Home affordability equations

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1 Introduction

This document outlines the assumptions and calculations for a very simple housing affordability model. The only input of the model is the Local Government Area (LGA) of residence. The output is the maximum price of a property that can be afforded for each year in the future. This output is extended with predicted median house price for each LGA for t years in the future, and whether that price is below the maximum affordable price.

The goal of the model is to reflect the inequity between geographies rather than to give an accurate prediction based on specific personal circumstances. As such, the assumptions chosen intend to reflect the typical (median) circumstances for individuals looking to purchase a home.

2 Assumptions

We assume all home buyers are couples and have not yet started saving for a deposit. LGA_α denotes the LGA of residence for the hypothetical "median" buyer, while LGA_β denotes the LGA for purchase consideration.

2.1 Household income and expenses

Household income is modelled on personal gross income for each LGA data from 2013-2017 by ABS[1]. Individuals around the age of 30 tend to earn more than the median income, and that income is expected to grow as become more senior in their careers. To reflect this, the personal gross income is scaled by 1.17x and projected to grow 0.56% year-on-year.

To lower the bar for the hypothetical first home buyers, we assume they will be purchasing with a partner. For 85% of couples in NSW, both individuals are income earners. We will estimate household income for a couple by 1.85x the personal income.

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[1]Household Expenditure Survey, Australia: Summary of Results

Household income $\mathrm{HI}(T, \mathrm{LGA}_\alpha)$ in LGA LGA_α t year after 2021 is

$$\mathrm{HI}(t, \mathrm{LGA}_\alpha) := 1.17 \cdot 1.85 \cdot \mathrm{MI}(\mathrm{LGA}_\alpha) \cdot (1 + 0.0056 + r_g(\mathrm{LGA}_\alpha))^t \qquad (1)$$

To calculate disposable income (gross income less income tax, Medicate Levy, HECS debt) for each LGA, a blanket effective tax rate of 17.96% is applied. This is calculated from median gross and disposable incomes of couples aged 35 years or below from the 2015-16 Household Expenditure Survey.

We assume the couples spend 85% of their disposable income and the remaining 15% is put into savings. 15% is estimated as the rough midpoint between the household saving ratio across Australia in March 2021 is 11.6% and the ratio for couples aged 35 years or below in NSW is 21.1% in 2016. We assume savings accrue an interest rate of 1% per annum, inline with typical savings account interests currently.

Household savings $\mathrm{HS}(t, \mathrm{LGA}_\alpha)$ in LGA LGA_α t year after 2021 is

$$\mathrm{HS}(t, \mathrm{LGA}_\alpha) := \sum_{s=0}^{t} \mathrm{HI}(s, \mathrm{LGA}_\alpha) \cdot (1 - r_t) \cdot (1 - r_E) \cdot 1.01^s \qquad (2)$$

The *net income surplus* (NIS) is a metric used to access loan capacity of the buyer's cashflow. It is defined as net disposable income less expenditures, exclusive of rent. In this model, rent is estimated by current housing costs for couples aged 35 years or below in NSW.

$$\mathrm{NIS}(t, \mathrm{LGA}_\alpha) := \mathrm{HI}(t, \mathrm{LGA}_\alpha) \cdot (1 - r_E + r_R) \qquad (3)$$

2.2 Housing market

Houses in NSW have an average annual growth rate of 6.8% over the last 25 years. The future property prices for all LGA is projected with a flat rate $r_P = 6.8\%$.

The median price $\mathrm{HP}(t, \mathrm{LGA}_\beta)$ for a house in LGA_α in t years from 2021 will be

$$\mathrm{HP}(t, \mathrm{LGA}_\beta) := \mathrm{MHP}(\mathrm{LGA}_\beta) * (1 + r_P)^t \qquad (4)$$

2.3 Home loan

For maximum affordability (minimum monthly repayment), we will assume home loan has a 30 year tenure. Since there is no easy way to predict future interest rates, we will assume that home loan interest is fixed at 3% for the duration of the loan.

3 Price of the most expensive property a buyer can afforded

3.1 What is the maximum price for which you can afford the 15% deposit needed?

$$\text{MaxPrice}_{\text{deposit}}(t, \text{LGA}_\alpha) = \text{HS}(t, \text{LGA}_\alpha)/0.15 \tag{5}$$

3.2 What is the maximum price for which you can afford the monthly repayments?

To calculate monthly repayments, we assume a fixed rate mortgage and use the following formula, which relates the interest rate r, length of repayment period N and principal P to the monthly repayment amount c

$$c = \frac{r(1+r)^N}{(1+r)^N - 1}P \tag{6}$$

Suppose that the household dumps its entire NIS into the monthly repayments, and we assume the fixed interest rate 3% and repayment period 30 years. The the above formula gives

$$\text{NIS}(t, \text{LGA}_\alpha) \cdot \frac{(1.03^{30} - 1)}{0.03 \cdot 1.03^{30}} = P \tag{7}$$

Then, to calculate P, we have

$$\text{MaxPrice}_{\text{repayment}} - \text{HS}(t, \text{LGA}_\alpha) = P \tag{8}$$

so we get

$$\text{MaxPrice}_{\text{repayment}} = \text{HS}(t, \text{LGA}_\alpha) + \text{NIS}(t, \text{LGA}) \cdot \frac{(1.03^{30} - 1)}{0.03 * 1.03^{30}} \tag{9}$$