Public Housing in Singapore: Determining Demand and Supply Factors and their Effects on Resale Prices by Coefficient Analysis

Background & Aim

- Ranked the **2nd most expensive** city globally
- **Housing cost** major contributor to rising cost of living

Public housing, managed by the state's Housing and Development Board (HDB), holds more than 80% of Singapore residents.

HDB Flat Types

1 Rm	2 Rm	3 Rm	4 Rm	5 Rm	Executive	Multi-generatioal

This study aims to

- account for trends in the **real median resale flat prices** using the Demand-Supply framework
- Conduct multiple sets of **Pearson's correlation** tests by flat type from 1990-2020
- Determine which significant factors of demand and supply affect the demand, supply and hence prices of resale flats in Singapore

Methodology

To determine demand and supply factors and the effects of demand and supply on resale prices, we use **Pearson's correlation**. The variables considered can be found in the table of variables in the appendices.

Hypothesis testing with Pearson's correlation:

- Data for analysis were obtained from publicly available datasets (e.g. from official government websites)
- Most variables had 31 years of data from 1990-2020 available (n=31), with the exceptions of real median monthly income of the whole state (n=26) and real median resale prices of multi-generation flats (n=30)

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 (y_i - \bar{y})^2}}$$

where:
- x_i, y_i are the individual sample points indexed with i
- $\bar{x} = \frac{1}{n}\sum x_i$ (the sample mean), and analogously for $\bar{y}$
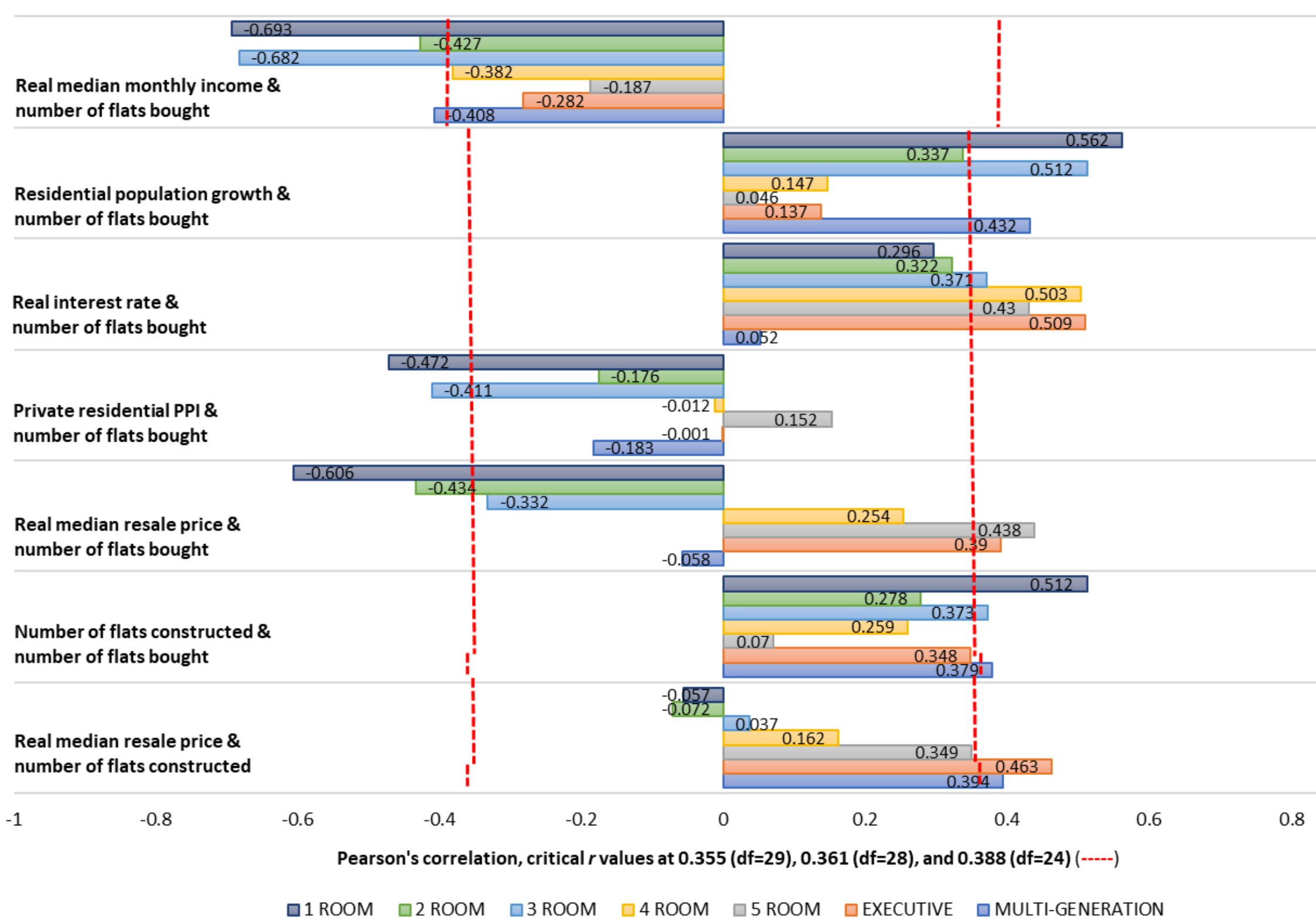- n is the sample size

The degree of freedom for Pearson's correlation is defined as: $df = n - 2$

The critical value for r, rcritical, is defined as: $r_{critical} = \frac{t}{\sqrt{n - 2 + t^2}}$, where t is the critical value for t - a "cut-off point" on the t distribution

Results & Discussion

Correlation tests to determine significant factors of demand, supply, and prices of resale flats:

- We reject the null hypothesis that there is no significant correlation between two variables at the 5% level of significance if |r| >= rcritical (which is denoted as the red dashed line)

Pearson's correlation, critical *r* values at 0.355 (df=29), 0.361 (df=28), and 0.388 (df=24) (-----)

Legend: 1 ROOM, 2 ROOM, 3 ROOM, 4 ROOM, 5 ROOM, EXECUTIVE, MULTI-GENERATION

- **Income effect**, whereby higher-income households prefer larger flats or private housing to otherwise smaller resale flats
- As Singapore's population growth is slowing, we expect future demand to chill
- Economic growth is a **confounding variable**, higher interest rates in booming economies
- Rising price associated with decrease in demand, income as a confounding variable
- 1/2-room flats are **inferior goods**; 5-room & executive flats are **normal goods**
- Fall in demand for 1/3-room & multi-generation prompted reduced construction
- Interestingly, prices increase with greater supply of executive & multi-generation

PPI refers to property price index. Each resale flat room type was examined separately.

Conclusion

Significant evidence that income, population growth, interest rates, and private property prices had either positive or negative correlations with the rising prices of resale flats in Singapore for certain flat types. We also found that for certain flat types, demand-supply, demand-price, and supply-price interactions were significant.

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Appendices

1. Consumer price index from 1990 to 2020 (Singapore Department of Statistics)
2. Median monthly household income from work including employer CPF contributions from 1990 to 2020 (Singapore Department of Statistics)
3. Number of flats constructed from 1990 to 2017 (Data.gov.sg)
4. Number of flats constructed from 2011 to 2020 (Statista)
5. Private residential property price index from 1990 to 2019 (Data.gov.sg)
6. Private residential property price index from 2009 to 2020 (Statista)
7. Real interest rate from 1990 to 2020 (World Bank Group)
8. Resale flat prices from 1990 to 2020 (Data.gov.sg)
9. Resident population growth from 1990 to 2020 (Singapore Department of Statistics)

Variables	Flat type	r	$\pm r_{critical}$
Real median monthly income & number of flats bought	1 room	-0.693	-0.388
	2 room	-0.427	-0.388
	3 room	-0.682	-0.388
	Multi-generation	-0.408	-0.388
Residential population growth & number of flats bought	1 room	0.562	0.355
	3 room	0.512	0.355
	Multi-generation	0.432	0.355
Real interest rate & number of flats bought	3 room	0.371	0.355
	4 room	0.503	0.355
	5 room	0.430	0.355
	Executive	0.509	0.355
Private residential PPI & number of flats bought	1 room	-0.472	-0.355
	3 room	-0.411	-0.355
Real median resale price & number of flats bought (demand)	1 room	-0.606	-0.355
	2 room	-0.434	-0.355
	5 room	0.438	0.355
	Executive	0.390	0.355
Number of flats constructed & number of flats bought	1 room	0.512	0.355
	3 room	0.373	0.355
	Multi-generation	0.379	0.361
Real median resale price & number of flats constructed (supply)	Executive	0.463	0.355
	Multi-generation	0.394	0.361

n	df	$t_{critical}$	$r_{critical}$
26	24	2.064	0.388
30	28	2.048	0.361
31	29	2.045	0.355