal subsidized housing units (either an absolute income figure or say y*% of the area's median income). In the short term however, the actual x and y may differ from the target x* and y* due to policy lags and unexpected income shocks. As discussed in Hulchanski (1995), housing affordability measures and income cut-offs used for the purpose of defining housing need for public policy purposes whether for rental or homeownership programs are 'arbitrary' and dependent 'upon the values or beliefs of individuals' (p. 489).

In the case of supply side programs, a public housing authority supplies subsidized housing where the price is based on a target x* times the median household income in the targeted group. In the presence of resource constraints and a public housing budget that is insufficient to provide subsidies to all eligible applicants, the housing authority keeps a waiting list of households which have applied for housing benefits. The length of the waiting list provides an important non-price signal to the housing authority to increase supply in order to maintain x*. At the same time, in the presence of uncertain income shocks, the housing authority may not adjust house prices fast enough so that prevailing x may be greater or below target x*.

When the income shock is positive, ratio $x < x^*$, the price difference between the price set by the housing authority and the market price increases. If y^* is set at a fairly inclusive level, there is an increase in housing demand in the targeted sector; the waiting list lengthens and this may cause the housing authority to increase housing starts. When the income shock is negative, and there is no downward adjustment, the ratio $x > x^*$, the waiting list shortens and the price difference between price set by the housing authority and the market price falls. This may have the effect of causing the housing authority to cut back on its building program. However, if the targeted sector is a small proportion of the population (y^* is a low number), the number of beneficiaries decrease in good times as incomes rise above the income cut-off point. Conversely, demand increases in bad times as more households become eligible to benefit from the program. Housing starts for the targeted sector in this framework respond to excess demand as reflected in the length of the waiting list, rather than directly to housing prices. When x is not equal to x^*, the length of the waiting list depends on the income cut-off point as well as on the magnitude of the deviation and this results in greater volatility in construction activity than the case when x is equal to x^*.

Policy decisions with regard to two policy variables, the income cut-off points and the quality of housing constructed by the housing authority therefore have implications for market outcomes. Income shocks affect the proportion of the population available for housing subsidies when absolute income cut-offs points are `sticky'. Besides the price, subsidies per unit are determined by the quality of housing built and sold by the housing authority and the production (land and construction) costs incurred.

Using the above framework, in the presence of income uncertainty and resource constraints, the objective of house price affordability is achieved for the targeted household at the expense of greater volatility in residential construction activity. When the size of the targeted sector is significant in size, there are spillover price volatility and crowding out effects on the non-targeted housing market segment. This results in political pressures on the government to expand the housing affordability target to a larger proportion of the population.

The methodology applied to study the implications of a homeownership affordability target on housing market elasticities is the reduced form method used by

Malpezzi and Mayo (1997). It starts with a simple model of demand and supply and derives a reduced form equation for the equilibrium price. Since both the demand equation and the supply equation are assumed to be in double-log forms, the estimated coefficients of the income (Y) and the price (P) term in the demand equation become the income and price elasticities, α_2 and α_1, respectively. Likewise, the coefficient of the price term in the supply equation β_1 represents the price elasticity of supply. As it can be shown below, the price elasticity of supply can be computed from the estimated coefficient of the equilibrium price equation once the values of the income and price elasticities of demand are given.

$$Q_D = \alpha_0 + \alpha_1\, P_h + \alpha_2\, Y + \alpha_3\, D$$

$$Q_S = \beta_0 + \beta_1\, P_h$$

$$Q_D = Q_S$$

Q_D is the log quantity of housing demanded, Q_S is the log quantity of housing supplied, P_h is the log of the relative price per unit of housing, Y is the log of income, and D is the log of population.

The reduced form of the system can be found by equating demand and supply and solving for P_h, the price of housing.

$$P_h = \frac{\alpha_0 - \beta_0}{\beta_1 - \alpha_1} + \frac{\alpha_2\, Y}{\beta_1 - \alpha_1} + \frac{\alpha_3\, D}{\beta_1 - \alpha_1}$$

Making the reduced form stochastic,

$$P_h = \gamma_0 + \gamma_1\, Y + \gamma_2\, D + \varepsilon$$

The price elasticity of housing supply is estimated as

$$\beta_1 = \frac{\alpha_2}{\gamma_1} + \alpha_1$$

where γ_1 is the estimated elasticity of housing price with respect to income, and the parameters α_1, the price elasticity of housing demand and α_2, the income elasticity of demand.

We ask the following question: what are the implications in the above model of a house price to income ratio target x* that is held constant despite changes in income and population? For a constant quality housing bundle, we obtain

$$P_h - Y = \log(x^*)$$

$$P_h = \log(x^*) + Y$$

Comparing it with the reduced form stochastic,

$$P_h = \gamma_0 + \gamma_1 Y + \gamma_2 D + \varepsilon$$

we expect a housing market with a house price to income ratio target to exhibit the following values for γ_1 and γ_2: γ_1 is equal to one; and γ_2 is equal to zero. Since the price elasticity of housing supply is estimated as

$$\beta_1 = \frac{\alpha_2}{\gamma_1} + \alpha_1$$

and γ_1 is equal to one, $\beta_1 = \alpha_2 + \alpha_1$.

i.e., the price elasticity of housing supply is equal to the sum of the price elasticity and the income elasticity of demand for housing. Since both α_2 and α_1 have been found from empirical studies to be less than one, we expect estimates of price elasticity of housing supply in price regulated markets to be relatively inelastic.

From the above general theoretical discussion, we extract some hypotheses concerning a regulated housing market where there exists a homeownership affordability target that is successfully implemented:

(i)   There is crowding out of the non-targeted sector and the size of the targeted housing sector tends to expand over time.

(ii)   Housing affordability tends to be fairly constant across income groups and over time.

(iii)   There is greater housing consumption equity than would exist in a market oriented housing economy. Given constant house price to income ratio targets, the income elasticity of demand for housing consumption is less than one.

(iv)   New construction of public housing is more sensitive to the length of the waiting list rather than house prices. Housing supply is relatively price inelastic.

(v)   House price changes are less dependent on population growth rates and construction costs than in a market-oriented housing model.

The above hypotheses regarding the implication of setting a homeownership affordability target can be subjected to testing in regulated housing markets with such a target. In the next section, we consider the case for the Singapore housing market.

Singapore as a case study

Singapore is a densely populated high-income city-state with 4.84 million people and a land area of only 700 square kilometers. Of the 4.84 million people in 2008, 3.16 million were citizens, 0.48 million were permanent residents, and 1.20 million were foreigners. Its Gross Domestic Product in 2007 was S$243 billion; the GDP per capita was S$52,994 or US$35,163 (Singapore Ministry of Trade and Industry website at www.mti.gov.sg).

The Singapore government has a long record of extensive intervention in the housing sector to ensure homeownership affordability and adequate supply of housing - a subsidized homeownership scheme was introduced in 1964. As a direct result of policy interventions and supply of affordable flats, the homeownership rate for resident Singaporeans exceeds 90 percent. An estimated 86 percent of the resident population reside in over 900,000 apartments in estates built by the Housing and Development Board (HDB) – locally referred to as public housing although 95% of the units are owned by their occupants on leasehold basis (a new unit has a leasehold of 99 years). The median house type in Singapore is the 4-room HDB flat which is about 90 sq m (see generally, Phang, 1992, 1996, 2001, 2007).

On the demand side, housing finance availability was supported through the channeling of compulsory savings to the Central Provident Fund (CPF) for housing down payments and monthly mortgage payments (see Phang, 2001, 2007 and Yuen, 2002 for detailed analysis of the mortgage finance system in Singapore). The HDB provides 30 year mortgages for its homeownership flats, charging an interest rate of 0.1 percent above the rate paid on CPF savings. The dominance of the state in the housing sector has been aided by an array of instruments on the supply side. These include land use planning, land acquisition by the state, government direct provision of housing, government sale of sites for private housing, as well as density controls and redevelopment regulation.

The state owns about 90 percent of all land today, up from about 44 percent in 1960 (Han, 2005). This dramatic increase in the state's landholdings was effected via land reclamation (reclaimed land automatically becomes state land) and most importantly, *eminent domain* provisions that made it easy and cheap in the past for the state to reacquire privately held land for development purposes. State ownership and control of land were considered essential to building industrial estates to attract multi-national corporations to invest in Singapore and building public housing on a large scale. Singapore's public land leasing system for <u>private</u> housing has played a secondary role to its public housing program which dominates the housing sector in terms of stock and annual supply. At present, 80% of the housing stock in Singapore has been developed by the public sector.

The history of the growth of the public sector dominance is consistent with hypothesis (i) that there is crowding out of the non-targeted sector and that the size of the targeted housing sector tends to expand over time. Table 1 shows various indicators of growth in the targeted sector, viz., increases in income cut-off points over a 35 year period from 1970 to 2005, and increasing share of resident population residing in the HDB sector which peaked at 87% in 1985. Table 2 shows that the variance of the private housing price index increased significantly from the 1980s to the 1990s. While other factors also drive house price changes, studies by Phang and Wong (1996), Tu and Wong (2002) have shown that price changes in the resale HDB and private housing market were significantly affected by various housing policies.

As another indication of the expansion of the targeted sector, housing schemes for the group excluded by HDB income cut-offs include:

(a) housing developed by the Housing and Urban Development Company (income ceiling of $4000 from 1974 and $6000 from 1985) which was discontinued in the later half of the 1980s; and

(b) the Executive Condominiums (EC) Scheme which was initiated in 1997. These are classified as private housing but with a monthly household income cut-off point of S$10,000; purchasers face many of the restrictions such as minimum occupancy period that apply to HDB homeowners. The government tenders state land on 99 year leasehold basis for the development of EC units to housing developers (private

as well as government-linked companies) who are responsible for design, construction, pricing, arrangements for financing and estate management.

Table 3 shows the 2008 house price to income ratio as well as debt service ratios for different flat sizes sold by the HDB. In addition to the subsidized price, since 2006, eligible households are entitled to additional housing grants which are based on household incomes. This lowers housing price to income ratios further for the lower income groups. As shown in Table 3, the house price to income ratio increases with flat size and is 4.6 and below for the majority of applicants (4 room and smaller flats). The debt-service ratio (DSR) is fairly constant across flat types (18% to 24%) and averages 21%, evidence that housing prices are determined based on incomes of the targeted groups and housing expenditure to income is fairly constant across the targeted income groups.

According to the Minister for National Development, "We monitor affordability by how much a flat buyer has to pay out of his monthly household income to service his mortgage payments…. The DSR for almost all flat types was lower than 23%. Why 23%? Because 23% is the monthly CPF contribution that can be used for housing mortgages. This means that the loan can be serviced entirely by their monthly CPF contributions. In other words, they need not fork out any cash to own their homes" (Mah, 2009, paragraphs 5 and 6).

Table 4 shows the variation in house price to income ratio over the past decade for a new HDB 4-room flat and using the median household income from work for resident households. The ratio shows a marked increase in the latter half of the 1990s with prices adjusting upwards with the housing boom and with increases being maintained during the post-Asian financial crisis period which saw significant market price declines (see Figure 1). The ratio was fairly stable in the economic recovery period 2000 to 2005 and ranged from 3.8 to 4.1. In 2006, as the housing market recovered, there were increases in new flat prices even as a new system of additional housing grants (ranging from S$5,000 to S$20,000 per eligible household) that were based on household income were introduced.

Figure 1 shows trends for GDP per capita and three house price indices for Singapore: new HDB, resale HDB, and private housing. To simplify comparison, the

indices have been adjusted such that they all have a value of 100 in 1993. It is apparent that the HDB chose not to follow market trends and adjust new flat prices downwards in line with income falls in the aftermath of the Asian financial crisis. This caused new HDB flats to be less affordable -- the number of applicants for new flats fell to 22,000 in June 2001 from its peak of 146,000 in 1997. Many households dropped out of the queue and the HDB was left with a surplus stock of about 20,000 unsold flats in the late 1990s (*The Straits Times*, 15 September 2001, 10 January 2002, and 20 September 2009). However, the policy to maintain new flat prices, which resulted in the large stock of unsold units which was cleared only in 2007, helped mitigate house price declines (*The Straits Times*, 20 September 2009). In 2002, the HDB suspended its queuing system, diverting remaining and new applicants to its project specific Built-to-Order program under which a project is commenced only when there is sufficient demand for units.

Table 5 shows the housing space consumption differences in Singapore as compared to the income gap. There is greater housing consumption equity than would exist in a market oriented housing economy. While the ratio of median household income of applicants for 5-room flats to 3-room flats is 2.57, the ratio of living space is 1.69. Based on the limited data on flat size and median household income data in Table 5, rough estimates of income elasticity of housing demand are less than one and these are consistent with estimates for other countries. Although household data would have provided more rigorous and precise estimates, the data is unavailable.

The increasing average price per sq m for larger flat types (from $1,956 to $3,082 per square meter for similar housing type) is an indication that the administered price of each flat type is based on factors other than development costs. The HDB has clarified that it determines the prices of its flats by "first looking at the recently transacted prices of resale units nearby. Adjustments are then made to account for factors like location, finishes of the flat and other attributes. The price reflects the flat's value at the point of purchase and is what people are willing to pay on the open market for such a unit. The HDB then sells it at a significant discount, which is the subsidy given by the Government" (*The Straits Times*, 20 September 2009, p.8).

The HDB tracks the number of applications for its housing programs closely and its building program is responsive to demand (as stated by the Minister for National

Development, *The Straits Times*, 15 September 2009). We would therefore expect supply of public housing to be relatively price inelastic. Table 6 shows the price elasticity of supply estimates using the Malpezzi-Mayo reduced form estimation method for the resale HDB price series and the private housing price series. The income coefficient for the HDB sector, where affordability is tracked closely, is close to one. From the literature on housing elasticites (Malpezzi and Mayo, 1987; Malpezzi and Maclennan, 2001), we assume the range of income elasticity of housing demand to be between 0.50 and 0.75, and price elasticity of housing demand to be between -0.3 and -0.5. Based on these values, reasonable estimates of price elasticity of supply for the HDB sector lie in the zero to 0.45 range; for the private housing sector (converting negative values to zero) the range of estimates lies between zero and 0.11.

As expected, the coefficient of the population coefficient is not significant for both resale HDB and private housing. This is consistent with hypothesis (v) concerning housing systems with homeownership affordability targets. In a study of Singapore's private housing market, Tu (2004) found that building material cost indexes and prime lending rates were also not significant variables in the supply model. She suggested that the "building material cost indexes reflect the building material costs for both public and private housing construction. Importing low-cost building materials has been the method used by Singapore's public housing provider to control the construction costs of public housing. Hence, the building material cost indexes are not an adequate indicator for the cost of private housing construction" (Tu 2004, p. 617). An alternative explanation offered here is that in a housing model with a targeted homeownership affordability ratio, housing prices and construction activity are policy driven and determined by other variables rather than costs.

Conclusion

There is a large literature on affordable housing and housing policy. This paper adds to the literature by analyzing the implications of setting homeownership affordability targets in the context of a targeted housing segment. The analyses suggest a number of market implications of such regulation as compared to a market oriented housing model. These include expansion of the targeted housing sector over time, the relative constancy

of actual housing price to income ratios for households in the targeted sector, greater housing space consumption equity, income inelastic housing demand, price inelastic housing supply, as well as house price changes that are relatively less driven by population growth rates and construction costs.

While the experience and data for Singapore were found to support the above hypotheses, it is neither possible nor desirable to make generalizations based on Singapore's rather unique housing experience. The expansion of the targeted housing sector requires appropriate political and financial support. This political support and appropriate financial regime that facilitated expansion in resources to the program are evident in Singapore and reflect the specific evolution of its housing policy.

Similar homeownership policies have been designed and followed by countries which have emphasized housing welfare and explicitly aim for increased homeownership rates such as Norway, Hong Kong, South Korea, and the UK. A targeted affordable housing policy, adopted under different fiscal and monetary constraints, would not necessarily have outcomes similar to Singapore. How the experiences of these countries relate to the findings presented here constitute potential areas for further comparative research.

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Table 1   Expansion of targeted sectors for eligibility of housing subsidy

Year	Income ceiling cut-off for HDB Homeownership Flats	% of resident population residing in HDB sector	Homeownership rate for resident households
1970	$1200 (1970)	35%	29%
1980	$2500 (1979)	81%	59%
1990	$5000 (1989)	86%	88%
2000	$8000 (1994)	83%	92%
2005	$8000 (1994)	82%	91%

Source: HDB Annual Reports.

Table 2   Variance in private housing price index

Decade	Variance
1979-1988	122
1989-1998	2200
1999-2008	395

Table 3   House price to income and debt-service ratios (DSR), 2008

HDB flat type	Average price*	Flat size in square metres+	Average price per sq m	Median income of applicants*	House price to income ratio#	Debt-service ratio*
2-room	$88,000	45	$1,956	$1,280	5.7 (3.1)	18%
3-room	$146,000	65	$2,246	$2,100	5.8 (4.6)	24%
4-room	$251,000	90	$2,789	$4,350	4.8 (4.6)	21%
5-room	$339,000	110	$3,082	$5,400	5.2	23%
Average						21%

Note: # the house price to income ratios in brackets take into account the Additional CPF Housing Grants which varies with household incomes. We assume the grant to be S$40,000 for 2-room flat applicants, S$30,000 for 3-room flat applicants and S$10,000 for 4-room flat applicants.

Sources: +HDB Annual Report; * figures from Mah (2009).

**Table 4   Estimated House Price to Income Ratio for
                4-room flat purchased directly from the HDB**

Year	Price of 4 room HDB flat+	Monthly household income*	House price to income ratio
1995	$135,830	$3,135	3.6
1997	$173,548	$3,617	4.0
1998	$182,450	$3,692	4.1
1999	$179,945	$3,500	4.3
2000	$176,100	$3,640	4.0
2001	$175,463	$3,860	3.8
2002	$167,511	$3,630	3.8
2003	$169,476	$3,600	3.9
2004	$177,790	$3,690	4.0
2005	$187,860	$3,860	4.1
2006	$215,643	$4,000	4.5
2007	$214,016	$4,380	4.1
2008	$251,000	$4,950	4.2

Notes:
+ Based on author's hedonic housing price regression estimation with flat type and location dummies using price data for new flats from HDB Annual Reports.
*Refers to monthly median household income from work for resident households; data for 1996 income is not available.

Source: Income data from Singapore Department of Statistics, *Key Household Income Trends, 2008*, January 2009.

Table 5   Housing space consumption gaps versus income gap 2008

HDB flat type	Flat size in sq m	Average price per sq m	Median monthly household income of applicants
2-room	45	$1,956	$1,280
3-room	65	$2,246	$2,100
4-room	90	$2,789	$4,350
5-room	110	$3,082	$5,400
5 to 3-rm ratio	**1.69**	**1.37**	**2.57**
5 to 2-rm ratio	**2.44**	**1.58**	**4.22**

**Source**: As for Table 3.

Table 6
Estimates of price elasticity of housing supply

Price series	Income coefficient γ_1	Population coefficient	Estimates of price elasticity of housing supply β_1 $\beta_1 = \alpha_2 / \gamma_1 + \alpha_1$ Income elasticity α_2	
			$\alpha_2 = 0.5$	$\alpha_2 = 0.75$
Resale HDB 1990-2008 annual R-square = 0.625	0.9985 (1.14)	0.8446 (0.67)	0.00 ($\alpha_1 = -0.5$) 0.20 ($\alpha_1 = -0.3$)	0.25 ($\alpha_1 = -0.5$) 0.45 ($\alpha_1 = -0.3$)
Private Housing 1975-2008 annual R-square = 0.880	1.8183 (4.58)	-1.1749 (-1.46)	-0.23 ($\alpha_1 = -0.5$) -0.03 ($\alpha_1 = -0.3$)	-0.09 ($\alpha_1 = -0.5$) 0.11 ($\alpha_1 = -0.3$)

Notes:
1. income series used is nominal per capita GDP, price series are nominal as well
2. figures in brackets below coefficient estimates denote t-statistics

Figure 1   Trends for nominal per capita income and housing price indices
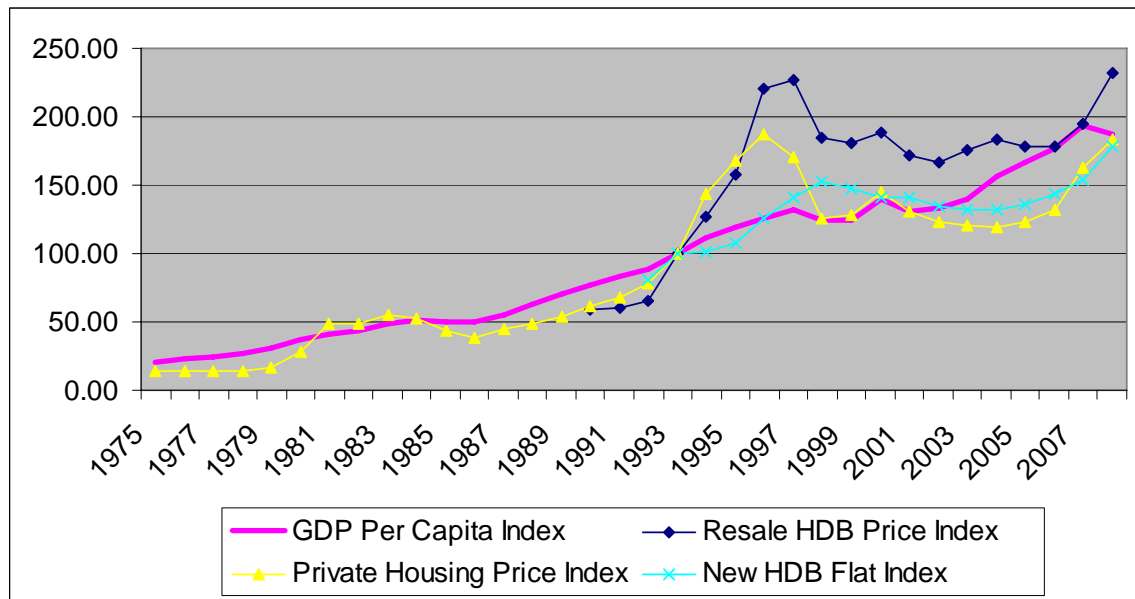
Sources: Indexes (1993=100) computed from data available on the websites of Singapore Department of Statistics (income series), Housing and Development Board, Singapore (Resale HDB Price Index), and Urban Redevelopment Authority, Singapore (Private Housing Price Index). The New HDB Price Index is based on author's hedonic housing price regression estimation with location and flat type dummies using price data for new flats found in the HDB's Annual Reports.