Demography, Credits and Property Prices: Evidence from a Panel of Diverse Economies

Tomoo Inoue [1] Kiyohiko G. Nishimura [2] Chihiro Shimizu [3]
Yongheng Deng [4]

[1]Seikei University

[2]National Graduate Institute for Policy Studies (GRIPS) and University of Tokyo

[3]Nihon University and Institute of Real Estate Studies, National University of Singapore

[4]Institute of Real Estate Studies, National University of Singapore

Hitotsubashi-RIETI International Workshop

—

December 15, 2017

Organization of the Presentation

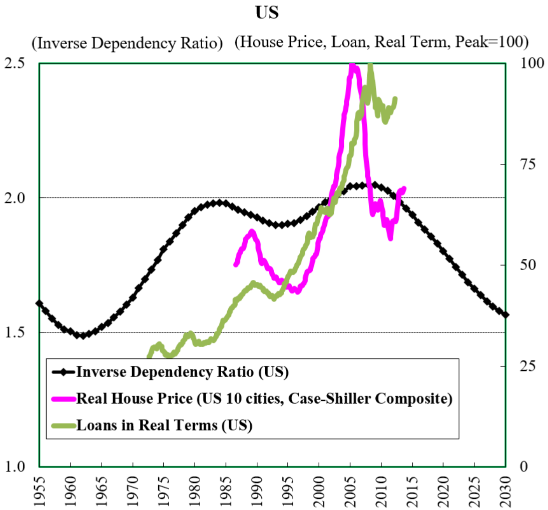
Motivation:
Demography, Credits and Bubbles

- Casual Observation about the Past Episodes of Property Bubbles Suggests Strong Correlation between Demographic Composition and Property Bubbles (and Loose Credits).

Demography, Credits and "Property Bubbles": United States

A demographic bonus (more working age people) might trigger the bubble, with a help of loose credit conditions.(Nishimura 2011, 2016)

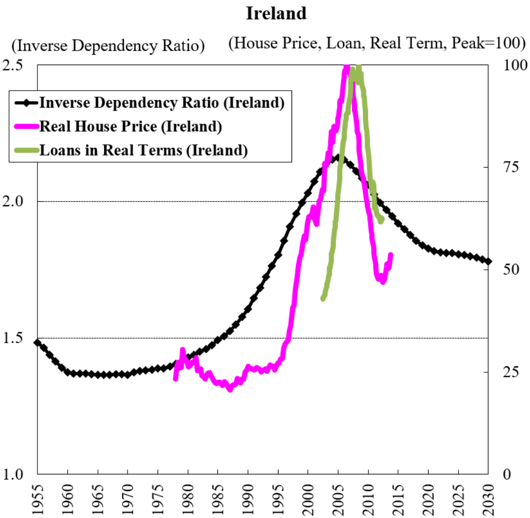
- Inverse Dependency Ratio = (Non-Work-Age / Working Age population)$^{-1}$



Demography, Credits and "Property Bubbles": Ireland

A demographic bonus (more working age people) might trigger the bubble, with a help of loose credit conditions.(Nishimura 2011, 2016)

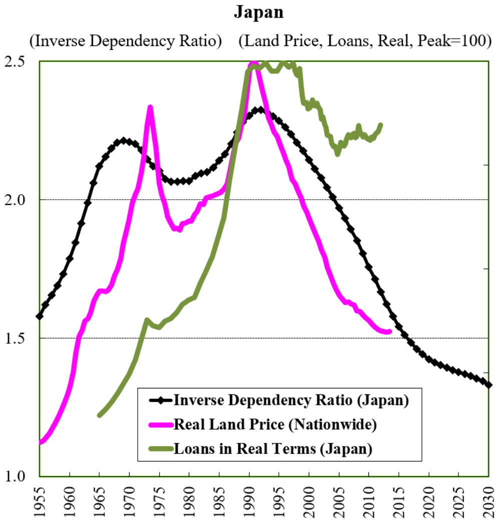
- Inverse Dependency Ratio = (Non-Work-Age / Working Age population)$^{-1}$



Demography, Credits and "Property Bubbles": Japan

A demographic bonus (more working age people) might trigger the bubble, with a help of loose credit conditions.(Nishimura 2011, 2016)

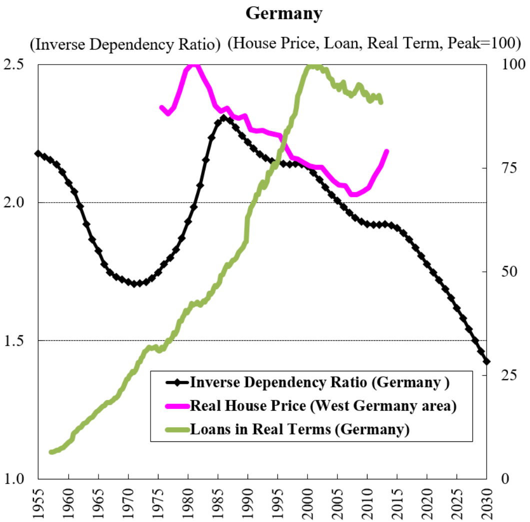
- Inverse Dependency Ratio = (Non-Work-Age / Working Age population)$^{-1}$



Demography, Credits and "Property Bubbles": Germany

A demographic bonus (more working age people) might trigger the bubble, with a help of loose credit conditions.(Nishimura 2011, 2016)

- Inverse Dependency Ratio = (Non-Work-Age / Working Age population)$^{-1}$



Economic Theory and Its Implications

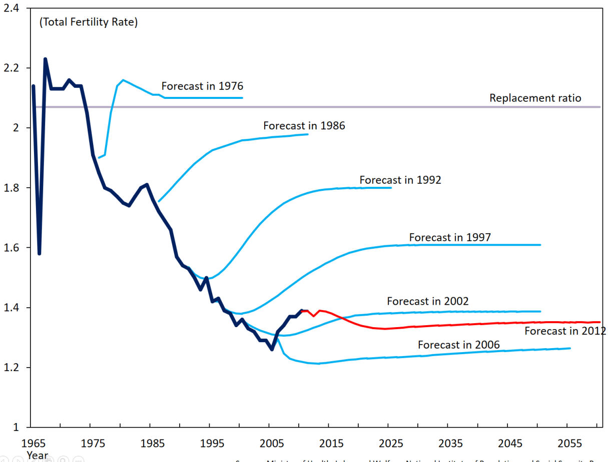
- If Expectations are "Rational" or Perfect Foresight on the Average, and the Supply of the Assets Is Elastic, then CHANGE IN DEMOGRAPHY IS NOT LIKELY TO MATTER MUCH FOR THOSE ASSETS' PRICES
    - Implications of the Mankiw-Weil (1989) controversy and a special issue of *Regional Science and Urban Economics* (1991)
    - Properties = Buildings → Elastic Supply (Depreciable Capital)
      + Land → Inelastic Supply (Non-Depreciable)
    - Focus on the Building Component of Property Prices
    - When property prices are anticipated to rise, then more buildings will be built to counteract expected price increases.
    - Since (1) demographic factors change very slowly and (2) they are mostly anticipated, and that (3) all anticipated changes in real conditions are already incorporated well in advance in property prices, a change in current demography is not likely to change property prices very much.

- If Expectations are "Rational" or Perfect Foresight on the Average, BUT the Supply of the Assets Is **Inelastic**, then DEMOGRAPHY MATTERS for Those Assets' Prices:
    - Very Long Run Portfolio Choice Model for Retirement of Nishimura and Takáts 2012, Tamai et al 2017
        - Focus on Land Component of Property Prices. Land as Physically Non-Depreciable Real Assets with Limited Supply (Inelastic Supply)
        - Also Money as A New Class of Assets in Non-Inflationary Environment, which is Physically Non-Depreciable Nominal Assets with Limited Supply (Exogenous, Policy-Determined)
        - Intuition: Baby-boomers demand more land and more real money than previous generation, to push up land prices and the price of real money (reciprocal of the price level). The central bank keeps price stable, which means land prices are even higher.
        - N&T and T+ found a sizable effect of aging on property prices.
- However, the theory based on generational portfolio choices are insufficient to explain often volatile property prices in the medium-run (say, 10 yrs) or in a business cycle (typically 2 yrs).

- However, are people's long-run forecasts such as those about demography are "Rational" Expectations (or Perfect Foresight on Average)? Especially when it takes long to realize expectation errors?
- In reality, they are not rational, as exemplified in the "expert forecasts" about Japanese fertility rates. Experts think
  - (1) the current unexpected change is transitory and short lived
  - (2) it will eventually return to their anticipated long run value which is closer to the "old normal"
  - (3) And when the actual value is persistently different from the their anticipated long-run value, they change the anticipated value, but very slowly, not immediately.
- Thus, forecasts about slow-moving factors are likely to be extrapolative in the long-run, wishful-thinking in the short-run, and very slow to adjust.

- Expert Forecasts about Slow-Moving Factors:
  Wishful Thinking in the Short Run (Unexpected Change is Temporary)
  and Extrapolative and Slow to Adjust in the Long Run

  (Assume to Return to "Normal", and Expected "Normal" Change only very gradually)
- Example: Total Fertility Rate Forecasts of Japanese Experts



Source: Ministry of Health, Labor and Welfare; National Institute of Population and Social Security Research.

- If people's expectations are extrapolative ("tomorrow is like today"), and suppliers (experts) forecasts are extrapolative, slow-to-adjust and wishful thinking, then DEMOGRAPHY MAKES a DIFFERENCE even in a shorter run. (Nishimura 2016)
- Population "Bonus" Period (Dominance of the Young)
  - Demand Side: excessive optimism
    - Economy has more prime-age, output-producing workers than before, relative to dependent elderly individuals.
    - Economy produces more discretionary income for consumption and investing; more left over after supporting dependent seniors.
    - A vibrant economy and optimistic expectations.
    - If people extrapolate from their experience, a demographic bonus can nurture optimism and higher demand for properties.
    - When child mortality is down, more children imply more future working population, fostering optimism further.
  - Supply Side: persistent short supply
    - Supply of buildings will increase but not sufficient to satisfy the excessive optimism, because of resource constraints and practical conservatism in business ("return to past normal" forecasts)
  - Result: Significant Increases of Property Prices.

- Moreover, when population bonus is coupled with easy credit, the swing of property prices become significantly larger through a self-feeding process, because of excessive leveraging.
    - Excessive optimism leads to excessive leveraging and temporarily high growth; in turn, feeding on each other, excessive leveraging and high growth reinforce excessive optimism.
- Population "Onus" Period (Dominance of the Old)

  Reverse in Course
    - Demand Side:
        - Spiral of pessimism, deleveraging, lower growth, and lower demand for properties
    - Supply Side:
        - significant oversupply, and "return to past normal" forecasts prevent rapid liquidation of the oversupply
    - Result: Significant decreases of property prices
    - People will switch from optimism to pessimism quite easily, while experts are likely to be the captive of own past. (Nishimura and Ozaki 2017)
- This "Leveraging and Subsequent Deleveraging" process—the alteration between bubbles and busts—is a key trait of Credit Cycles.

(Reinhart and Rogoff, Buttiglione et al 2014)

Our Research

- We investigate RPPI (Residential Property Price Index) to ask:
  - Would the observation ("demography matters on short-run property prices") be confirmed in the econometric analysis of diverse economies/countries? Or more specifically speaking, (1) How will the changes in population makeup (whether population bonus or onus) affect the property prices? (2) What is the interaction between demopgraphic factors and credit conditions? (3) Is there a confounding cyclical component in property prices?
- Although ideally long time-series data of property prices are desirable to account for the effect of very slow-moving demography, we cannot find such data in one country.
- Thus, we look for a panel of economies sufficiently diverse in their demographics and economic activities.
- Panel data from 20 economies for the period 1971-2015 are collected and used (Five Asia-Pacific, Twelve European, Two North American, One African)

Models and Data: Long-run Relationship and Short-run Cyclical Effects

RPPI (residential property price index) Models

- Model:
  Long-run nominal RPPI model based on Present Value Relation
  - Assume that property prices P^{rppi} are equal to the present value of future nominal real rents $P^{cpi} \times (real\ Rent)$ in the long run,

$$P^{rppi} = \frac{P^{cpi} \times (real\ Rent)}{i - \pi^e - g^e}$$

    where i nominal interest rate, π^e expected CPI inflation, and g^e is expected real rent growth.
  - The long-run relationship is likely to be homogeneous, since it is the no-unexploited-arbitrage-opportunity condition of competitive equilibrium, common to all financial markets.
  - However, short-run adjustment may be heterogeneous. Because of country-specific institutions and transaction costs, the long run relationship is not immediately achieved but only partially and gradually.

- Demographic factors may influence:
  1. expected future rent growth factor g^e
     - Population bonus $\Rightarrow$ optimistic
       $\Rightarrow$ Higher expectations on future rent growth and *vice versa*
  2. expected inflation π^e
     - Population bonus $\Rightarrow$ optimistic $\Rightarrow$ demand outpaces supply
       $\Rightarrow$ higher inflation and *vice versa*
- Real rent is approximated by a function of output per worker

$$\log(real\ Rent) = \beta_0 + \beta_1 \log\left(\frac{Real\ GDP}{Working\text{-}age\ Population}\right)$$

Long-run nominal RPPI regression model with demographic factors

$$\log P_{jt}^{rppi} = \mu_0 + \alpha_0 \log P_{jt}^{cpi} + \alpha_1 \underbrace{\log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right)}_{\approx \text{current real rent}} + \alpha_2 \underbrace{i_{jt}}_{\approx \text{current nominal rate}}$$
$$+ [\text{demographic factors (in levels)}]_{jt} + \epsilon_{jt}$$

- Alternative Model: Long-run Real RPPI model
  - It is sometimes assumed that the current real interest rate r_t is equal to the current nominal interest rate i_t minus the realized rate of inflation $\pi_t = \Delta \log P_t^{cpi} = \log P_t^{cpi} - \log P_{t-1}^{cpi}$.
  - This is equivalent to assume inflationary expectations π^e is equal to the actual inflation π_t from the previous period.
  - Defining real RPPI be $real\ P^{rppi} = P^{rppi}/P^{cpi}$, we have a "real RPPI model" in that all variables are all in "real terms".

$$real\ P^{rppi} = \frac{real\ Rent}{r - g^e}$$

  - Demography influences real RPPI through g^e only.

Long-run real RPPI regression model with demographic factors

$$\log real\ P_{jt}^{rppi} = \mu_0 + \alpha_1 \underbrace{\log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right)}_{\approx \text{current real rent}} + \alpha_2 \underbrace{r_{jt}}_{\approx \text{static expectation real rate}}$$

$$+ [\text{demographic factors (in levels)}]_{jt} + \epsilon_{jt}$$

- Short-run Adjustment: Modified Augmented Error Correction
  - The present-value relation determines the fundamental value of RPPI, which may not be achieved instantaneously because of large transaction costs and substantial imperfect information.
  - Moreover, property prices may be influenced by cyclical macro factors (GAPs) over business cycles, in addition to fundamentals (FDMs). Optimism is in upturns and pessimism in downturns.
  - This suggests (explained later) the "modified augmented" error correction model (below) as short-run adjustment of RPPI.

Short-run Nominal RPPI: Modified Augmented Error Correction ARDL(2,2,2-Lg)

$$\Delta \log P^{rppi}_{jt} = \phi_j \underbrace{(\log P_{j,t-1} - \theta_j \text{FDM}_{j,t-1})}_{\text{long run relation}} + \delta_{0,j} \Delta \log P^{rppi}_{j,t-1}$$

$$+ \delta_{1,j} \Delta \text{FDM}^*_{jt} + \delta_{2,j} \Delta \text{FDM}^*_{j,t-1} + \delta_{3,j} \text{GAP}_{j,t} + \delta_{4,j} + \epsilon_{jt}$$

$$\text{where FDM} = \left(\log P^{cpi}, \log\left(\frac{Y}{pop^{wrk}}\right), i, \text{demo factors}\right);$$

$$\text{GAP} = \text{Deviation from the HP Filter trend of } \left(\log\left(\frac{Y}{pop^{wrk}}\right), i\right);$$

$$\text{FDM}^* = \text{FDM excluding } \left(\log\left(\frac{Y}{pop^{wrk}}\right), i\right).$$

Variables in the RPPI Regression Model

- Three core variables in RPPI regression models
  1. RPPI index, logged ($lnrppi_{jt}$)
     - Source: Quarterly "Long-term Series on Nominal Residential Property Prices" in BIS Residential Property Price database
     - Quarterly index are average for each year
  2. Nominal interest rate, in log ($nint_{jt}$)

$$\log\left(1+\frac{rate}{100}\right)$$

     - Source: Annual "Interest Rates, Government Securities, Government Bonds, Percent per annum" (IFS).
  3. Real GDP per working population, logged ($ly2wpop_{jt}$)

$$\log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right)$$

     - Source: Nominal GDP taken from IFS is divided by CPI taken from IFS, except for Germany, UK and Korea, for which OECD statistics is used.

Population variables

- Source: UN population database

	young generation			working generation			old generation			total
cohort	1	2	3	4	$\cdots$	13	14	$\cdots$	17	1-17
age	0-4	5-9	10-14	15-19	$\cdots$	60-64	65-69	$\cdots$	80+	0-
pop	$-_{1jt}$	$-_{2jt}$	$-_{3jt}$	$-_{4jt}$	$\cdots$	$-_{13jt}$	$-_{14jt}$	$\cdots$	$-_{17jt}$	$-_{jt}$

- $pop_{kjt}(: -_{kjt})$: populations of cohort k for country j at year t
- Shares of young, working, and old generations

$$n_{jt}^{yng} = \frac{\sum_{k=1}^{3} pop_{kjt}}{pop_{jt}}, \quad n_{jt}^{wrk} = \frac{\sum_{k=4}^{13} pop_{kjt}}{pop_{jt}}, \quad n_{jt}^{old} = \frac{\sum_{k=14}^{17} pop_{kjt}}{pop_{jt}}$$

Generation Shares and Estimation

1. demographic $\text{factors}_{jt} = \delta_1 n_{jt}^{yng} + \delta_2 n_{jt}^{wrk} + \delta_3 n_{jt}^{old}$
2. Recall that all three population variables are ratios, thus

$$n_{jt}^{yng} + n_{jt}^{wrk} + n_{jt}^{old} = 1$$

3. Impose a restriction on the parameters $\delta_1 + \delta_2 + \delta_3 = 0$ at the time of estimation (Stoker(1986), Fair & Dominguez (1991))
4. Demographic factor is written as:

$$\begin{aligned} \text{demographic factors}_{jt} &= \delta_1 n_{jt}^{yng} + (-\delta_1 - \delta_3) n_{jt}^{wrk} + \delta_3 n_{jt}^{old} \\ &= \delta_1 (n_{jt}^{yng} - n_{jt}^{wrk}) + \delta_3 (n_{jt}^{old} - n_{jt}^{wrk}) \end{aligned}$$

then one can estimate δ_1 and δ_3 and their standard errors.

5. δ_2 is calculated from δ_1 and δ_3.

Complete List of Countries/Regions in Our Sample

Asia-Pacific (5)
Australia(AU) Hong Kong(HK) Japan(JP)
Korea(KR)
New Zealand(NZ)

America (2)
Canada(CA) United States(US)

Rest of the World (1)
South Africa(ZA)

Europe (12)
Belgium(BE) Switzerland(CH)
Germany(DE) Denmark(DK)
Spain(ES)
France(FR) United Kingdom(GB)
Ireland(IE) Italy (IT)
Netherlands(NL) Norway(NO)
Sweden(SE)

- Twenty Countries: Five Asian Countries (Regions) and South Africa Are Included for Diversity
- Unbalanced Panel (Some Data Missing in Underlined Countries)
- Actual Data Used in Empirical Analysis Are Selected from This Set. Balanced Panel (17 Countries) and Total (20 Countries).

Diagnostics

(Non-)Stationarity of Variables in the Panel

- Before proceeding with the regression analysis, we should examine stationarity (or non-stationarity) of the variables,
  - since inadvertent mixing of stationary and non-stationary variables in regressions may cause problems.
- We start with such tests for the panel of variables we consider.
- Pesaran's CIPS Panel Unit Root Tests.
  - Null Hypo. H_0: All panels contain unit roots.
  - Alternative Hypo. H_a: Some panels do not have unit roots.
  - Cross-sectional dependence of residuals are accounted for.
- Hadri's Stationarity Tests.
  - Null Hypo. H_0: All panels are stationary.
  - Alternative Hypo. H_a: Some panels are non-stationary.
  - Note: Hadri test works only for balanced data set.
- The balanced set of 17 countries, 1971 - 2015

Summary Interpretation of CIPS and Stationarity Tests

- Level
  1. CIPS: H_0 cannot be rejected for $ly2wpop$ so that all countries are non-stationary. However, H_0 is rejected for others implying some countries are stationary.
  2. Stationarity Tests: H_0 are rejected for all, so that all variables in all countries are non-stationary.
- First differences
  1. CIPS: H_0 cannot be rejected for no_nw so that all countries are non-stationary. However, H_0 is rejected for others implying some countries are stationary.
  2. Stationarity Tests: H_0 cannot be rejected for $lnrppi$ and $nint$ so that they are stationary in all countries. For all others ,H_0 is rejected, implying they are non-stationary in all countries.
- Second differences
  1. CIPS: H_0 is rejected for all variables, implying some countries are stationary for all variables.
  2. Stationarity Tests: H_0 cannot be rejected for all variables, so that they are stationary in all countries.

Summary Interpretation of Individual URTs for Nominal RPPI

- Except for CPI and demographic ratios, most variables can be regarded as $I(1)$.
- CPI: ADF Tests (WSDF tests) suggest Switzerland and Germany (Germany and US) are $I(1)$ and others are $I(2)$.
- Demographic ratios: Results are mixed but largely $I(1)$ or $I(0)$.
- Note: Results should be interpreted with caution, since:
  1) the sample period is short, and
  2) they are sensitive w.r.t. the choice of deterministic components.

- In sum, CPI's order of integration is hard to determine. Thus for empirical analysis, we should examine two cases, i.e., $I(1)$ and $I(2)$.

Estimation Results

1. Long-run nominal RPPI models with demographic factors

- We first consider the case that CPI is $I(1)$ like other variables.
- Then, the following long-run nominal RPPI model is an appropriate model to be estimated, which is homogeneous among countries.

Long-run nominal RPPI models with demographic factors

$$\log P_{jt}^{rppi} = \mu_j + \alpha_1 \log P_{jt}^{cpi} + \alpha_2 \log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right) + \alpha_3 i_{jt} + \alpha_4 \log pop_{jt}^{total} + \alpha_5 (n_{jt}^{yng} - n_{jt}^{wrk}) + \alpha_6 (n_{jt}^{old} - n_{jt}^{wrk}) + \epsilon_{jt}$$

Panel Cointegration Tests and Estimation Methods

1. We first apply Panel Cointegration Tests examining whether a long run relationship exists.
2. Then, Panel Cointegrating Regressions of Homogeneous Long-Run Relations are estimated by:
    1. Fully-Modified OLS (pooled FMOLS and weighted FMOLS)
    2. Dynamic OLS (pooled DOLS and weighted DOLS)

	Homogeneous long run variance of innovation vectors for all countries	Heterogeneous long run variance of innovation vectors for each country
Fully-Modified OLS	pooled FMOLS	weighted FMOLS
Dynamic OLS	pooled DOLS	weighted DOLS

    3. We also report the long run part of Pooled Mean Group Estimates allowing Heterogeneous Short-run Adjustment (details are given later) for comparison purposes.

Comments on the Panel Cointegration Tests

1. Among the 11 test statistics by Pedroni (1999,2004), panel v-stat (both) and panel ADF-stat (both) reject the null of no cointegration at 5% and 1% levels. In addition, group ADF-stat also rejects the null at 1% level.
2. According to Pedroni (2004), if $T < 100$, the most powerful tests are group ADF and panel ADF. In our case, both group ADF and panel ADF reject the null at 1% significance level.
3. Kao's (1999) test indicates that the model is panel cointegrated with 1% significance level.
4. Overall, we can conclude that there exists a significant long run relationship between the variables. That said, we estimate the long-run coefficients in the next slides.

Demography and RPPI -"Nominal" Formulation

Baseline Nominal RPPI: Balanced Panel of 17 Countries 1971-2015

ES(Spain), HK(Hong Kong), and KR(Korea) are excluded due to missing observations

Eq Name:	FMOLS1	FMOLS2	DOLS1	DOLS2	PMG
$\log P^{cpi}$	1.072	0.989	0.987	1.053	1.1006
	(0.047)***	(0.006)***	(0.070)***	(0.058)***	(0.0530)***
$\log(Y/pop^{wrk})$	0.780	1.064	1.577	1.386	1.1445
	(0.110)***	(0.010)***	(0.170)***	(0.150)***	(0.1191)***
i	-2.876	-1.968	-1.731	-1.960	-2.3885
	(0.594)***	(0.011)***	(0.818)**	(0.648)***	(0.4610)***
$\log pop^{total}$	0.847	0.966	-0.146	-0.022	1.2239
	(0.213)***	(0.002)***	(0.343)	(0.268)	(0.2999)***
$n^{yng} - n^{wrk}$	2.558	2.601	2.839	2.817	4.9896
	(0.640)***	(0.002)***	(0.925)***	(0.774)***	(0.6201)***
$n^{old} - n^{wrk}$	-3.584	-3.432	-4.128	-4.152	-3.3787
	(0.534)***	(0.001)***	(0.914)***	(0.719)***	(0.6880)***
Observations:	765	765	748	748	731
R^2:	0.953	0.954	0.995	0.995	NA

- ***/**/* indicates the estimates are significant at 1%/5%/10% levels
- FMOLS1=pooled, FMOLS2=weighted, DOLS1=pooled, DOLS2=weighted
- PMG=ARDL(2,2,2-Lg) for 1973-2015 (for comparison, discussed later)

Findings of the "Nominal" Baseline Model

Representative "Nominal" Result: FMOLS2

$$\widehat{\log P_{jt}^{rppi}} = 0.989 \log P_{jt}^{cpi} + 1.064 \log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right) - 1.968\, i_{jt}$$
$$+ 0.966 \log pop_{jt}^{total} + 2.601(n_{jt}^{yng} - n_{jt}^{wrk}) - 3.432(n_{t}^{old} - n_{jt}^{wrk}) + \text{others}$$

General Comments on "Nominal" Long-run Relationship

1. $n^{yng} - n^{wrk}$ (young dependency ratio) has strongly positive effects on residential property prices *) A baby boom implies optimism
2. $n^{old} - n^{wrk}$ (old dependency ratio) has strongly negative effects on residential property prices *) Aging implies pessimism
3. Current real GDP per worker ($\log(Y/pop^{wrk})$) has positive effects as a proxy of real rents (as expected)
4. Current nominal rate of return (i) has negative effects implying a statistically significant effect of credit conditions (as expected)
5. Present-value relation explains long-run RPPI very well (high R^2).
6. Coefficient of CPI ($\log P^{cpi}$) is close to unity (no money illusion)

Findings of the "Real" Baseline Model

Representative "Real" Result: FMOLS2

$$\log \widehat{real\ P}_{jt}^{rppi} = 1.128 \log\left(\frac{Y_{jt}}{pop_{jt}^{wrk}}\right) - 2.142 r_{jt} + 1.003 \log pop_{jt}^{total} + 1.756(n_{jt}^{yng} - n_{jt}^{wrk}) - 3.125(n_{t}^{old} - n_{jt}^{wrk}) + \text{others}$$

General Comments on "Real" Long-run Relationship

1. "Real" results are qualitatively quite similar to "nominal" results
2. In particular, nominal interest rates and "static expectation" real interest rates have qualitatively the same effects on the prices.
3. To examine whether demo. factors influence through rent growth expectations only, compare the "real" and "nominal".
   - The coeff. of young-to-working, and old-to-working age ratios are smaller both in FMOLS and DOLS in reals than nominals, suggesting demo ratios also affect inflationary expectations.

Population composition and real RPPI in the long-run

- UN's historical and (median) predicted population data are used.
- Contribution of population factor is calculated as:

$$\text{factor}_{jt} = \exp\left(1.756(n_{jt}^{yng} - n_{jt}^{wrk}) - 3.125(n_{t}^{old} - n_{jt}^{wrk})\right)$$

- $\text{factor}_{j,1970}$ is normalized as one.

Figure: Japan and Euro

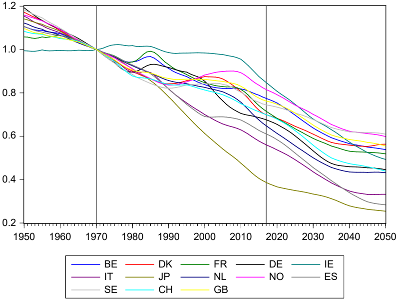
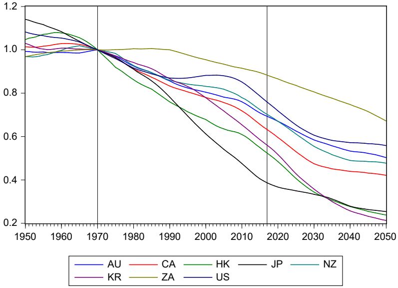


Figure: Japan and non-Euro



Real interest rate and real RPPI in the long-run

- Historical real interest rate data is used.

$$\text{factor}_{jt} = \exp\left(-2.142 r_{jt}\right)$$

- $\text{factor}_{j,1970}$ is normalized as one.

Figure: Japan and Euro

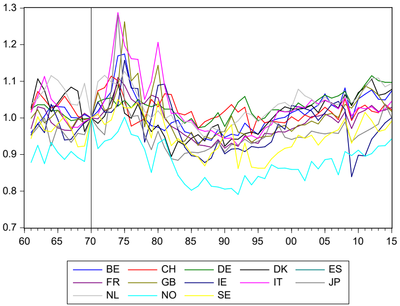
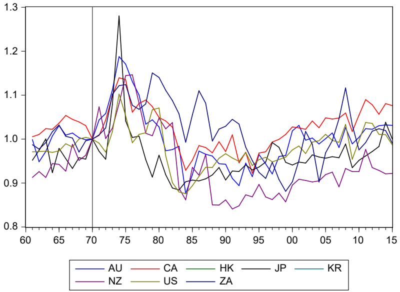


Figure: Japan and non-Euro



GDP per working age population and real RPPI in the long-run

- Historical GDP and working age population data are used.

$$\text{factor}_{jt} = \exp\left[1.128 \log\left(\frac{Y_{jt}}{pop^{wrk}_{jt}}\right)\right]$$

- $\text{factor}_{j,1970}$ is normalized as one.

Figure: Japan and Euro

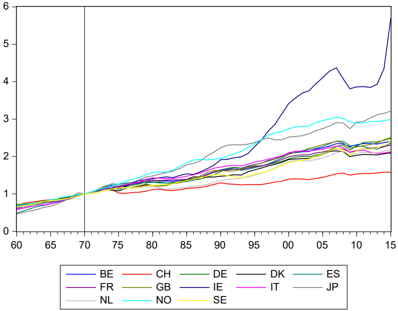
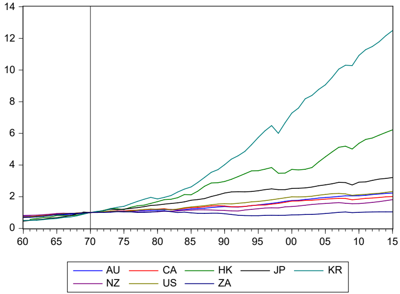


Figure: Japan and non-Euro



Cross-Term Effects Between i and (n^{yng} and n^{old})

Balanced Panel of 17 Countries in Period 1971-2015

Eq Name:	FMOLS1	FMOLS2	DOLS1	DOLS2
$\log P^{cpi}$	1.115 (0.047)***	1.035 (0.006)***	1.077 (0.069)***	1.142 (0.044)***
$\log(Y/pop^{wrk})$	0.807 (0.109)***	1.045 (0.012)***	1.124 (0.158)***	0.882 (0.113)***
i	9.336 (5.811)	11.162 (0.013)***	9.038 (6.062)	8.604 (4.270)**
$\log pop^{total}$	0.744 (0.213)***	0.867 (0.002)***	0.075 (0.283)	0.213 (0.194)
$n^{yng} - n^{wrk}$	3.442 (0.812)***	2.958 (0.003)***	3.112 (0.979)***	2.799 (0.591)***
$n^{old} - n^{wrk}$	-4.795 (0.736)***	-4.679 (0.001)***	-6.229 (0.895)***	-5.481 (0.491)***
$i \times (n^{yng} - n^{wrk})$	-9.261 (5.533)*	-4.258 (0.003)***	-3.680 (6.372)	-7.039 (5.405)
$i \times (n^{old} - n^{wrk})$	31.142 (10.551)***	28.834 (0.003)***	27.711 (10.249)***	29.634 (8.181)***
Observations:	765	765	748	748
R^2:	0.954	0.956	0.998	0.997

- ***/**/* indicate the estimates are significant at 1%/5%/10% levels;
- FMOLS1=pooled, FMOLS2=weighted, DOLS1=pooled, DOLS2=weighted

Demography and Credits: Interpretation (1)

Rearranging the terms in a representative FMOLS2 result, we have

$$\begin{aligned}\widehat{\log P_{jt}^{rppi}} &= 1.035 \log P_{jt}^{cpi} + 1.045 \left(\frac{Y_{jt}}{pop_{tj}^{wrk}} \right) \\ &+ \left(-2.34 - 4.258 \widetilde{n_{jt}^{yng}} - 24.576 \widetilde{n_{jt}^{wrk}} + 28.834 \widetilde{n_{jt}^{old}} \right) i_{jt} \\ &+ 0.867 \log pop_{jt}^{total} + 2.958 n_{jt}^{yng} + 1.721 n_{jt}^{wrk} - 4.679 n_{jt}^{old} \\ &+ \text{other factors}\end{aligned}$$

where (1) -2.34 is the coefficient of the nominal interest rate (credit condition) i of country j when the country's demographic composition n^x ($x = yng, wrk, or\ old$) is at the (cross-sectional) historical average $\overline{n^x}$, and (2) $\widetilde{n_{jt}^x}$ indicates whether the economy is in a demographic bonus phase ($\widetilde{n_{jt}^{wrk}} > 0$) or onus one ($\widetilde{n_{jt}^{old}} > 0$)

Demography and Credits: Interpretation (2)

The results (of this extended model with cross-term effects between credit conditions and demographic factors in the last slide) imply

- The credit condition's negative coefficient on property prices (that is, a positive effect of declining interest rates) is -2.34, which is in line with the baseline models' results.
- A demographic bonus (n_{jt}^{wrk} ↑) substantially strengthens the positive effects on declining interest rates (loose monetary policy).
- In contrast, a demographic onus ($\widetilde{n_{jt}^{old}}$ ↑) makes decreasing interest rates (monetary easing) have substantially less positive effects on residential property prices.
- These results strongly support the hypothesis of a strong interaction between demographics and credit conditions in Nishimura (2011, 2016).

4. Short-Run Property Price Dynamics

- Short-run RPPI model: (1) Augmented Error Correction of RPPI
  - The fundamental value may not be achieved instantaneously because of transaction costs and imperfect information.
  - Moreover, property prices may be influenced by cyclical macro factors over business cycles, in addition to fundamentals.
  - This suggests the following "augmented" error correction process.
    - Let y_{jt} be RPPI, which gradually incorporates the changes in macro fundamentals x_{jt}, for example, in a ARDL(1, 1) way:

      $$y_{jt} = \delta_{0,j} + \lambda_j y_{j,t-1} + \beta_{0j} x_{jt} + \beta_{1j} x_{j,t-1} + \varepsilon_{jt}$$
    - The traditional error correction process of this ARDL(1,1) is

      $$\Delta y_{jt} = \phi_j (y_{j,t-1} - \theta_j x_{j,t-1}) + \delta_{0,j} + \beta_{0j} \Delta x_{jt} + \varepsilon_{jt}$$

      where $\phi_j = -(1 - \lambda_j)$ and θ_j is the coefficient of the long run relationship.
    - We augment this error correction process with the possible effect of cyclical macro factors z_{jt} (whose long-run effects are nil) :
  - $$\Delta y_{jt} = \phi_j (y_{j,t-1} - \theta_j x_{j,t-1}) + \delta_{0,j} + \beta_{0j} \Delta x_{jt} + \beta_{0j}' z_{jt} + \varepsilon_{jt}$$

- Using this Modified Augmented Structural Error Correction Model framework, we will examine the characteristics of property price movement which are shared among the diverse economies of our sample.

- Specifically, we ask
  - Is property price dyanmics smooth (that is, are shocks gradually waned down), or bumpy, hump-shaped (are they amplified initially then reversed sharply)?
  - Are there significant influences of short-run macro cyclical factors on property prices?
  - Are there any differences between nominal interest gaps and (stationary expectation) real interest gaps?

PMG Framework

- Adapted from Shin, Pesaran, and Smith (1999)
- Impose Long-run Homogeneity: $\theta_j = \theta$ and $\eta_j = \eta \quad \forall\ j$
- However, Short-run Heterogeneity is allowed: ϕ_j; δ_{*j}; λ_{2j}; δ'_{*j}
- Then the PMG model is

$$\begin{aligned}\Delta y_{jt} = \phi_j(y_{j,t-1} - \theta x_{j,t-1} - \eta n_{j,t-1}) + \delta_{0,j} - \lambda_{2j}\Delta y_{j,t-1} \\ + \delta'_{0j}\Delta n_{jt} + \delta'_{1j}\Delta n_{j,t-1} + \delta'_{2,j} z_{jt} + \varepsilon'_{jt}\end{aligned}$$

- Thus, long-run homogeneity assumption that we have made so far can be tested in this framework.

Hausman Tests: PMG versus MG

- $\boldsymbol{\theta}$ is a set of long-run coefficients
- Hypotheses
  - H_0: Difference in coefficients $\boldsymbol{\theta}$ is not systematic
  - H_a: Difference in coefficients $\boldsymbol{\theta}$ is systematic
- $\hat{\boldsymbol{\theta}}_{\text{MG}}$ is consistent under H_0 and H_a
- $\hat{\boldsymbol{\theta}}_{\text{PMG}}$ is inconsistent under H_a, but efficient under H_0
- Test statistic is formed as

$$(\hat{\boldsymbol{\theta}}_{\text{MG}} - \hat{\boldsymbol{\theta}}_{\text{PMG}})'[var(\hat{\boldsymbol{\theta}}_{\text{MG}}) - var(\hat{\boldsymbol{\theta}}_{\text{PMG}})]^{-1}(\hat{\boldsymbol{\theta}}_{\text{MG}} - \hat{\boldsymbol{\theta}}_{\text{PMG}}) \sim \chi^2(g)$$

where g is the number of long-run coefficients

	nominal		real	
estimation period	test stat	p value	test stat	p value
1973-2015	3.48	0.7464	1.99	0.8510
1974-2015	3.97	0.6802	3.60	0.6089
1975-2015	4.63	0.5927	6.75	0.2402
g	6		5	

PMG Estimates of Long Run and Short Run: Real Models, 17 Countries

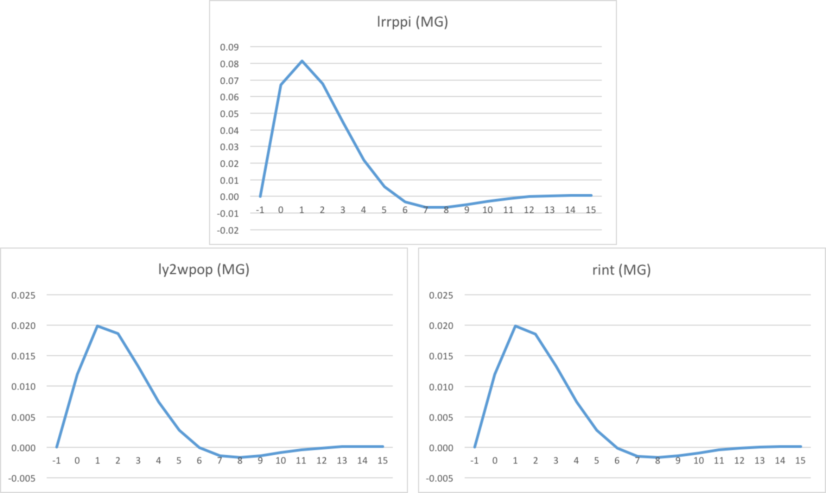
	(1) 1973-2015	(2) 1974-2015	(3) 1975-2015
Long-run relation			
$\log(Y/pop^{wrk})_{-1}$	1.0487***	1.0381***	0.9825***
	[0.0977]	[0.0917]	[0.0806]
r_{-1}	-1.7017***	-1.3020***	-1.2636***
	[0.3940]	[0.3520]	[0.2998]
$\log pop^{total}_{-1}$	2.7473***	2.8789***	3.2393***
	[0.3045]	[0.2687]	[0.2862]
$n^{yng}_{-1} - n^{wrk}_{-1}$	4.9127***	5.4630***	6.2617***
	[0.5872]	[0.5406]	[0.4340]
$n^{old}_{-1} - n^{wrk}_{-1}$	-2.7678***	-3.6290***	-4.7135***
	[0.7652]	[0.6754]	[0.5367]
N	731	714	697
ll	1413.69	1403.91	1402.84

Standard errors in brackets
$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

	1973-2015	1974-2015	1975-2015
Short-run adjustment			
error-correction term$_{-1}$	-0.2276***	-0.2529***	-0.2577***
	[0.0572]	[0.0581]	[0.0631]
$\Delta\log realP^{rppi}_{-1}$	0.4987***	0.4703***	0.4612***
	[0.0668]	[0.0660]	[0.0624]
$\log(Y/pop^{wrk})^{gap}$	0.5992***	0.5362**	0.6059***
	[0.2310]	[0.2485]	[0.2279]
r^{gap}	0.6570***	0.6258***	0.5718**
	[0.2153]	[0.2115]	[0.2622]
$\Delta\log pop^{total}$	13.7890*	17.1636**	17.7216**
	[7.1102]	[6.7906]	[7.5650]
$\Delta\log pop^{total}_{-1}$	-7.1566	-9.7351*	-10.0908*
	[5.2126]	[4.9824]	[5.5447]
$\Delta(n^{yng}-n^{wrk})$	0.9786	1.2187	-0.4231
	[2.9889]	[3.2043]	[3.0770]
$\Delta(n^{yng}-n^{wrk})_{-1}$	-5.8289*	-7.1970*	-6.4518
	[3.4944]	[3.8368]	[4.0698]
$\Delta(n^{old}-n^{wrk})$	0.8340	1.6175	2.4921
	[3.4753]	[3.1820]	[3.5127]
$\Delta(n^{old}-n^{wrk})_{-1}$	1.5507	2.6746	3.0097
	[3.6302]	[3.7572]	[4.0420]
constant	-9.9244***	-11.4564***	-12.3064***
	[2.4397]	[2.5281]	[2.8899]

Standard errors in brackets
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Mean-group responses of $\log real\ P^{rppi}$ to three shocks

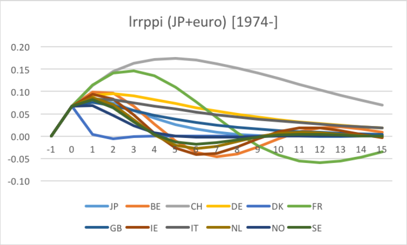


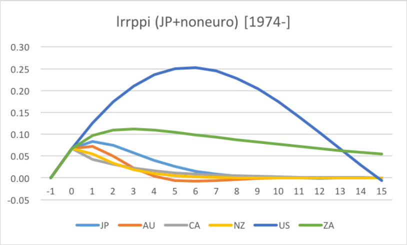
- Units of horizontal axis are years.
- Responses up to 15 years after the shock are plotted.

Findings about the Short-Run Adjustment I

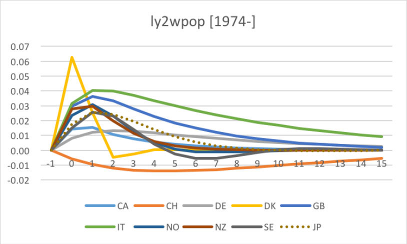
- Short-run property price adjustment is "bumpy" or "hump-shaped".
  - The PMG estimate of the property price adjustment shows that a shock will overshoot prices initially and then the change is reversed.
  - A typical autoregressive part (as in the nominal RPPI 1973-2015 case) is $y_{jt} = 1.161y_{j,t-1} - 0.428y_{j,t-2} + \cdots$ (see the next "footnote" slide)
- Cyclical factors influence property prices significantly. .
  - In the upturn, both long-run fundamentals and short-run cyclical factors push property prices higher, and *vice versa*.
  - The effects of Real-GDP-per-working-age-population GAP is most visible, and its magnitude is close to the long-run effects.
  - A monetary policy cycle factor (nominal interest rate gap) has similar effects in reverse, though not as much as real GDPpwkap.

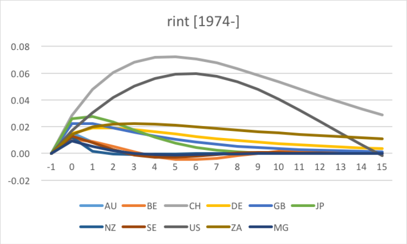
Resp of $\log real\ P^{rppi}$ to its own shock (1SD)





Resp of $\log real\ P^{rppi}$ to $\log(Y/pop^{wrk})$ and r^{gap} (1 SD shock)





- Countries with statistically significant $\hat{\delta}_2$ are reported.
- About $\log real\ P^{rppi}$, Japan's $\hat{\delta}_2$ was not statistically significant, thus added as a reference (dotted line, left graph).

Findings about the Short-Run Adjustment II

- Contrastive effects between nominal interest GAP and real interest GAP.
    - Although real interest hikes reduce real RPPI in the long run,
    - a widening real interest GAP raises property prices.
    - One explanation is that real interest rates in the long run relation is the cost of funds (supply side), while real interest GAP in the short run indicates a higher demand for properties (demand side).

Conclusion

Summing Up

- Property prices of diverse economies during past 44 years
- Time series properties of variables in question are scrutinized and used to construct and estimate appropriate models
- Major findings of this paper are
  1. Demographic composition has significant impacts on residential property prices.
  2. The young dependency ratio $n^{yng} - n^{wrk}$ has strong positive effects on Residential Property Prices RPPI
  3. The old dependency ratio $n^{old} - n^{wrk}$ has strong negative effects on Residential Property Prices RPPI
  4. The present value relation has a very high explanatory power (very high R^2) for long-run residential property prices RPPI.

Summing Up - Continued

- Major findings of this paper - Continued
  1. When demographic bonus (young's dominance) is coupled with easy credit, RPPI are substantially higher than otherwise.
  2. The opposite is the case in a demographic onus (aging) phase, though to a lesser extent.
  3. In the short-run movement of RPPI, a sizable effect of cyclical factors is found, in addition to the effect of the change in long run fundamentals.
  4. Short-run movement of RPPI is "bumpy" or hump-shaped in the sense that a shock is first amplified then dampened.
  5. However, short-run RPPI dynamics differ considerably among countries.

Thank You for Your Kind Attention.