



To buy or not to buy?



# Macro-prudential Policies Post-crisis

- ▶ Monetary policy became a “blunt tool”
- ▶ Central banks turned to macro-prudential policies
  - ▶ e.g. loan-to-value ratio, stamp duties, etc
  - ▶ mostly aimed at housing market
- ▶ Objectives of MPPs
  1. to promote the resilience of the financial system by mandating higher levels of liquidity, capital and collateralisation
  2. to restrain the build-up of financial imbalances by slowing credit and asset price growth

# Movements in house prices

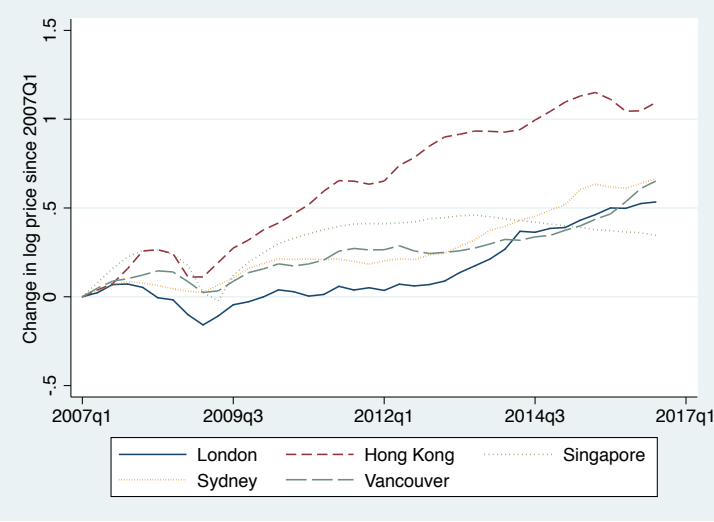


Figure: House price movements in major cities since 2007.

## How does macro-prudential policies work?

- ▶ Lean against the wind (Zhang and Zoli 2016)
- ▶ Discretion vs rule (Kuttner and Shim 2016)
- ▶ House price indices still show upward trends

# Monetary vs macro-prudential policies

- ▶ Interest rate affects consumption and investments
  - ▶ hence the inflation
- ▶ LTV, DSTI ratios affect demand for loans
  - ▶ affect the demand for housing only indirectly
  - ▶ hence the house price more indirectly

# Inelastic housing demand

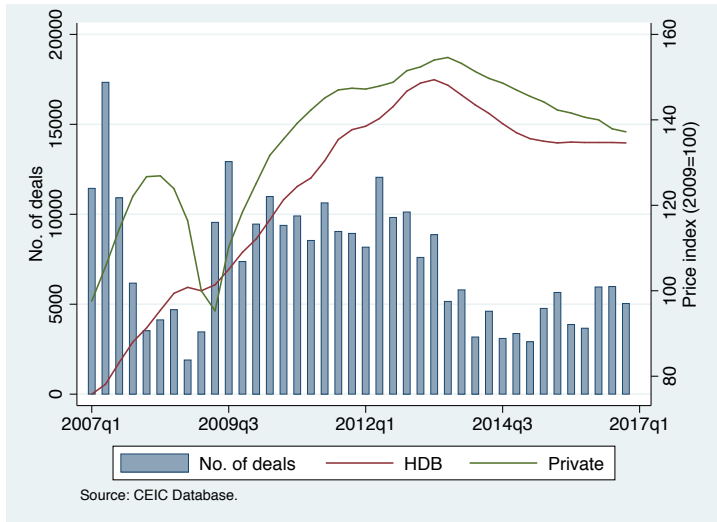


Figure: No. of deals and property price indices.

# Outline

- ▶ Motivation
- ▶ Singapore's context
- ▶ Methodology and data
- ▶ Results
- ▶ Conclusion



# Singapore's housing market

- ▶ Public housing sector is dominant (Phang 2001)
  - ▶ Singapore citizens can afford their first homes
- ▶ Prone to foreign speculation (Chow and Xie 2016)
  - ▶ Free mobility of capital in and out of the real estate sector
  - ▶ Foreign investors have freedom in acquiring private properties in Singapore
- ▶ Challenge to policy makers
  - ▶ Housing market needs to remain attractive to investors
  - ▶ At the same time affordable to local residents and fundamentally healthy

# Cooling measures in Singapore

## Cooling Measures vs. Non-Landed Private (NLP) Overall SPI

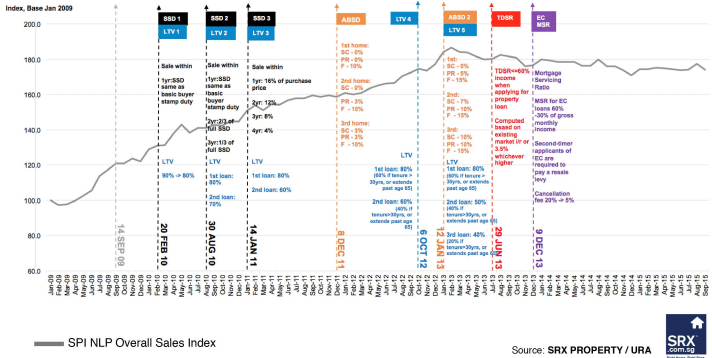


Figure: Cooling measures and private property price index.

# Cooling measures in Singapore

## Cooling Measures vs. HDB Resale SPI vs. HDB Resale Volume

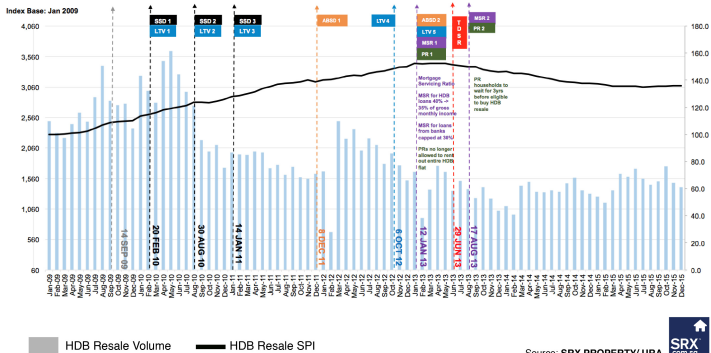


Figure: Cooling measures and private property price index.

# Data

- ▶ SRX data for private and HDB transactions spanning from Jan 1, 2007 to Jun 30, 2016
  - ▶ Price
  - ▶ Size
  - ▶ Geo-location
  - ▶ Property type
- ▶ Monthly consumer price index from the CEIC Database
- ▶ We calculate the log real price per square foot

# Sampling periods

Table: Sampling periods.

s	Period	Date
0	Before cooling measures	Jan 1, 2007 – Sep 13, 2009
1	During cooling measures	Sep 14, 2009 – Dec 9, 2013
2	After cooling measures	Dec 10, 2013 – Jun 30, 2016

# Hypothesis testing

- ▶ For a total of  $S$  sampling periods, we define  $\tau$  the conditional quantile  $Q_s(\tau|\mathbf{x})$  of the log real house price psf  $Y_s$  at period  $s$  on the geo-location  $X = \mathbf{x}$ :

$$P[Y_s \leq Q_s(\tau|\mathbf{x}) | X = \mathbf{x}] = \tau \quad (1)$$

- ▶ Null hypothesis:

$$H_0 : Q_s(\tau|\mathbf{x}) = Q_{s'}(\tau|\mathbf{x}) \quad (2)$$

for all  $s \neq s'$ .

- ▶ Acceptance of the null hypothesis implies stable house prices across the two periods

# Uniform confidence bands (Chao et al. 2017)

- ▶ Bootstrapped simultaneous confidence bands
- ▶ For each period, and at location  $\mathbf{x}$ , we compute an estimator of  $Q_s(\tau|\mathbf{x})$  by

$$\hat{Q}_s(\tau|\mathbf{x}) = \arg \min_{q \in \mathbb{R}} \sum_{i=1}^{n_s} K_{h_s}(\mathbf{x} - X_i^s) \rho_{\tau}(Y_i^s - q) \quad (3)$$

# Uniform confidence bands

- ▶ Härdle, Ritov, and Wang 2015 and Chao et al. 2017
- ▶ The simultaneous confidence set with nominal level  $\alpha$ :

$$\mathcal{C}_s(\mathcal{X}_0) := \left\{ (\mathbf{x}, q) \in \mathcal{X}_0 \times \mathbb{R} : q \in \left[ \hat{Q}_s(\tau|\mathbf{x}) \pm c_{\tau,n} \xi_{\alpha}^* \right] \right\} \quad (4)$$

where  $c_{\tau,n}$  is the scaling factor

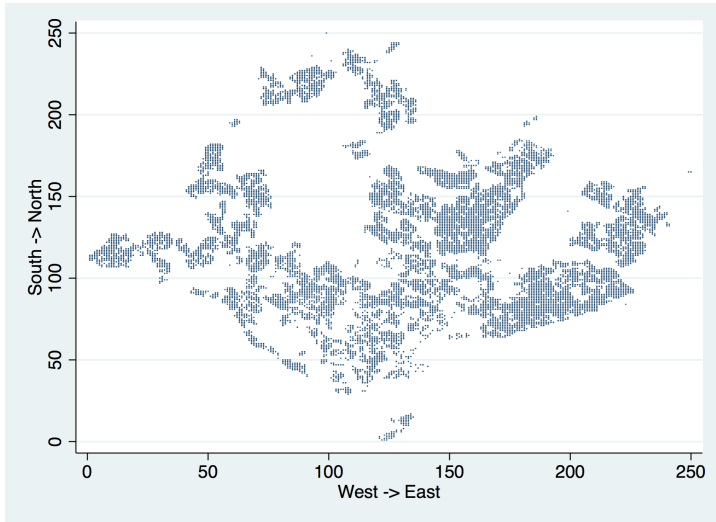
$$c_{\tau,n} := \sqrt{\frac{\tau(1-\tau)}{n_s |h_s| \hat{f}_{X^s}(\mathbf{x}) \hat{f}_{Y^s|X^s}^2(\hat{Q}_s(\tau|\mathbf{x})|\mathbf{x})}} \quad (5)$$

- ▶ The null hypothesis is rejected when two confidence sets ( $s \neq s'$ ) are disjoint:

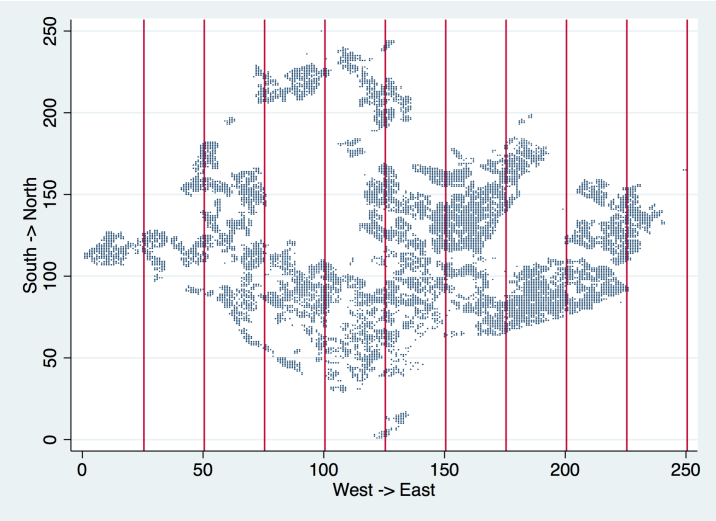
$$\mathcal{C}_s(\mathcal{X}_0) \cap \mathcal{C}_{s'}(\mathcal{X}_0) = \emptyset \quad (6)$$



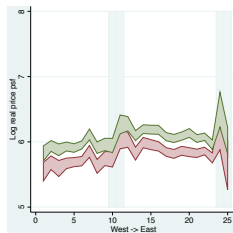
# A $250 \times 250$ grid of Singapore



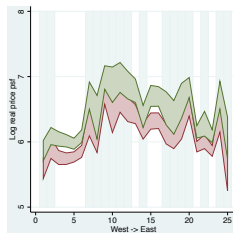
# From west to east



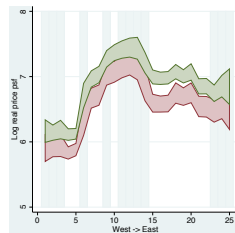
# Price dynamics: West to east



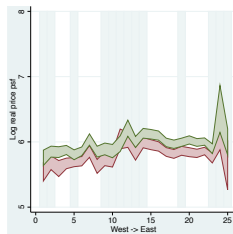
(a)  $s = 1, \tau = 20\%$



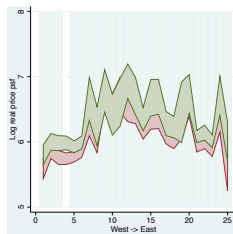
(b)  $s = 1, \tau = 50\%$



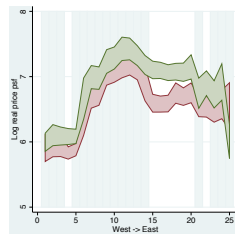
(c)  $s = 1, \tau = 80\%$



(d)  $s = 2, \tau = 20\%$

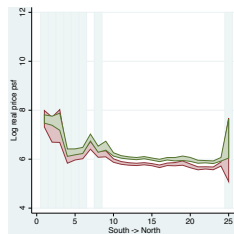


(e)  $s = 2, \tau = 50\%$

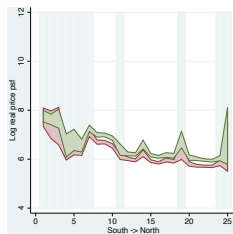


(f)  $s = 2, \tau = 80\%$

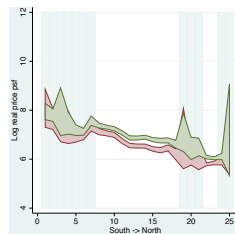
# Price dynamics: South to north



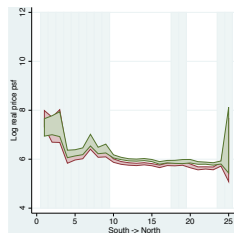
(g)  $s = 1, \tau = 20\%$



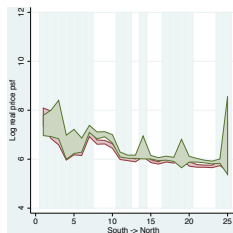
(h)  $s = 1, \tau = 50\%$



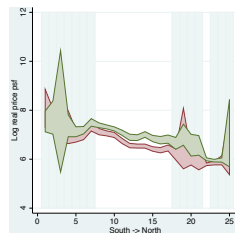
(i)  $s = 1, \tau = 80\%$



(j)  $s = 2, \tau = 20\%$

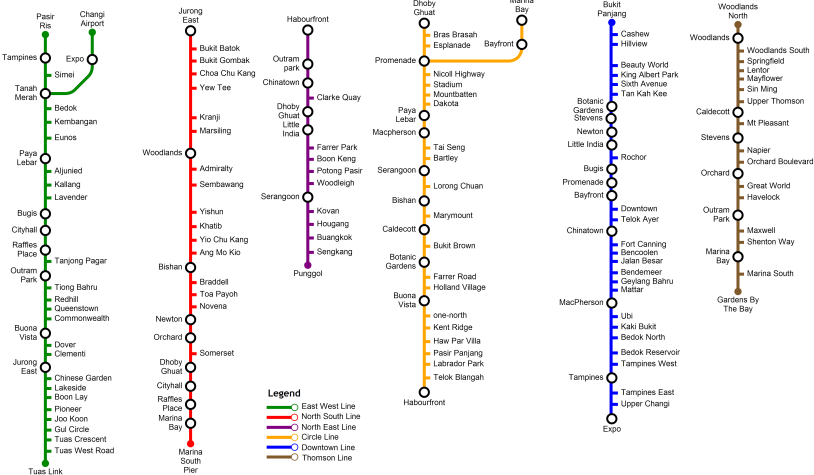


(k)  $s = 2, \tau = 50\%$



(l)  $s = 2, \tau = 80\%$

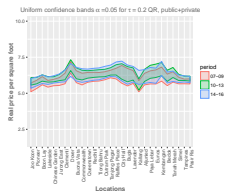
# MRT stations in Singapore



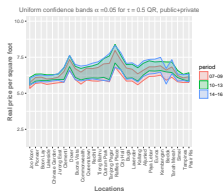
# Neighbourhood of an MRT station: Toa Payoh



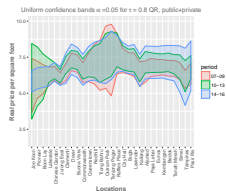
# Price dynamics: EW line



(m)  $\tau = 20\%$

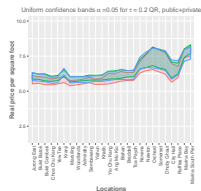


(n)  $\tau = 50\%$

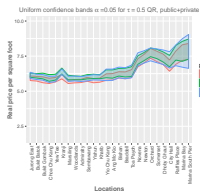


(o)  $\tau = 80\%$

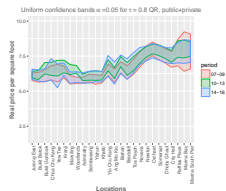
# Price dynamics: NS line



(p)  $\tau = 20\%$



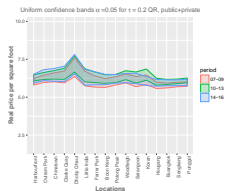
(q)  $\tau = 50\%$



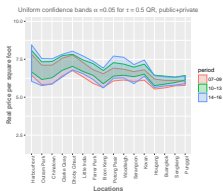
(r)  $\tau = 80\%$



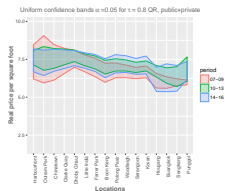
# Price dynamics: NE line



(s)  $\tau = 20\%$



(t)  $\tau = 50\%$



(u)  $\tau = 80\%$

# Findings

- ▶ Cooling measures are more likely to suppress demand for loans, not for housing
- ▶ We observe a pattern of substitution effect down the price distribution
- ▶ Prices of the high-end houses are cooled first
- ▶ Prices at the lower percentiles respond to cooling measures with lags

# Upcoming plan

- ▶ Use different independent variables:
  - ▶ E.g. distance from MRT stations
- ▶ Use specific policy tools as independent variables:
  - ▶ LTV ratio
  - ▶ Debt servicing ratio
  - ▶ Stamp duties

Thank you!

# References I

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