ETH zürich

Analysis of Real Estate Bubbles in Eight Residential Markets

Testing for econometric regime shifts and concordance indicators using fundamental based methods

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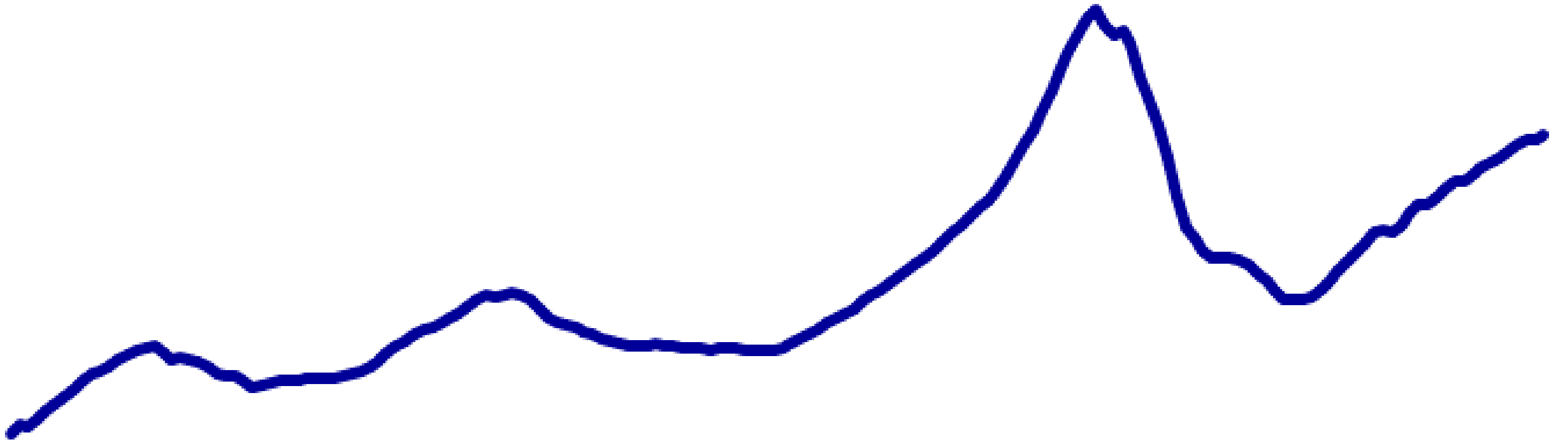
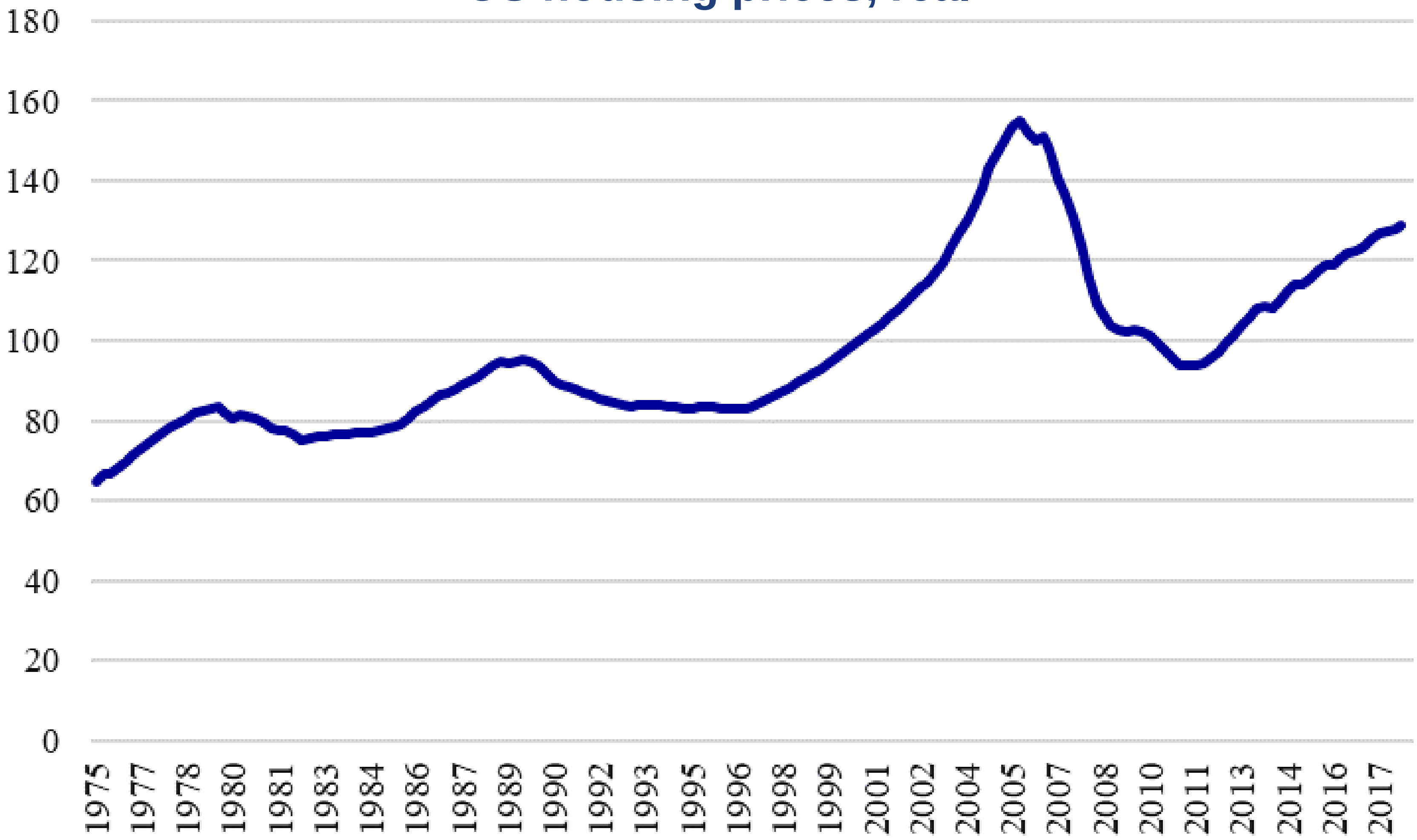
Entrepreneurial Risks D MTEC

Research focus



Research focus

US housing prices, real



Source: Bank of International Settlements (2019)

Entrepreneurial Risks D MTEC

Research questions

- How can we identify a housing price bubble with fundamentals?
- Which (out of eight) countries show such regimes?

Relevance
Systemic Risk

- Housing stores
- Private wealth
- Mortgage debt

Price corrections have impacts on…

- Defaults
- Creditor liquidity
- The wider economy (spill-overs)

Relevance
in Switzerland

- **SNB Financial Stability Report (2018)**

[…] has resulted in imbalances on the mortgage and residential real estate markets.

- Mortgage debt at over 1’000 bio. CHF
- Vacancy rates in residential investment properties at high levels

- **Swiss Bankers Association (March 2019)**

[…] considering [more] amandments to self-regulation

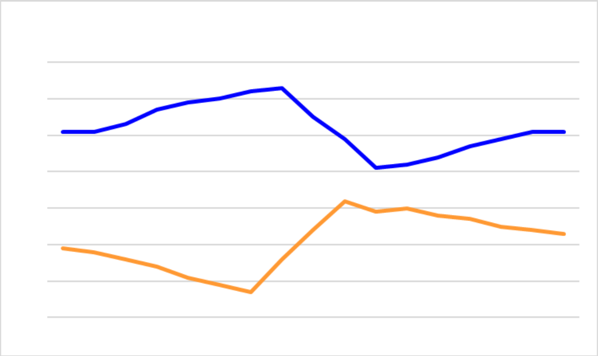
Previous work focused on Error Correction Models

- Review of various **econometric papers** on housing prices in different countries
- Works of Anundsen (2013) found **bubble regime** for the US
- **Not yet used** for other countries
- **Error Correction Models & Cointegration** Assuming that prices adjust to a long term equilibrium with fundamentals

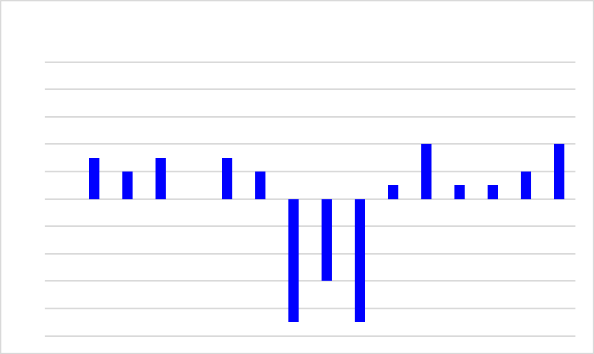
Previous work focused on Error Correction Models

Prices

User cost of housing



Levels

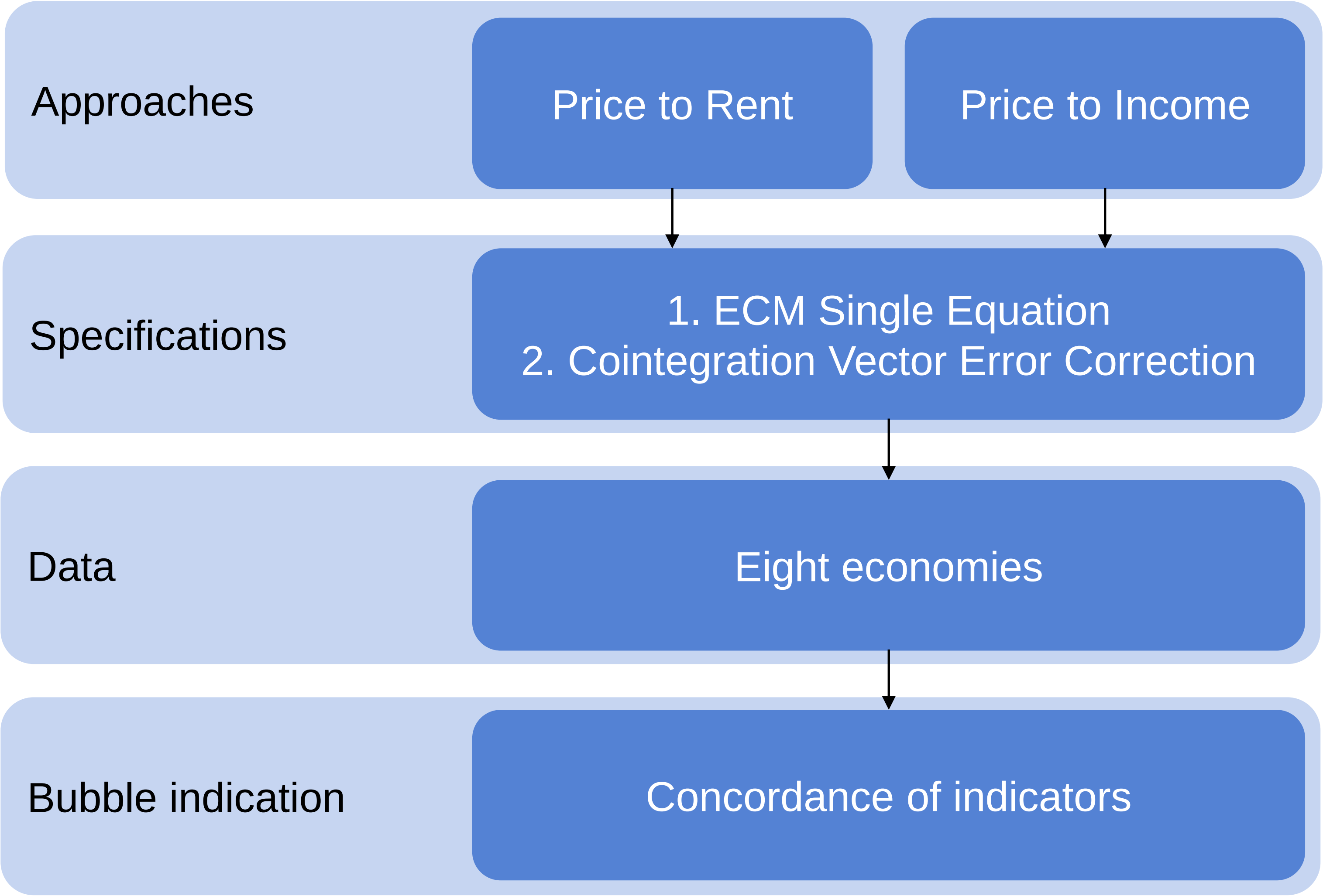


Differences

Prices and
User cost
are cointegrated

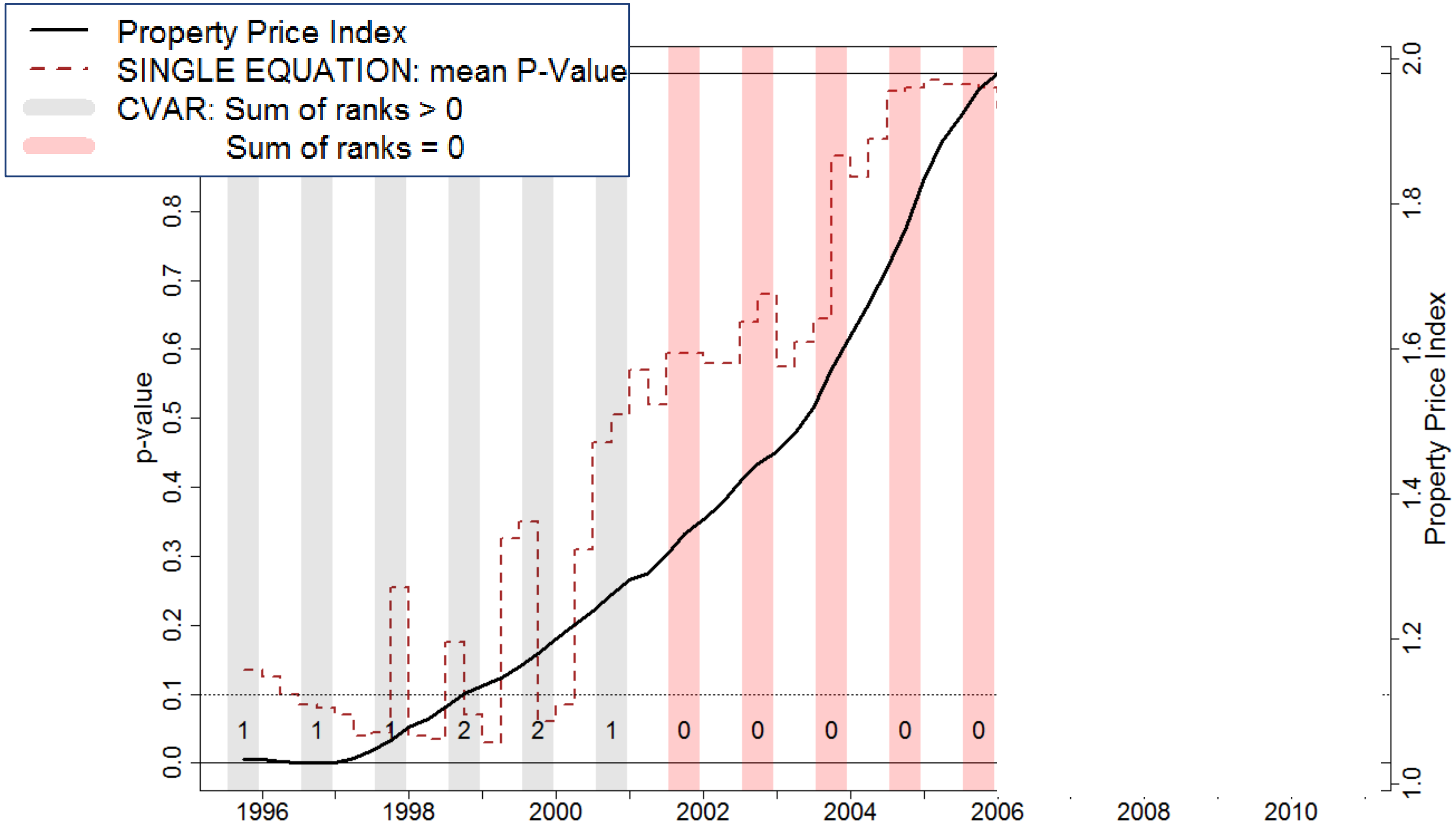
Cointegration

Methodology

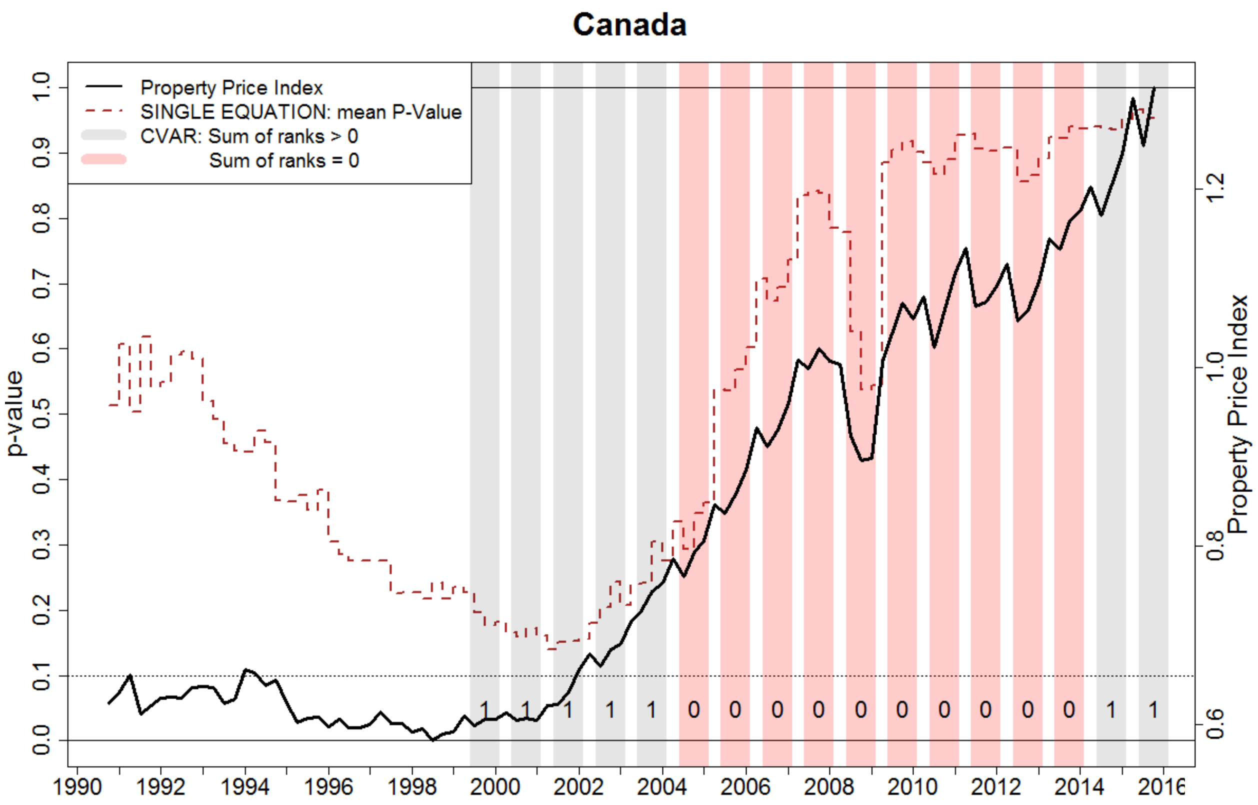


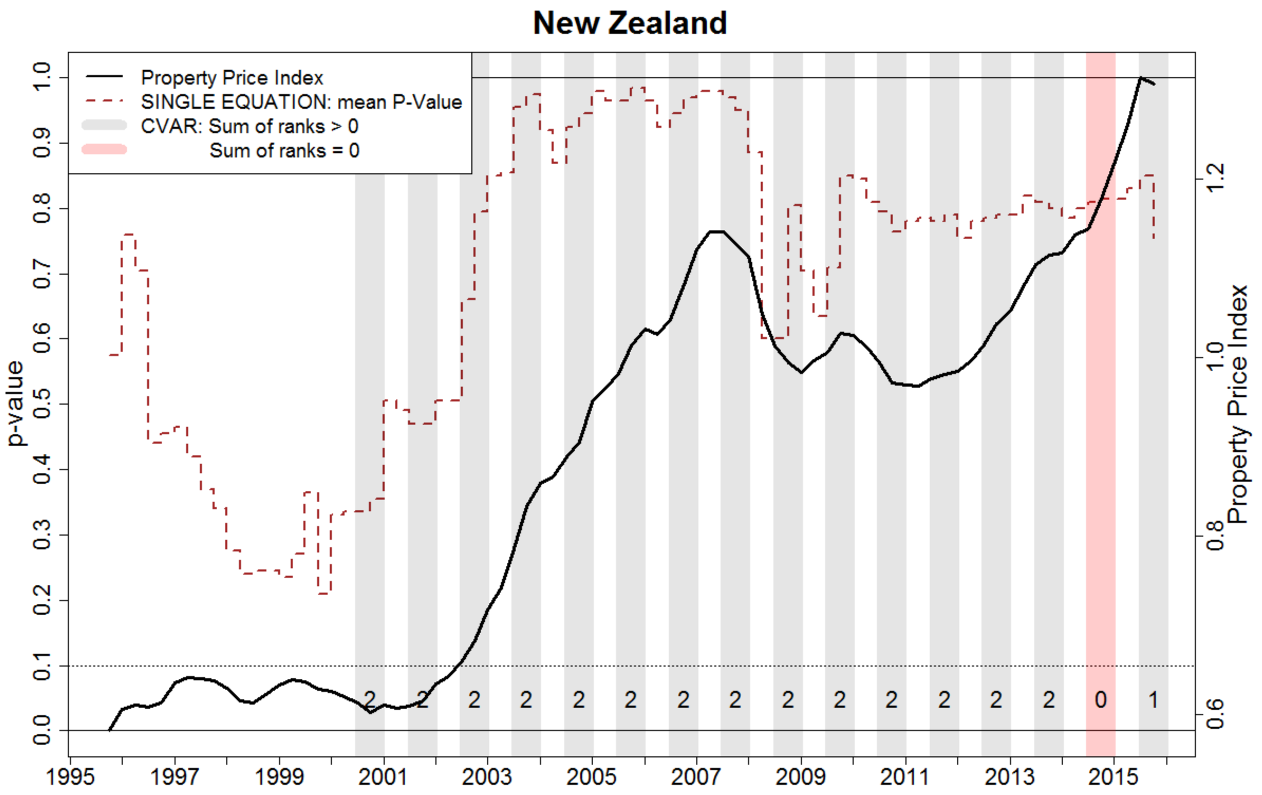
Results for the US

- Concordant bubble regime between 2002 and 2009

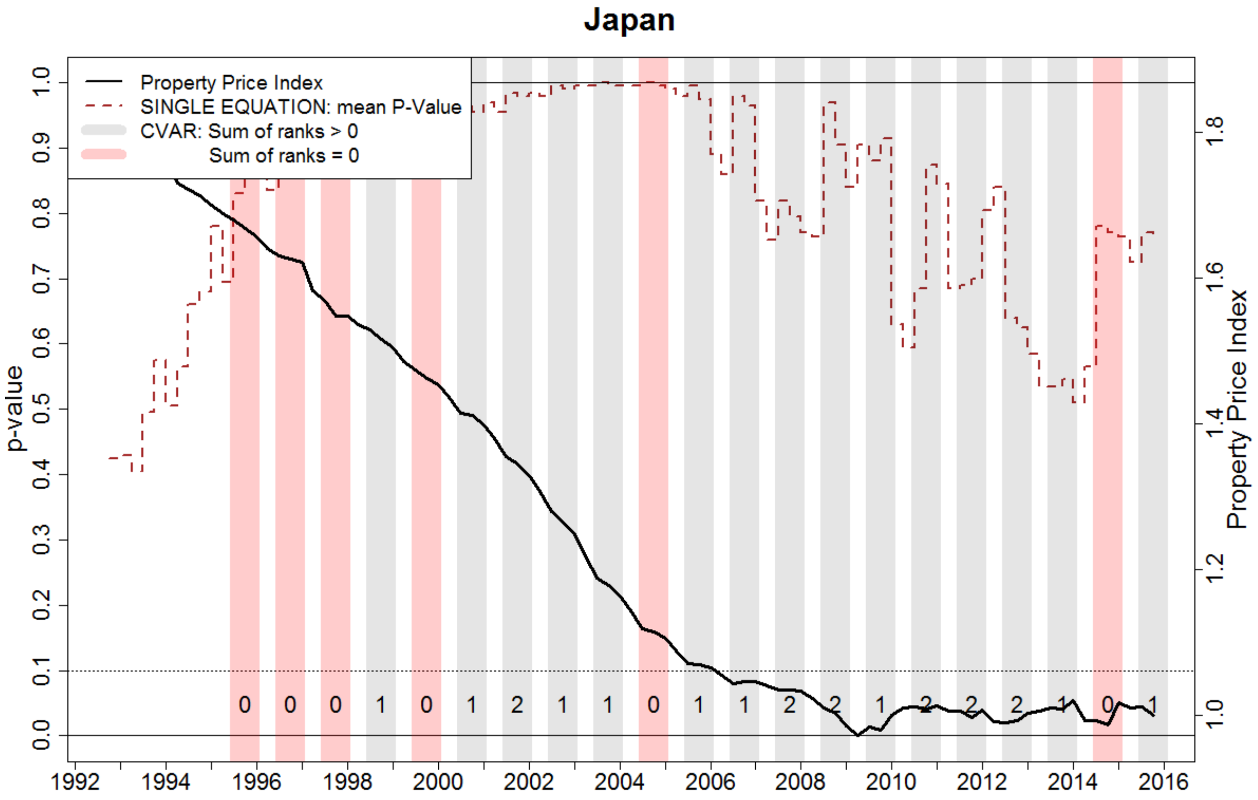


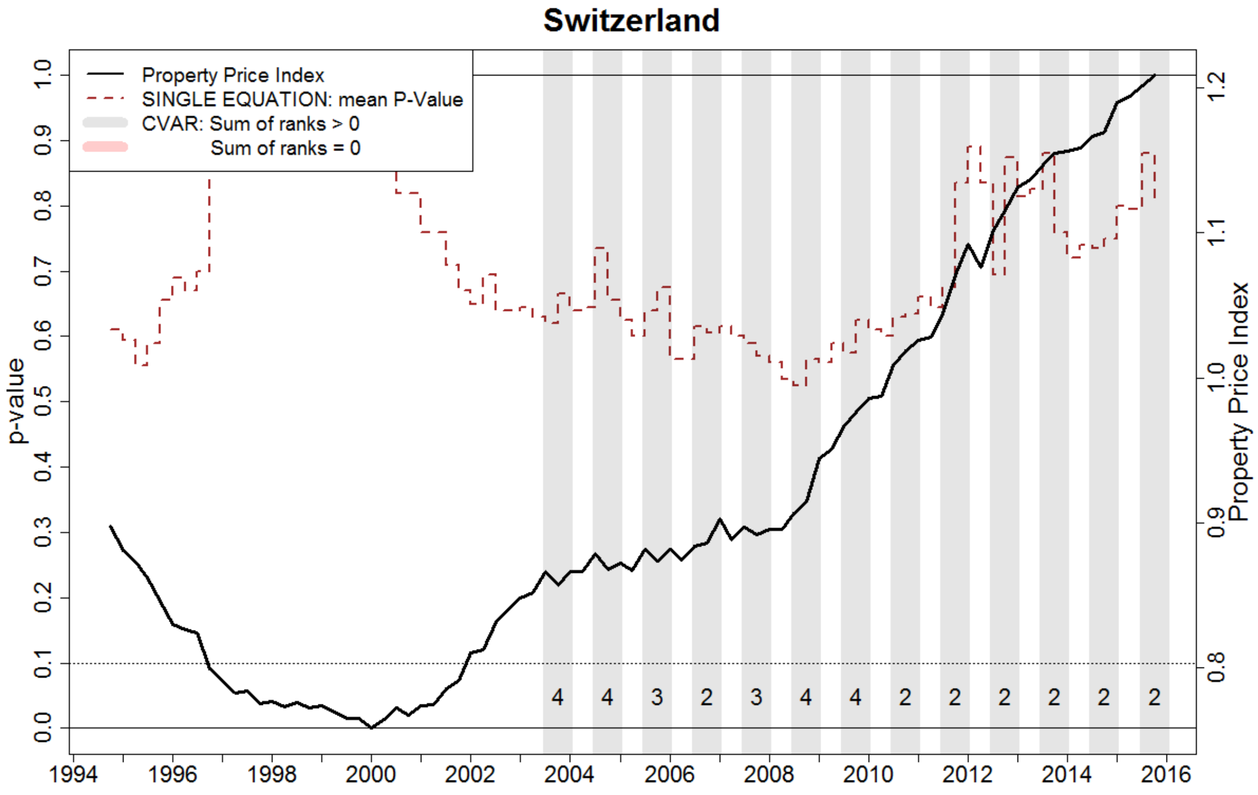
Signals in Canada and New Zealand





Japan - a difficult case - and Switzerland





Thesis methodology is more conservative than literature

Indications of a bubble regime

	Literature	Thesis
Canada		x
France	x	
Germany		
Japan	x	
Netherlands	x	
New Zealand	x	x
Switzerland	x	
United Kingdom	x	

(Independent of period)

Takeaway

- **Don’t buy a home in Canada or New Zealand**

- **Switzerland’s owner occupied sector seems (or seemed) safe**

- **Data has higher impact than model specifications**
  You can not compensate data deficiencies with better model specifications.

Review

- **Prof. Dr. Maximilian von Ehrlich**
  University of Bern
- Research fellow at the Center for Regional Economic Development (CRED)

Panel discussion

Contact information and credits

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Appendix

A0 Data Description and temporal properties

Variable	Description	Dimension	Deflation	Main Source
PH	Property Price Index	Index	by CPI2	BIS
Pop	Population	[Total residents]		
R	Real housing rent	Index	by CPI2	OECD
Y	Per capita disposable income	[national currency/resident]	by CPI2 and Pop	AMECO
H	Per capita Housing stock	[national currency/resident]	by PJ and Pop	Oxford Economics
CPI1	CPI Less shelter	Index		
CPI2	CPI All items	Index		
UC	User Cost	$(1-\tau y)(i+\tau p) - \pi + \delta$		
δ	Housing depreciation rate	[%] of property value		
τ_p	Property tax rate	[%] of property value		OECD
τ_y	Average income tax rate	[%] of marginal income		OECD
π	Inflation rate	[%] Annual rate		
i	Mortgage interest rate	[%] Annual rate		

- **No** seasonal adjustment
- **User cost** is constructed out of the following rates collected per country and if necessary, aggregated: depreciation, property tax, income tax, mort-gage interest, and inflation. Deflators are the consumer price index (CPI), once without housing components (CPI1), for deflating PH, R and Y, once measured for all items in order to account for the inflation in the user cost (CPI2).
- Additionally, the value of the housing stock is deflated by an appropriate metric, depending on the measure used for the stock (PJ). st (UC).

A1 Single Equation Methodology Price-to-Rent

$$\Delta \mathrm{ph}_t = \mu + \alpha_{ph} (\mathrm{ph} - \gamma_r r - \gamma_{UC} UC)_{t-1}$$

$$+ \sum_{i=1}^{p} \rho_{ph,i} \, \Delta \mathrm{ph}_{t-i} + \sum_{i=0}^{p} \rho_{r,i} \, \Delta r_{t-i} + \sum_{i=0}^{p} \rho_{UC,i} \, \Delta UC_{t-i} + \sum_{l=1}^{3} \lambda_{d,l} d_l + \varepsilon_t$$

H_0: $\alpha_{ph} = 0$

(indicating no cointegration)

H_A: $\alpha_{ph} \neq 0$

(indicating cointegration)

whereas $ph - \gamma_r r - \gamma_{uc}\, UC$ is called the error correction term. Furthermore, lagged differences with up to p lags as well as seasonal dummies, d_l, are introduced for the quarters $l=1,2,3$ while the 4th quarter seasonal effect is captured by μ. Note that the error correction term accounts for

A2 VECM & CVAR Methodology Price-to-Rent

$$\Delta \boldsymbol{y}_t = \prod \boldsymbol{y}_{t-1} + \sum_{i=1}^{p-1} \boldsymbol{\Gamma_i} \, \Delta y_{t-1} + \boldsymbol{\Phi} D_t + \varepsilon_t$$

Here, y_t is a k × 1 vector of the endogenous variables, Φ being a k × d matrix of coefficients and D_t is a vector of d constants, including centered seasonal dummies and the intercept. Since there are several possible deterministic trends, they are included in Π. Now $\Pi \boldsymbol{y}_{t-1}$ is the error correction term and the error is given by $\varepsilon_t \sim IIN(\mu=0, \sigma=\Omega)$, with Ω being diagonal. In detail Π and Γ_i are defined as follows

A3 Log Periodic Power Law Fit (independent of fundamentals)

$$ph_t = A + B(t_c - t)^m + C(t_c - t)^m \cos[\omega \ln(t_c - t) - \phi] \qquad [18]$$

where ω is the log frequency and ϕ is a phase constant. Hence the bubble indicator is a detected faster-than-exponential growth of PH_t, (in levels) possibly extended by log periodic oscillations[10].

A4 Concordance Indicator

$$I_K = \frac{1}{T}\left[\sum_{t=1}^{T} S_{x,t}\, S_{y,t} + \sum_{t=1}^{T}(1 - S_{x,t})(1 - S_{y,t})\right] \quad \forall K$$

$$i_S = \begin{cases} 1 & Total\ concordance\ or\ \rho_S = 1 \\ (0,1) & \\ 0 & No\ \ concordance\ or\ \rho_S = -1 \end{cases}$$

The set K can either consist of the countries, whereas x and y would correspond to the approaches, or K denotes the approaches and x and y are the countries respectively. In this study, both cases are of interest. The concordance indicator I_K first calculated for all possible combi-

A5 Results Cross-Country Concordance

	CAN	CH	FRA	GER	JAP	NL	NZ	UK
CAN	1.00	0.36	0.50	0.54	0.68	0.52	0.59	0.41
CH	0.36	1.00	0.77	0.61	0.54	0.57	0.66	0.71
FRA	0.50	0.77	1.00	0.62	0.62	0.69	0.76	0.91
GER	0.54	0.61	0.62	1.00	0.69	0.71	0.80	0.62
JAP	0.68	0.54	0.62	0.69	1.00	0.55	0.69	0.54
NL	0.52	0.57	0.69	0.71	0.55	1.00	0.72	0.66
NZ	0.59	0.66	0.76	0.80	0.69	0.72	1.00	0.75
UK	0.41	0.71	0.91	0.62	0.54	0.66	0.75	1.00

A6 Results Cross-Model Concordance (only Canada)

Table 14 Concordance matrix for Canada

	cvar invd noT	cvar invd	cvar ptor noT	cvar ptor	sing ptor	sing invd	LPPLs	PL
cvar invd noT	1.00	0.56	1.00	1.00	1.00	0.83	0.67	0.67
cvar invd	0.56	1.00	0.56	0.56	0.56	0.39	0.44	0.33
cvar ptor noT	1.00	0.56	1.00	1.00	1.00	0.83	0.67	0.67
cvar ptor	1.00	0.56	1.00	1.00	1.00	0.83	0.67	0.67
sing ptor	1.00	0.56	1.00	1.00	1.00	0.83	0.67	0.67
sing invd	0.83	0.39	0.83	0.83	0.83	1.00	0.72	0.83
LPPLs	0.67	0.44	0.67	0.67	0.67	0.72	1.00	0.89
PL	0.67	0.33	0.67	0.67	0.67	0.83	0.89	1.00

This table reports the concordance indices (see [21]), a measure of coincidence for bubble cycles, specification wise for the recursive estimations of Canada. CVAR refers to equation [12] for *ptor* and [15], for *invdem*, whereas *sing* represents the single equation specification, [7] and [11] respectively. *noT* indicates, that no Trend is included in the equation specification. *PL* represents the power law fit after [18] and *LPPLs* is log periodic power law fit following [19]. A 0 indicates no synchronization, a 1.00 represents synchronization over the total overlapping sample.