Lifetime Income and Housing Affordability in Singapore

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Abstract

Most commonly used measures of housing affordability are essentially short-run indicators that compare current income with house prices or housing costs. Despite the emphasis in the literature on the importance of long-term affordability, researchers have not developed measures of lifetime income because of data constraints. Many developed countries publish annually household income by age of household heads. Using these data for Singapore, the paper presents a methodology to compute lifetime income from predicted annual household earnings over the working life for each birth cohort in the dataset. The lifetime income of Singapore households by three income quantiles sheds new light on widening income gaps. The affordability index, defined as the ratio of lifetime income to house price, reveals informative trends and cycles in housing affordability in both the public and the private sectors. The paper argues that residential property price escalations need to be avoided.

1. Introduction

After 40 years of concerted efforts by the government to house Singaporeans, Singapore now has proportionately the biggest public housing sector in the developed world. In 2007, the public sector accounted for 79 per cent of the total housing stock and accommodated 81 per cent of the resident population (*Yearbook of Statistics Singapore*, 2008). Unlike Hong Kong, where there is also a large public housing sector but with a large proportion of public house renters, Singapore has achieved an impressive record of homeownership under the public housing programme.[1] Facilitated by various government policies such as the Approved Housing Scheme introduced in 1968, subsidised new public flats supplied by the Housing and Development Board (HDB) and subsidised housing loans,[2] private ownership of public housing reached 79 per cent of the total resident population of Singapore in 2007 (*Yearbook of Statistics Singapore*, 2008).

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Singapore's private housing sector has also grown over the years. Although originally intended to serve mainly the high-income earners, growing incomes have opened up the private residential market to a large segment of the population. Quite contrary to some perceptions that the private housing market caters primarily to foreigners, data from the Real Estate Information System (REALIS) show that between 1997 and 2005 about 82 per cent of the private housing stock was owned by Singapore citizens and permanent residents and close to 90 per cent of new buyers of private housing are local people. Even the rental demand for private housing by foreigners has not been that high; in 2003, owner-occupation of private housing was about 88 per cent (DOS, 2005). Government policies have also been shifting to rely more on the private sector to meet housing needs. With a higher population target of 5.5–6.5 million residents, the demand for housing will continue to increase. With aspirations to upgrade to private housing rising high (DOS, 2006) and several episodes of house price escalations in the past, housing affordability has become a hot issue among the potential buyers.

There are several factors in operation in this regard. First, some major policy changes have led to an increasing interaction between the public and private housing sectors. For example, compulsory savings in the Central Provident Fund (CPF) that could only be withdrawn for the purchase of public housing have been allowed for private housing purchases since 1981. Furthermore, the HDB resale market has been deregulated since 1989 to allow HDB-dwellers to purchase private property. The provision of subsidised funds and the removal of policy restrictions have bridged the public and private sectors and directly triggered the upgrading trend in the Singapore housing market. Upward housing mobility is well noted in the local literature (Lee and Ong, 2005; Yuen *et al.*, 2006; DOS, 2006).

Secondly, an intertwined housing price structure shapes the Singapore housing market now. There are three housing submarkets in Singapore: the new HDB flats market, the HDB resale flats market and the private property market. As the prices of the latter two segments are market determined, they tend to be affected by a similar set of macroeconomic conditions and price movements stay closely aligned, although private houses command a much higher price.[3] As for new HDB flats, since 1990, the government has revised its objective from affordability to quality. Although the new flats are still sold at a subsidised price, the price is partially pegged to the resale market price (Ng and Chow, 2004). In fact, despite the dominance of the public housing segment in Singapore, the private housing market has come to dominate the price trends of the housing market in general. A causality analysis within a cointegration framework as discussed in Rajaguru and Abeysinghe (2008) clearly shows that the private housing market leads in setting the price trends in the Singapore housing market.

In this context, a measure of housing affordability would be a useful indicator for policy-makers. The literature shows that researchers have used different measures of housing affordability. Some common measures include a ratio of housing cost to current income or mortgage payments to current income (Keare and Jimenez, 1983; Kamath, 1988). A measure of accessibility defined by the Australian National Housing Strategy (NHS, 1991) assesses the household's ability to afford a downpayment. Considering Singapore's upgrading phenomenon, Ong and Sing (1999) suggested a modified measure of affordability, which they termed a 'threshold upgradeability index'. This index considers the scenario that a household in the public housing sector qualifies for upgrading to private housing if the resale of the HDB flat generates enough cash for a downpayment and the household's current income level is

sufficient for mortgage payments (Lee and Ong, 2005; Yuen *et al.*, 2006). Png (2007) takes the ratio of the 90th percentile of household income to private residential property price as a measure of affordability of private housing in Singapore. There is a branch of literature that tries to define a normative standard of affordability limit for the purpose of housing assistance for households that fall into housing-induced poverty (Kutty, 2005; Stone, 1990, 1993, 2006; Thalmann, 1999).[4] In essence, all these are measures of short-term housing affordability.

As pointed out by Quigley and Raphael (2004), housing affordability is not a clearly defined term; it is affected by a number of factors such as house price, household income both in the long run and short run, and financial market imperfections. Therefore, there are various ways of specifying housing affordability which may lead to different public policy approaches. Gans and King (2004) distinguished between long-term and short-term affordability. Households with long-term affordability problems are those who, in their lifetime, are unlikely to have sufficient income to pay for a house. Short-term affordability problems concern households who may have lifetime incomes sufficient for a house purchase, but face short-term restrictions in financing it. They point out that these two measures lead to different policy approaches. Nevertheless, they concentrated on a short-term affordability measure.

Quigley and Raphael expressed their concern over the limitations of affordability measures based on annual income. They argued that

> When housing affordability is measured by rent-income ratios based on annual income ... housing will appear to be less affordable for the very young and very old; it will appear to be more affordable to households at the peak of their lifetime income profiles (Quigley and Raphael, 2004, p. 194).

They further argued that housing choice is one of the biggest expenditures for a household and is likely to be made based on a self-assessment of permanent income rather than current income. Households are unlikely to adjust housing consumption in response to short-run fluctuations in income. In fact, the shortcomings of annual income as a measure of housing affordability are well documented in the literature (Goodman and Kawai, 1982; Miron, 1984; Goodman, 1988; Bogdon and Can, 1997; Mayer, 1999; Bohlmark and Lindquist, 2006). Haider and Solon (2006) have shown in a more general context that the usual practice of using current earnings as a proxy for lifetime earnings with errors-in-variable techniques does not lead to any satisfactory results.

The sub-prime mortgage crisis in the US that surfaced as a much bigger global financial and economic crisis in 2008 also highlights the importance of having measures of long-term housing affordability. Sub-prime lending focused primarily on short-term affordability facilitated by easy mortgages. Despite the emphasis in the literature on the importance of long-term affordability, researchers have not developed measures of lifetime income because of data constraints. In this paper, we try to bridge this gap by showing a methodology to compute a measure of long-term housing affordability that takes into account the lifetime income of households.

In section 2, we provide a brief demonstration of why property price should be assessed against lifetime income and mortgage payments against permanent income. We also present a regression methodology for predicting the age–income profile for different birth cohorts and then compute time-series of aggregate lifetime income (wealth) for Singapore for three income quantiles. Section 3 presents our housing affordability index as the ratio of lifetime income (wealth) to residential property price, an index which is meaningful both in direction and magnitude.

We conclude in section 4 with a discussion of policy implications.

2. House Price and Lifetime Income

To reiterate why it is important to compare house price with a measure of lifetime income, it should be noted that the house price can be represented by a discounted present value of future mortgage payments. Typically, a house purchase is financed by taking a mortgage which involves an interest cost. Even if one uses personal savings for buying a house or for a downpayment, this still involves a cost in terms of forgone interest earnings. For simplicity, we can set the house price equal to a fixed-rate N-year mortgage quantum L (loan), which requires an annual repayment of R. If the mortgage rate is r and house price is P^h then we have

$$P^h = L = R\sum_{n=1}^{N}(1+r)^{-n} = R\left(\frac{1-(1+r)^{-N}}{r}\right) \quad (1)$$

This shows that P^h is a stock measure and R is a flow measure. Therefore, we obtain a meaningful assessment of long-term housing affordability only if we compare the house price with a stock measure like lifetime income (wealth) and mortgage payment with a flow measure like permanent income.

Lifetime income and permanent income are well established concepts in economics under the life cycle and permanent income hypotheses of consumption (Modigliani and Brumberg, 1954; Friedman, 1957). Under the permanent income formulation, lifetime income or wealth (W) is defined as the current income plus the discounted present value of expected future incomes, where income is broadly defined to include both labour and non-labour incomes. Permanent income (Y^p) is the annuity value of the wealth. For illustrative purposes if income (Y) is earned over A+1 periods, we can write

$$W = \sum_{i=0}^{A}(1+r)^{-i}Y_i = Y^p\sum_{i=0}^{A}(1+r)^{-i} = Y^p\left(1+\frac{1-(1+r)^{-A}}{r}\right) \quad (2)$$

For $N = A$ and if Y^p / P^h is reasonably small, from (1) and (2) we get $P^h / W \cong R / Y^p$. Therefore, these two ratios carry similar information content and should co-move. Since $N \neq A$ in general, P^h / W would be a better measure of affordability than R / Y^p because R can be lowered, holding r constant, simply by extending the amortisation period, N, which amounts to using up more of lifetime earnings for interest payments.

Because of the difficulty of estimating lifetime income and permanent income, in practice R_t / Y_t and P_t^h / Y_t are often used to assess housing affordability. However, as Quigley and Raphael (2004) have argued, the use of current income (Y_t) may produce a misleading picture of affordability depending on which income level is picked on the age–income distribution. Gan and Hill (2009) advocate using P_t^h / Y_t by measuring it over the entire distribution and taking the average instead of just focusing on the median house price and median income. As we shall see in Figure 1, the use of an unfiltered cross-sectional distribution may still distort the affordability measure.[5]

Moffitt (1982, 1984) devised a method for constructing lifetime income based on observed household income by age. Although Miron (1984) also estimated lifetime income assuming constant income growth rates, Moffitt's method is more promising. We adapt Moffitt's method to construct aggregate measures of lifetime income of Singapore households based on some limited data available. In Singapore, time-series data on mortgage payments are hardly available. Therefore, we focus only on comparing house price with measures of lifetime income to assess housing affordability.

At our request, the Department of Statistics, the Government of Singapore, provided us with unpublished data on household income by age.[6] These data span over 13 years (1990, 1995, 1997–2007) and represent the income of resident households categorised by the age of the household head for 9 age-groups given in Table 1 where we have set the last open interval to 60–64 to have equal five-year intervals. We obtained the data for the three income quartiles: lower (25th percentile), median (50th percentile) and upper (75th percentile). We simply refer to these as lower, median and upper income quantiles.[7]

Ideally, we need a proper panel dataset to estimate lifetime income. In such a dataset, we will have the income record of each household tracked over the years. Unfortunately, such data are hardly available. The data we now have are regarded as a pseudo-panel in the literature, first extensively studied by Deaton (1985, 1997). In a pseudo-panel, each cross-sectional survey may include a different set of households randomly selected for the survey purpose. Therefore, it is not possible for us to track the same household over time. Nevertheless, it is possible for us to track the income profile of cohorts defined by the year of birth. The difficulty, however, is that the limited data we have do not provide a complete income profile from age 20 to 64 for every birth cohort. The problem is presented in Table 1. In the table, birth cohorts are indicated by C*xx–xx*. For example C66–70 refers to the sample group that was born in 1966–70. As highlighted in the table, incomes for the cohort C66–70 are available only over the 20–39 age range. We need, therefore, a way to fill in the missing income points in order to get complete income streams for each cohort.

There are many cohorts alive in one particular year. Therefore, the age–income profile in a given year will be a misrepresentation of the life-cycle income profile that we are interested in. As highlighted by Figure 1, the age–income profile for different cross-sections appear

Table 1. Cohort plan from income data available

Age	*1990*	*1995*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
20–24	C66–70	C71–75	C71–75	C71–75	C71–75	C76–80	C76–80	C76–80	C76–80	C76–80	C81–85	C81–85	C81–85
25–29	C61–65	C66–70	C66–70	C66–70	C66–70	C71–75	C71–75	C71–75	C71–75	C71–75	C76–80	C76–80	C76–80
30–34	C56–60	C61–65	C61–65	C61–65	C61–65	C66–70	C66–70	C66–70	C66–70	C66–70	C71–75	C71–75	C71–75
35–39	C51–55	C56–60	C56–60	C56–60	C56–60	C61–65	C61–65	C61–65	C61–65	C61–65	C66–70	C66–70	C66–70
40–44	C46–50	C51–55	C51–55	C51–55	C51–55	C56–60	C56–60	C56–60	C56–60	C56–60	C61–65	C61–65	C61–65
45–49	C41–45	C46–50	C46–50	C46–50	C46–50	C51–55	C51–55	C51–55	C51–55	C51–55	C56–60	C56–60	C56–60
50–54	C36–40	C41–45	C41–45	C41–45	C41–45	C46–50	C46–50	C46–50	C46–50	C46–50	C51–55	C51–55	C51–55
55–59	C31–35	C36–40	C36–40	C36–40	C36–40	C41–45	C41–45	C41–45	C41–45	C41–45	C46–50	C46–50	C46–50
60–64	C26–30	C31–35	C31–35	C31–35	C31–35	C36–40	C36–40	C36–40	C36–40	C36–40	C41–45	C41–45	C41–45

bimodal, which stands counter to the hump-shaped age–income curve predicted by the life-cycle model.[8] Since various cohorts stay pooled in a given cross-section, the life-cycle component and the cohort effect remain mixed. As an economy progresses, cohorts may differ from each other due to changing education and economic opportunities and other factors. Deaton (1994, 1997) regarded these differences as a cohort effect which shifts the life-cycle age–income profile upward if each successive generation becomes better-off. If we plot the age–income profile by different cohorts, as in Figure 2, the hump shape emerges. Figure 2 also shows that the age–income profiles for different cohorts are roughly parallel to each other, especially for later cohorts. This allows us to assume fixed cohort effects in the regression model that follows.[9]

After arranging the available data in an unbalanced panel format, we can use the following regression of income to generate a complete income profile from age 20 to 64 for each cohort in our sample

$$\log Y_{it} = \mu + \alpha_1 Age_i + \alpha_2 Age_i^2 + \beta' x_t + \sum \gamma_j Cohort_j + \varepsilon_{it} \quad (3)$$

where, $i = 1, 2, ..., A$ is the the ith age; $t = 1, 2, ..., T$ is the tth year; and $j = 1, 2, ..., J$ is the jth cohort; in a balanced dataset $j = A\text{-}i+t$ and $J = A+T\text{-}1$. Further, x is a vector of variables to capture business cycle effects; and *Cohort* represents cohort dummies.[10]

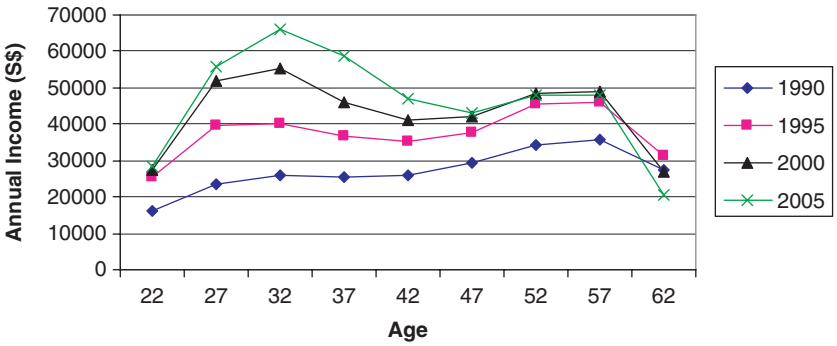

Figure 1. Age–income profile by cross-section (median quantile).

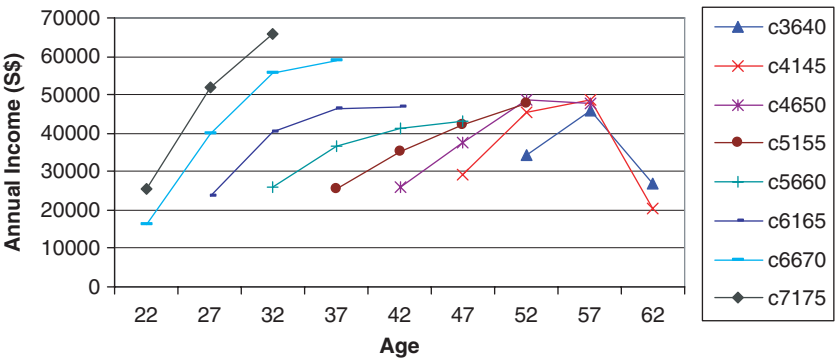

Figure 2. Age–income profile by cohorts (median quantile).

Note that equation (3) comes under what is known as the age–period–cohort (APC) analysis, especially in the medical statistics literature (Holford, 2006). A purely dummy variable approach to the three effects leads to an unidentified model because of the perfect collinearity among the three time variables (period – age = cohort). Although statistical methods are being devised to solve the identification problem (McKenzie, 2006; Yang *et al.*, 2008), Heckman and Robb (1985) argued against such mechanical approaches that disregard the underlying subject matter. In this spirit, we tried to capture the period effect that represent business cycle effects common to all households in a given period by using a composite GDP index of Singapore's trading partners and Singapore's unemployment rate as x variables in equation (3). These variables did not improve the goodness of fit of the model, so we proceeded to estimate (3) without $\beta' x_t$.

A disadvantage of having the x variables in the model is that we have to predict their future values well over 30 years to generate future income data for younger generations. The cohort coefficients, on the other hand, are easier to handle. Although they are estimated from past data, it is usually the case that young people project their income profile by looking at the income profile of their elders in similar professions. Therefore, if necessary, the cohort coefficients of the young generations can be calibrated to shift the income profile up or down to produce some scenarios of affordability for policy purposes.

For the computation of our housing affordability index, we need the lifetime income in nominal terms. However, our computations also shed light on lifetime income inequality which should be measured in real terms. We used the annual consumer price index over 1990–2007 to deflate the nominal income figures to obtain real incomes. In all, therefore, we ran six regressions to obtain our results, the three income quantiles each in both nominal and real terms. For illustrative purposes, we report some results for the median income quantile. Based on 153 observations and using the mid-points of age-groups as age, the estimated regression for median nominal income is[11]

$$\begin{aligned}\log\hat{Y} = {} & \underset{(16.3)}{5.189} + \underset{(14.8)}{0.203}\,Age - \underset{(-12.7)}{0.00193}\,Age^2 + \underset{(0.9)}{0.093}(C31-35) + \\ & \underset{(0.2)}{0.024}(C36-40) + \underset{(0.7)}{0.077}(C41-45) + \\ & \underset{(1.3)}{0.148}(C46-50) + \underset{(1.4)}{0.169}(C51-55) + \underset{(2.8)}{0.38}(C56-60) + \\ & \underset{(5.3)}{0.74}(C61-65) + \underset{(7.3)}{1.06}(C66-70) + \underset{(8.8)}{1.32}(C71-75) + \\ & \underset{(8.6)}{1.39}(C76-80) + \underset{(8.1)}{1.53}(C81-85)\end{aligned} \tag{4}$$

where, $R^2 = 0.69$, SE = 0.19, t-statistics in parentheses.

All the six regressions fit the data well with reasonably large R^2 values ranging from 0.69 to 0.83.[12] Figure 3 plots two age–income profiles for the median income group after controlling for the cohort effects. Unlike Figure 1, which shows bimodal income peaks at age-groups 30–34 and 55–59, Figure 3 shows income peaks around age 50–55. The cohort effect shows that, as the Singapore economy progressed, each successive birth cohort enjoyed a higher income profile.

Figure 3 represents three dimensions of lifetime income as pointed out by Fullerton and Rogers (1993, ch. 4). First, for example, the movement from A to B represents a pure life-cycle effect in the absence of economic growth (absence of cohort effect). Secondly, the movement from B to C represents the

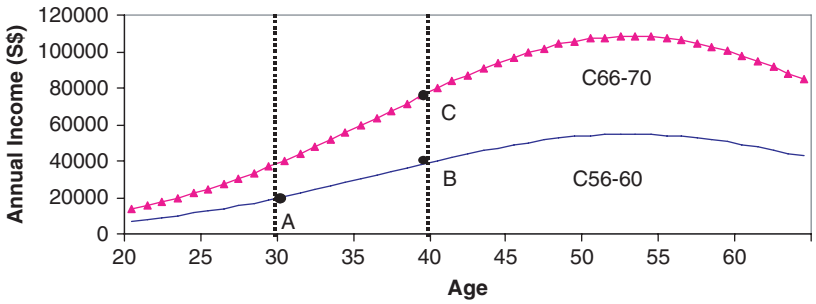

Figure 3. Life-cycle income profiles for selected cohorts (median quantile).

growth (cohort) effect. Thirdly, the movement from A to C represents the longitudinal movement resulting from the combined life-cycle and growth effects. Since we can compute the lifetime income from each curve in Figure 3, we can construct a cohort income profile that would provide us with a time-series of lifetime incomes.

After generating a complete income profile for each cohort from the regression method, we can compute the lifetime income or wealth relevant for a housing purchase as:

$$W_a = \sum_{i=a}^{A} \frac{\hat{Y}_i}{(1+r)^{i-a}} + W_{a-1} \qquad (5)$$

where, W_a is the wealth at age a for a household in a given cohort; $\hat{Y}_i$ is the estimated (expected) income at age i; and r is the discount rate.

The first term on the right-hand side of equation (5) is the discounted present value (PV) of the expected income stream from age a to A and the second term is accumulated savings at age a-1 or the initial wealth. The second term can easily be computed using the standard recursive formula

$$W_{a-1} = (1+r_{a-2})W_{a-2} + S_{a-1}$$

where, S_a represents savings and r_a is the interest rate on savings at age a. Note that when the discounted PV in equation (5) is computed, we have to use a fixed r since future interest rates are not known at age a.

We choose $a = 30$ in equation (5) as roughly the age at which a household considers housing affordability. We obtain the discounted PV of the income stream from age 30 to 64 using two discount rates, 5 per cent, which has been the average prime lending rate during the observation period, and 8 per cent; to assess the impact on affordability when the mortgage rate goes up. Although we can compute W for different choices of a, computations based at age 30 provide sufficient information for policy analysis.

With a = 30 we have to generate accumulated savings from age 20 to 29 to obtain W from equation (5). We can estimate savings of young households as $S_i = \hat{Y}_i s_i$, where s_i is the savings rate for i = 20, 21, ..., 29. Singapore has conducted a household expenditure survey since 1972/73 at five-year intervals (see DOS, 2009a). From the age–expenditure and age–income distributions published in these surveys, we can compute expenditure rates (expenditure/income) of young households for lower, middle and upper income quantiles. The savings rate is then obtained as one minus the expenditure rate. After computing the savings rates at five-year intervals over 1972/73–2007/08, we converted them to annual frequency by regressing them on the country's average propensity to save (APS = 1—C/GDP,

where C is consumption expenditure).[13] Since APS is available annually, we use the predicted values from these regressions to estimate savings rates at the annual frequency. In 1972/73 the savings rates of young households were very small (only 3 per cent for the lower income group). As a result, the predicted savings rates from APS become zero and negative when we move to years before 1970. We set the negative savings rates to zero.

The next issue is what interest rate to be used to accumulate savings. More than 70 per cent of the financial assets of Singapore households are held in currency and deposits and in the CPF (DOS, 2009b). Therefore, we use the weighted average of the interest rates for savings deposits and CPF ordinary account deposits as the appropriate interest rate. The share of currency and deposits has fluctuated around 56 per cent over the years; therefore, we use the weights 0.56 and 0.44 for the two interest rates respectively. With savings and interest rate series in hand, we can accumulate savings from age 20 to 29 by working through the recursion $W_{a-1} = (1 + r_{a-2})W_{a-2} + S_{a-1}$ by assuming $W_{19} = 0$.

Note that, because of the grouping of the income data to five-year age-intervals, our wealth measure from equation (5) provides a time-series at five-year intervals centred at the mid-year of each five-year birth cohort. Since *W* moves smoothly over time, we apply the spline interpolation method in the SAS software package to obtain a time-series of wealth at the annual frequency.

Before we proceed to constructing a housing affordability index, it would be useful to shed some light on lifetime income distribution. For this we set $a = 20$ and $A = 64$ and $r = 0.05$ in equation (5). Since earning starts at age 20, the second term on the right-hand side of equation (5) becomes zero at age 19. Figure 4 presents real lifetime income of households at different quantiles by birth year of household heads. It is interesting to see that real lifetime incomes of cohorts born before the 1960s were stagnant for all the three quantiles. With the rapid growth of independent Singapore since the 1960s, the lifetime income of later cohorts also grew rapidly. Growth of lifetime income slowed down for cohorts born after 1975. These cohorts entered their working age after the mid 1990s when the Singapore economy entered a turbulent period starting with the Asian financial crisis in 1997. What is most striking to note is that the income inequality, even when measured in terms of lifetime income (instead of the usual annual income), has not only widened but the gradients of the income profiles of the upper and lower income groups have moved in opposite directions for the cohorts born after 1975. Even for the median income category, the lifetime

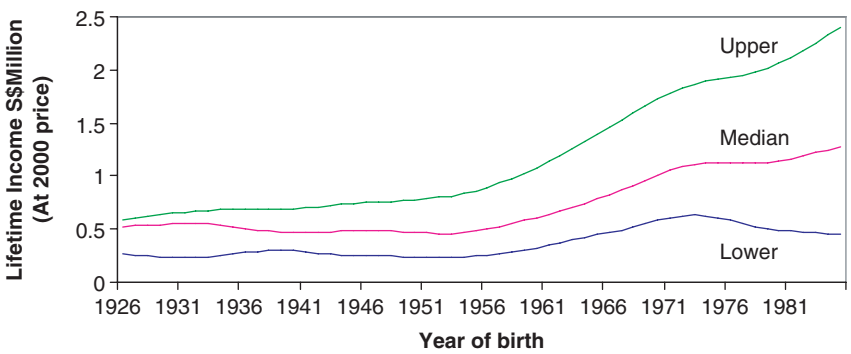

Figure 4. Real lifetime income by birth year of household head at different income quantiles.

income has not shown much growth since the Asian financial crisis.

3. The Housing Affordability Index (HAI)

We define our housing affordability index (HAI) as

$$HAI_{a,t} = \frac{W_{t-a}}{P_t^h} \tag{6}$$

where, W_{t-a} is the lifetime income or wealth (in nominal terms) expressed by the year of birth (t-a); and P_t^h is the average price of the chosen property type in year t. Since we have chosen $a = 30$, $HAI_{30,1980}$, for example, is the housing affordability index for the 30-year age-group in 1980.

There are number of points worth mentioning with regard to this index. First, even if a person buys a property at age 30, his earnings before 30 are incorporated into the index. For first-time home buyers without inherited wealth, these earnings provide the needed savings for downpayments. Therefore, the index captures not only the long-run affordability, it also captures short-run affordability.

Secondly, an increase in the index means that affordability is improving. Obviously, we can take the reciprocal of the *HAI* to obtain the portion of lifetime income spent on a house. This corresponds to the standard practice of looking at the mortgage payments to current income ratio. Since an increase in this ratio (P^h / W) means a deterioration of affordability, a graphical interpretation of the trends becomes a bit confusing.

Thirdly, not only the direction but also the magnitude of the index is meaningful. An index value of unity means that the household's lifetime income is just enough to pay for the property. However, since households need extra income for living, we have to define a value bigger than unity such that they do not fall into perpetual indebtedness by committing to properties which are beyond their means. The question is how to define an optimal cut-off point. If we can define a standard non-housing expenditure share of income that is uncorrelated with housing expenditure, then we can work out the residual lifetime income and then obtain the HAI. HAI = 1 in this case is a natural cut-off point, HAI<1 implying a housing-induced reduction of non-housing expenditure. Results in Abeysinghe and Choy (2007) indicate a strong negative correlation between housing and non-housing expenditures in Singapore; therefore, defining a standard for non-housing expenditure from observed data is difficult. In the absence of such a measure, at this stage we suggest the use of a common rule-of-thumb criterion to define a cut-off value for our HAI. In Singapore, it is common for banks to decide on home loans based on a mortgage instalment to salary ratio of 35 per cent. Despite the problem associated with this, as a rough guide we may use this ratio and define HAI>2.86 (= 1/0.35) as the affordable range. These types of cut-off value, unfortunately, provide meaningful comparisons of affordability across households only if we keep either the numerator or the denominator of the ratio fixed.

Presently, we do not have detailed data series on prices of different types of properties in Singapore. What we have are two price indices; one is the private property price index released by the Urban Redevelopment Authority since 1975 and the other is the HDB resale price index released by the Housing and Development Board since 1990. Using some starting average price levels, we can use the rate of change of these indices to construct average price series for the private and public housing sectors. For the private sector, we used an average price of S$1 308 000 in 1997 as estimated by Phang and Wong (1997) and, for the HDB resales, we used an average price of S$276 210 in 2007Q4 by taking the weighted average of prices for three-room ($197 000; 31 per cent), four-room ($273 000; 38 per

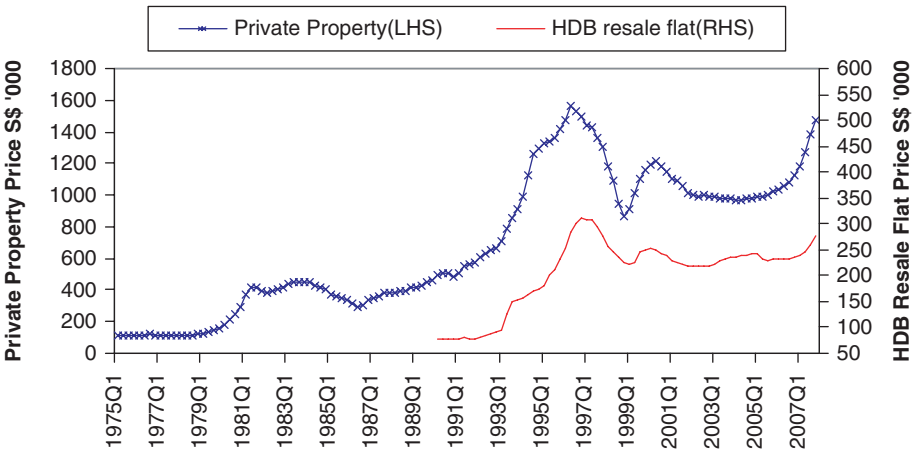

Figure 5. Average price of private housing and HDB resale flats (quarterly).

cent), five-room ($340 000; 23 per cent) and executive ($415 000; 8 per cent) flats.

Figure 5 shows the average price levels for both the private and public residential properties. Both price series follow similar trends and turning-points with a sustained large price gap of similar magnitude over the years. Since 1980, the average annual growth of private residential property prices was about 11 per cent, with prices increasing, on a year-on-year basis, by 102 per cent in 1981Q1, 47 per cent in 1994Q3 and 31 per cent in 2007Q4. The price of HDB resale flats has followed similar cycles.

Table 2 presents the HAI (ignore HAI-adjusted for the moment) by income quantiles for private and public residential properties computed for the 30-year-old age-group at the 5 per cent discount rate. Figure 6 highlights the cyclical movements of the HAI for private properties for the three income quantiles. Since the cohort income profile moves smoothly, cycles in HAI are primarily determined by the gyrations of property prices. The largest drop in HAI across income groups occurred in the early 1980s and housing affordability never recovered to the pre-1980 levels. The price bubble in the mid 1990s resulted in another substantial erosion of affordability of private property across income groups. If we use the 2.86 cut-off value mentioned earlier, the magnitude of the numbers in Table 2 indicates that private properties become unaffordable even for the first-time buyers of the 75th income percentile when property prices escalate as in the mid 1990s and in 2007. In fact, the household expenditure survey (DOS, 2009a) shows that the average monthly household income of private flat owners in 2007/08 was S$16 311 and that for landed property owners it was S$20 427. These income levels fall into the top 20 per cent and top 10 per cent income groups respectively. Therefore, the lower affordability we observe for the 75th percentile is not surprising; private properties are only for the top income groups.

The same computations in Table 2 for average-priced HDB resale flats show a much better affordability picture. Although the price bubble in the mid 1990s led to an erosion of the affordability of HDB resale flats, even for the low income group the HAI remains about 4 for average-priced flats; in other words, their lifetime income is about four times the average price of a resale HDB unit or 23 per cent of their lifetime income (see the bottom row of Table 2). It should be noted that housing grants provided by the government to qualifying low-income groups are not accounted for

Table 2. Housing affordability index for 30-year-olds by income quantile (r = 5 per cent)

	Private property						*HDB resale flats*		
	HAI			*HAI-adjusted*			*HAI*		
Year	*Lower*	*Median*	*Upper*	*Lower*	*Median*	*Upper*	*Lower*	*Median*	*Upper*
1975	2.8	5.0	8.0	—	—	—	—	—	—
1976	2.7	4.9	7.7	—	—	—	—	—	—
1977	2.7	5.0	8.1	—	—	—	—	—	—
1978	2.7	5.0	8.2	—	—	—	—	—	—
1979	2.3	4.2	7.0	—	—	—	—	—	—
1980	1.3	2.5	4.2	—	—	—	—	—	—
1981	0.8	1.5	2.6	—	—	—	—	—	—
1982	0.8	1.5	2.6	—	—	—	—	—	—
1983	0.7	1.3	2.4	—	—	—	—	—	—
1984	0.8	1.4	2.7	—	—	—	—	—	—
1985	1.0	1.8	3.3	—	—	—	—	—	—
1986	1.2	2.1	4.0	—	—	—	—	—	—
1987	1.0	1.9	3.6	—	—	—	—	—	—
1988	1.1	1.9	3.6	—	—	—	—	—	—
1989	1.0	1.8	3.4	—	—	—	—	—	—
1990	1.0	1.7	3.2	1.2	2.1	3.8	6.0	10.6	19.5
1991	1.0	1.7	3.1	1.1	2.0	3.6	6.4	11.2	20.3
1992	0.9	1.6	3.0	1.1	1.9	3.5	6.4	11.0	19.9
1993	0.8	1.3	2.4	0.9	1.6	2.9	4.5	7.8	14.0
1994	0.6	1.0	1.8	0.7	1.2	2.1	3.8	6.6	11.7
1995	0.5	0.9	1.6	0.6	1.1	1.9	3.3	5.7	10.0
1996	0.5	0.9	1.5	0.6	1.1	1.9	2.5	4.3	7.6
1997	0.6	1.0	1.8	0.8	1.3	2.3	2.6	4.5	7.8
1998	0.8	1.5	2.5	1.1	2.0	3.4	3.4	5.9	10.2
1999	0.9	1.5	2.6	1.2	2.0	3.4	3.7	6.4	11.0
2000	0.8	1.4	2.4	1.1	1.8	3.1	3.8	6.6	11.1
2001	1.0	1.7	2.8	1.3	2.2	3.7	4.4	7.6	12.7
2002	1.1	1.9	3.2	1.4	2.5	4.1	4.7	8.2	13.6
2003	1.1	2.0	3.3	1.5	2.7	4.4	4.6	8.0	13.3
2004	1.1	2.1	3.4	1.5	2.8	4.6	4.4	7.9	13.1
2005	1.1	2.0	3.4	1.4	2.7	4.5	4.4	8.2	13.7
2006	1.0	1.9	3.2	1.3	2.5	4.2	4.3	8.3	14.0
2007	0.8	1.6	2.7	1.0	2.0	3.3	3.8	7.7	13.0
Ave 1980–2007	0.9	1.6	2.9	1.1	2.0	3.4	4.3	7.6	13.1
Price–income ratio percentage, 1980–2007	111	63	34	91	50	29	23	13	8

by our income data. Disaggregated income and price data by HDB flat type are needed for a more informative analysis of the affordability of the public housing.

Adjusted HAI for Upgraders

As mentioned earlier, one important phenomenon of the Singapore property market is the upgrading from smaller HDB flats to larger HDB flats and from HDB flats to private properties (DOS, 2006). Our income data do not include capital gains from property sales (see endnote 6) and we do not have access to such data. However, we can make an adjustment to our HAI for private properties to account for the HDB-upgrader effect. Since most of the upgraders from HDB to private housing in Singapore rely entirely or largely on cash

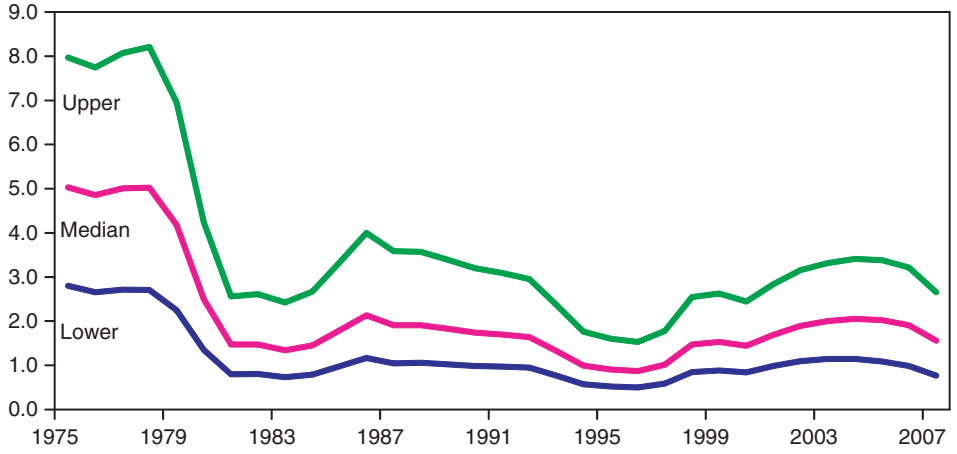

Figure 6. HAI of private property for 30-year-old age-group at different quantiles.

proceeds from the sale of HDB flats for downpayment on the private property purchase, we adjust our HAI for private properties as follows

$$HAI_{a,t}^{adj} = \frac{W_{t-a}}{P_t^{pri}\left[1-(P_t^{HDB}/P_t^{pri})\right]} \quad (7)$$

where, the relative price P_t^{HDB}/P_t^{pri} (HDB resale price to private property price ratio) captures the effect of the differential growth rate of the two price series.

The adjustment indicates that keeping lifetime income and private property price the same, an increase in resale price of HDB flats provides a bigger amount of cash for the downpayment, leaving a smaller mortgage burden for the household to finance the private property. It should be noted, however, that there is an overadjustment here. In Singapore, when a household sells its owner-occupied HDB flat in the resale market, it has to settle the outstanding loan of the flat if any, return the CPF housing withdrawals with interest and settle relevant payments before completion of the resale transaction.[14] Therefore, a household may not be able to make use of all the cash proceeds from the transaction for the downpayment on the private property. Moreover, a household is likely to settle the minimum downpayment using a portion of the cash proceeds and keep the rest for other investment purposes. As we have no way to factor in all these possibilities, our adjustment (overadjustment, rather) is only suggestive.

Table 2 also presents the results for HAI-adjusted private property for the 30-year-old group for different income quantiles. A data plot shows that, apart form the level shift which shows the wealth effect that upgraders could enjoy, the two curves share similar turning-points resulting from the co-movement of property prices in the private and public sectors. It is worth noting that even the HAI-adjusted values have been below the 2.86 guide limit for the middle-income earners. Even for the upper-income group, affordability deteriorated in the mid 1990s. This implies that rapid escalation of both private and public property prices does not necessarily make the upgraders better off.[15]

4. Conclusion

As we have seen in this exercise, meaningful measures of housing affordability are obtained when we compare house price with lifetime income or mortgage payments with permanent

income. Despite the emphasis in the literature on the importance of focusing on long-run income measures, housing affordability is usually assessed based on short-run measures that compare mortgage payments or house price with current incomes. Difficulty of computing lifetime income due to data constraints has been the main reason for not venturing into long-run measures of housing affordability.

Many developed countries publish survey-based data on household income by age of household heads. Based on these data for Singapore, we have presented a regression procedure to predict the entire income profile over the working life of different birth cohorts. We have then presented a procedure to obtain lifetime income or wealth for each birth cohort as the discounted present value of the future income stream plus accumulated savings at the age at which a house purchase occurs. We measure housing affordability by the ratio of lifetime income to house price so that the increase in the index implies improving affordability. This measure is likely to be better than the ratio of mortgage payments to permanent income because the monthly mortgage payment can be reduced by increasing the amortisation period that does not amount to improved affordability in the long run. Although our focus is on long-run housing affordability, our measure of wealth also takes into account the short-run affordability through accumulated savings. Despite the initial computational involvement, the procedure can easily be automated for ready updating of the affordability index.

Our estimates of lifetime income in Singapore for three income quantiles show that even the lifetime income inequality has been increasing rapidly, especially since the Asian financial crisis. In fact, despite the substantial growth of the economy, the lower income quantile has seen a drop in their real lifetime income. As for housing affordability, our index shows that past episodes of house price escalation have led to a substantial erosion of housing affordability.

A natural question to ask then would be, with more than 90 per cent homeownership (both public and private), why should there be any concern about property price escalations if higher prices mean higher wealth for Singaporeans? Although there is no question that a higher price means a higher value of the housing stock, how this translates into a 'wealth effect' is what matters for the aggregate economy. Abeysinghe and Choy (2007) have examined in detail the wealth effect of property prices on consumption in Singapore and found that the wealth effect is very much absent. In the absence of cheaper suburbs which offer quality living, the only way for Singapore residents to unlock property values is, apart from emigrating, to downgrade to smaller units. This does not seem to be happening extensively (DOS, 2006) and explains why the 'housing wealth effect' on consumption is insignificantly small. Instead, Abeysinghe and Choy (2007) observe the presence of a negative and significant 'price effect' of house-price escalations on consumption expenditures, leading to a fall in the average propensity to consume (see also Ludwig and Slok, 2002; Phang, 2004). This fall is present even in the different income quantiles that we examined in this exercise to compute the savings rates. With the 99-year lease system, even the bequest value of higher property prices is likely to be dominated by the negative 'price effect'.

Overall, there seems to be a 'paradox of housing price' in operation here. If in aggregate the 'price effect' of high property prices outweighs the wealth effect, it is important that property prices do not escalate to erode housing affordability. The average growth rate of lifetime income for cohorts born after 1960 for the median quantile has been about 4–5 per cent which has also been the average growth rate of per capita disposable income

since 1975. Property prices should fall in line with this trend. Although it is difficult to avoid property price cycles, policies could be devised to reduce the amplitude of these cycles. In this regard, it is worth questioning why one should let the private housing market—that accounts only for about 20 per cent of the housing stock—dominate the price trends of the entire housing market and erode housing affordability.

Notes

1. It is common in Singapore to use the term 'public housing' to refer to public-sector-provided flats owned by private individuals. These flats are built by the government and sold to Singaporeans at subsidised rates, but subject to a 99-year lease term. The main government agency responsible for public housing is the Housing and Development Board (HDB).
2. The HDB concessionary mortgage rate is pegged at 0.1 per cent above the Central Provident Fund Ordinary Account interest rate. In 2008, the HDB concessionary interest rate was 2.6 per cent, 3 points lower than the average interest rate of banks and financial companies on housing loans for 15 years (www.hdb.gov.sg; www.mas.gov.sg). As of 2008, to be eligible for the HDB concessionary loan, monthly household income should not have exceeded S$8000.
3. The demand for HDB resale flats arises primarily from those households who cannot afford private housing, who do not qualify for new HDB flats, who want to avoid the long waiting time for a new HDB flat and who are concerned about the location.
4. A review of literature on various social and macroeconomic consequences of homeownership can be found in Dietz and Haurin (2003).
5. Note that the main objective of Gan and Hill (2009) was to offer another affordability index based on a criterion similar to value-at-risk. An informal exercise that tries to use permanent income to measure housing affordability in the UK can be found at: http://boards.fool.co.uk/Message.asp?mid=11698976.
6. The (gross) income data defined in the household expenditure survey refer to regular income from work or employment, as well as income received from rental, investment (for example, interest and dividends) and other sources such as pensions and cash contributions received from relatives. Irregular or extra-ordinary receipts like proceeds from sale of properties, or one-off payments such as lump-sum CPF withdrawals, insurance claims and Economic Restructuring Shares from the government, as well as rebates and waivers on rent and utilities for HDB flats are not included.
7. Note that many developed countries publish income by age annually; therefore, our methodology is not constrained by the data. Although Singapore does not publish these data, they can be obtained from the Department of Statistics on a regular basis.
8. The bimodal income pattern in a cross-section is likely to result from women withdrawing from the labour force or taking no-pay leave during child bearing and rearing years.
9. We provide plots for the median quantile only because the three income quantiles share similar shapes.
10. Going by the standard practice, we use log Y to reduce heteroscedasticity and skewness of income data and also to provide coefficients that represent the growth effect on income. The quadratic age function is well justified by the observed hump shape of the age–income profile (see Attanasio and Browning (1995) and Attanasio and Guglielmo (1995) for the hump shape in UK and US income data respectively).
11. Note that, in order to have more observations for age-groups, we interpolated 1991–94 values assuming constant income growth rates. We did not do the same for 1996 because of the distorted growth rates resulting from the Asian financial crisis in 1997.
12. Given the nature of the data and the type of regression, a residual analysis for diagnostics will be of little help in this case.
13. These disaggregate savings rates and APS show a close correspondence. The R^2 values for lower, middle and upper income regressions were 0.82, 0.87 and 0.94 respectively.
14. According to DOS (2006), in 2005 about 85 per cent of those who shifted to larger units had

outstanding HDB loans exceeding $100 000. Relevant payments include an upgrading cost, applicable for the HDB flats that are affected by HDB's Main or Lift Upgrading Programme and an upgrading levy, applicable to the flats in an upgrade precinct.

15. We do not report the results at the 8 per cent discount rate to conserve space. The results show that the average HAI values over 1980–2007 remain above 3 for HDB flats and that for private properties fall to an unaffordable value of 2.3, even for upgraders.

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