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學術論著

人口老化是否影響房價？亞洲八國分析

Does Population Aging Affect Real Housing Prices? Evidence from Eight Asian Economies

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摘　要

我們檢視了八個亞洲經濟體中人口老化對房價的影響。鑑於大多數亞洲經濟體都比已開發國家經濟體年輕，我們預計他們的人口老化對實際房價的負面影響應該相對較小。然而，我們的研究結果顯示負面影響幅度卻很大。根據Takats(2012)的估算，已開發國家人口老化將導致實際房屋價格在2035年之前每年下降約80個基本點，但是平均而言，亞洲經濟體的下降幅度卻高達每年134個基本點。另外，我們結果進一步發現，在經濟自由度較大的地區，如香港、新加坡、台灣和南韓，其下跌幅度將遠低於樣本中的其他地區。

關鍵詞：房價、人口老化、撫養比例、亞洲經濟體

ABSTRACT

We examine the effect of an aging population on housing prices in eight Asian economies. Given that most Asian economies are younger than advanced economies, we expected their demography to have a comparatively small negative effect on real housing prices. Our findings, however, show that the negative effect is large. On average, total population and population aging will cause real housing price returns to decrease by approximately 134 basis points per annum until 2035, compared to 80 basis points in advanced economies until 2050, as estimated by Takats (2012). The results further show that in regions with greater economic freedom, such as Hong Kong, Singapore, Taiwan, and South Korea, the downward influence will be less than that in regions with less economic freedom.

Key words: housing prices, population aging, old dependency ratio, Asian economies

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1. Introduction

As the global population becomes older, greater attention is paid to understanding the influence of an aging population on financial assets. The lifecycle hypothesis (Modigliani & Brumberg, 1954; Ando & Modigliani, 1963) suggests that working people purchase assets and then sell them after retirement, thus implying that asset values may change based on different demand cycles. During the 1970s, the dramatic rise in real housing prices in the U.S. coincide with the entrance of the baby boom generation into stages of life typically associated with high demand for housing. Extensive studies have examined whether a general asset price meltdown is expected in the future and how the baby boom and bust in the U.S. has affected the nation's equity, debt, and real estate markets.

Unlike well-developed economies, Asian economies have very different financial market mechanisms and cultures. On average, the economic growth for China, Hong Kong, Indonesia, South Korea, Malaysia, Singapore, Taiwan, and Thailand has been far greater than that of the G7 economies over the past 25 years. With respect to the GDP, the G7 members, on average, have a 2 percent growth rate while the rate for the Asian economies is almost three times higher at 6 percent. In economies with rapid growth, asset prices have soared as demands of wealthier households have increased significantly. For example, housing costs in Asia have risen despite government controls, such as the expanded property-purchasing limitations in China and the extra stamp duties and luxury taxes in Singapore, Hong Kong, and Taiwan. These new policies have not, as yet, successfully slowed the growth in housing prices in year 2011.

The Asian economies are facing rapid economic growth as well as changing demographic structures. Table 1 shows the estimates and projections of the population median age for Asian and advanced economies. From Panel A, we observe that, similar to the populations in advanced economies, Asian populations are aging. The average forecasted median age for Asian economies in 2035 (44.2 years old) is very close to that for advanced economies (45.7 years old). Panel B further details the old age dependency ratio (OLD thereafter) for the same period. Hong Kong and Singapore have the highest ratios, 50.8% and 50.2%, respectively, in 2035. Japan has the highest ratio of 61.4%, and Germany has the second highest, 60.3%, for the same year. On average, in 2035, the projected ratio for Asian economies is 38.1%, which is relatively low compared to that of 49.4% for advanced economies. The population aging issue in Asia is, therefore, projected to be less severe than that for the G7 members in the future.

Overall, as the Asian economies have higher economic growth and a lower OLD than advanced economies, it is interesting to investigate whether the effect of economic growth on housing prices outpaces that of an aging population. How the housing market reflects changes in the demographic structure is especially critical for households that are aging and whose major assets are real properties.

The purpose of this study is to examine the effect of economic growth and population aging on real housing prices in the past and the predicted effect in the future for Asian economies. Unlike previous studies, which focus on advanced economies, we investigate regions that have the potential

Table 1. Population Prospectus

Panel A: Estimates and Projections of Population Median Age				
Unit: years	*2010*	*2015*	*2025*	*2035*
China	34.5	36.2	40.1	44.7
H.K.	41.8	43.7	46.6	48.9
Korea	37.9	40.6	45.1	48.6
Indonesia	27.8	29.6	33.3	36.9
Malaysia	26.0	27.5	30.2	33.2
Singapore	37.6	40.3	44.8	47.8
Taiwan	37.4	39.9	45.5	50.4
Thailand	34.2	36.2	40.1	43.4
Average	34.7	36.8	40.7	44.2
Canada	39.9	40.8	42.4	43.9
France	39.9	40.8	41.9	42.7
Germany	44.3	46.5	48.3	49.4
Italy	43.2	45.0	48.4	50.3
Japan	44.7	46.4	50.1	52.2
U.K.	39.8	40.3	40.8	41.9
U.S.	36.9	37.3	38.6	39.6
Average	41.2	42.4	44.4	45.7
Panel B: Estimates and Projections of the Old Age Dependency Ratio				
Unit: %	*2010*	*2015*	*2025*	*2035*
China	12.7	14.4	21.7	33.3
H.K.	18.4	21.5	35.4	50.8
Korea	17.1	20.0	31.9	48.7
Indonesia	9.5	10.0	13.8	20.6
Malaysia	8.6	10.1	14.8	19.9
Singapore	13.6	17.6	31.5	50.2
Taiwan	16.1	18.6	31.5	48.0
Thailand	14.1	15.9	23.8	33.6
Average	13.8	16.0	25.6	38.1
Canada	22.5	25.8	35.9	44.3
France	28.5	32.6	39.8	45.9
Germany	33.4	35.5	43.9	60.3
Italy	33.5	36.5	42.2	54.8
Japan	38.3	46.8	54.7	61.4
U.K	27.8	30.6	34.6	41.2
U.S.	21.8	24.6	32.7	38.1
Average	29.4	33.2	40.6	49.4

*Source: United Nations World Population Prospectus (2011).

*Note: The median age is the age that divides the population into two parts of equal size.

*Note: The old-age dependency ratio is the ratio of the population aged 65 years and over to the population aged 20 to 64.

to grow both in terms of their population and their economy. We expect that an asset price meltdown may not occur and that the negative effect of population aging may be less due to the growing economies and different preferences toward real estate holdings in Asia. The relatively younger age structures in growing economies may also help to slow the downward influence on Asian housing prices.

However, our study shows that after controlling for macroeconomic factors, the downward influence of the OLD for Asian regions is larger than that estimated by Takats (2012) for 22 advanced economies. We find that the positive effect of the total population on real housing prices is more than doubled. In addition, based on forecast data from the United Nations World Population Prospectus (UNPP) (2011), average real housing price returns for our eight Asian economies are expected to decrease by 134 basis points per annum over the next two decades, which is greater than the expected 80 basis points per annum by Takats (2010). The evidence indicates that the effect of population aging on house prices in Asia is even more serious and deserves further attention.

The remainder of this paper is structured as follows. Section II reviews the literature, and Section III describes the research methodologies and data. The empirical results and robustness checks are presented in Section IV, and Section V summarizes and concludes the findings.

2. Literature review

The effect of population aging on financial markets and asset returns is discussed extensively in the literature. We focus on the links between the population age structure and housing markets.

The lifecycle hypothesis of savings proposed by Modigliani & Brumberg (1954) and Ando & Modigliani (1963) suggests an interdependence between demography and asset prices. This hypothesis posits that a household evens out its consumption over a lifetime by using positive savings to build an asset portfolio during its early working age and selling off its stock of assets during retirement. As a population ages, an excess supply of assets occurs and downward pressure on asset prices may follow as retirees gradually liquidate their asset holdings. This theoretical model has inspired many empirical works to examine the relationship between population age structures and asset returns.

Bakshi & Chen (1994) address how the composition of household saving portfolios changes over their lifetimes. They show that when the average age of U.S. households increases, the aggregate demand for financial assets increases while housing demand decreases. Erb et al. (1997) find little relation between world average demographic measures and expected returns, although population demographics are likely to reveal the risk exposure of a particular country. Ang & Maddaloni (2005) examine the link between equity risk premiums and demographic changes using a long sample for 15 countries, and find that demographic variables significantly predict excess returns.

Empirical investigations of the relationship between demographic structure and housing prices can be traced to Mankiw & Weil (1989), who document that decreases in the number of births over time appear to have a substantial negative effect on the price of housing. Moreover, they forecasted that by 2007, housing prices in the U.S. would decline by a total of 47 percent as the baby bust generation reached the house-buying age. However, Hamilton (1991), Hendershott (1991), and Holland (1991) questioned Mankiw-Weil's results. Using Canadian data, Engelhardt & Poterba (1991) do not find a significant association between demographic demand and housing prices, suggesting that the evidence observed by Mankiw & Weil (1989) may be country specific. Swan (1995) also advises caution in applying the Mankiw-Weil forecast because housing price forecasts need to integrate information on demand with information for both cost factors and the supply of new houses.

Takats (2012) uses housing price data from 22 advanced economies over 40 years and finds that demographic variables, including the OLD and total population, are significantly related to real housing prices. He concludes that the historical demographic tailwind leads to partial housing price dividends, and the forecasted demographic headwind should result in a decline in real housing prices of approximately 80 basis points per annum over the next 40 years, other conditions remaining constant. Nguyen (2012) investigates the effect of each age group in the population on the returns of all assets and concludes that population aging has the strongest effect on housing prices. She shows that as the population ages, real returns on housing and bonds decline and that equity premiums are higher in countries with relatively older populations.

From the literature, we observe that population aging significantly affects both housing and capital markets in advanced economies. Especially, after the 2008 subprime crisis, greater attention has been placed on housing, which accounts for the highest percentage of most households' wealth and is also most affected by the aging problem. However, there has been less focus on how an aging population affects the Asian economies that have been growing and are still under development. Therefore, we investigate whether Asian housing markets behave in the same way as those in other regions. Our study focuses on eight Asian economies and contributes to the literature by providing greater insight into the aging problem worldwide.

3. Data and methodology

3.1 Hypothesis

The lifecycle theory suggests that population aging results in excess supply in asset markets and downward pressure on asset prices. Consequently, housing prices are expected to decline as households age. Past studies provide empirical evidence to support this argument. However, no conclusive and comprehensive studies have been conducted in Asia. While we expect to observe a similar negative relationship as Asian populations become older, certain differences must be taken into consideration. First, compared with advanced economies, Asian economies are still growing and the demand for housing continues to rise. Second, there is a difference in perception toward housing in Asia, where real estate is always the first chosen asset to hold and pass on to the next generation. In 2012, the home ownership rate in the U.S. was 65.3%, based on the Census of Housing by the U.S. Census Bureau, and in Japan and Germany it was 61.6% and 53.3%, based on the Statistics Bureau of Japan and European Commission, respectively. However, it was 79.2% in Taiwan, according to the Directorate-General of Budget, Accounting and Statistics; 90.5% in Singapore, according to the Department of Statistics; and 93.5% in China, according to the Institute of Social Science at Peking University. These figures indicate that Asian households have strong preferences for owning properties. Thus, even when households grow old, they may not sell their houses as predicted by the lifecycle hypothesis. Consequently, housing prices may not decline with the aging population. Accordingly, the combined effect of fast growing economies and the attitude toward housing may offset the negative effect of aging on housing prices.

3.2 Data

Our sample includes data from four industrialized economies—Hong Kong, South Korea, Singapore, and Taiwan—and four rapidly developing economies—China, Indonesia, Malaysia, and Thailand— for the 1988 to 2011 period.

The dependent variable, the real house price index (RHPI), is the nominal house price indices compiled by the bank for international settlements (BIS) (2013) and the CEIC Asia database. The house prices are transformed into real terms by deflating the home country's consumer price index. Previous studies have applied similar Asian house price data (Zhu, 2006; Glindro et al., 2011; Ciarlone, 2012; Igan & Loungani, 2012). However, whereas those studies use quarterly data. Since not all variables in our study have quarterly data, in order to be consistent, we use yearly data over a longer time span by taking the averages of the quarterly housing prices in a year to capture the slow-moving trait of demographic changes.

Figures 1 and 2 show the real house price trends from 1988 to 2011. The industrialized economies have more price observations during the sample period. Figure 1 shows that house prices strongly co-moved after the Asian Financial Crisis in 1997. For the rapidly developing economies,

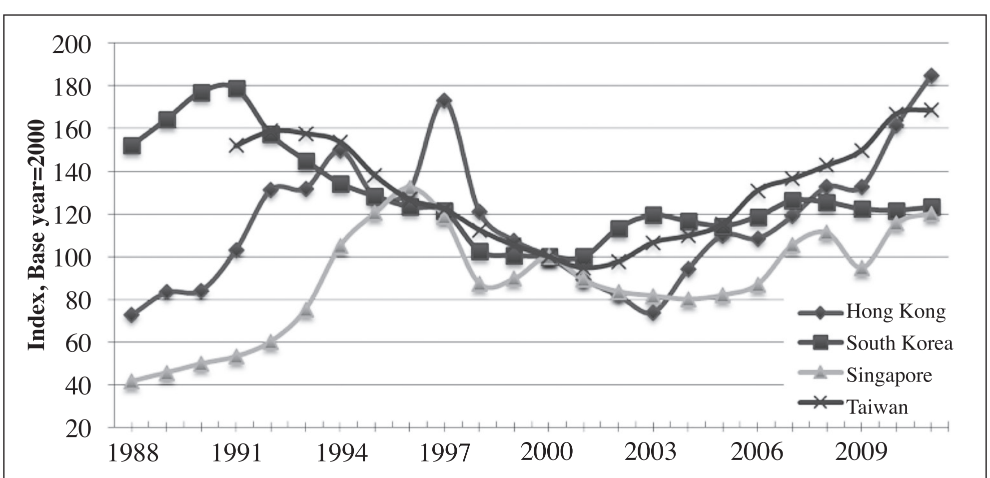

Figure 1. Real House Prices in the Four Industrialized Economics

*Sources: bank for international settlements (BIS) and CEIC.

*Note: the time series are deflated by consumer price indices: 2000=100.

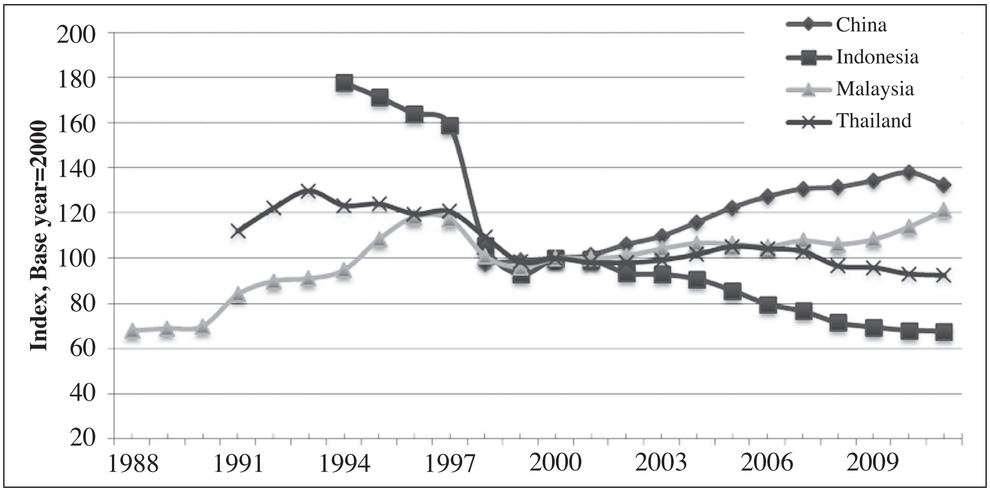

Figure 2. Real House Prices in the Rapidly Developing Economies

*Sources: bank for international settlements (BIS) and CEIC.

*Note: the time series are deflated by consumer price indices: 2000=100.

Figure 2 demonstrates a less volatile real house price trend. China tends to grow the fastest, with Malaysia following in second place. In contrast, Thailand and Indonesia do not recover after 1997, with Indonesia showing the greatest lag. Real house prices in Indonesia decline over time due to high domestic inflation, which deflates the nominal value of real estate.

The demographic variables, the OLD and total population, are collected from the United Nations World Population Prospects (2011). Both series are based on five-year intervals and are interpolated linearly into yearly frequencies. (Ang & Maddaloni, 2005; Egert & Mihaljek, 2007; Takats, 2012).

The macroeconomic variables, the real GDP per capita, unemployment rate, and real interest rate, are compiled from the World Bank's World Development Indicator database. The stock value of foreign direct investment inflow over GDP is collected from the United Nations Conference on Trade and Development. The land supply indices are collected from the CEIC database. Because the definitions of land supply vary from country to country, we follow the method of Glindro et al. (2011) by using building permits as a proxy and standardize different series by indexation. The demographic and macroeconomic data for Taiwan are compiled from the AREMOS database and the Taiwan Economic Journal.

3.3 Empirical model

Different from most previous studies that concentrate on the demographic influence only, we incorporate more explanatory variables and consider endogeneity and multicollinearity issues.

In Equation (1), the real GDP per capita (RGDPCAP) captures the economic effect, such as household wealth, and is expected to be positively correlated with real house prices (RHPI). We apply two demographic factors. The first is the OLD that is measured by the fraction of the population aged

65 and older divided by the working-age population aged 20 to 64. The second is the total population (POP). These two forces work simultaneously, but in opposite directions. The OLD capture the composition effect, which is negatively linked to house prices, while the POP captures the size effect, which is positively linked to house prices.

We further incorporate housing demand-side factors, including the unemployment rate (UNEMPLOY), the real interest rate (RIR), and the stock value of foreign direct investment inflow over GDP (FDI). The unemployment rate is the proxy for labor market conditions and is expected to have a negative sign. The real interest rate is defined as the lending rate deflated by the inflation rate. It is a proxy for the opportunity cost of purchasing real estate and is expected to have a negative effect on housing prices. We incorporate the FDI to control for housing demand caused by foreign capital inflow. The sign of FDI is expected to be positive.

As housing supply also significantly affects housing prices, we include land supply (LSI) with a one-period lag to prevent simultaneous bias. We expect the effect to be negative because an increase in the housing supply should depress housing prices.

$$f\{\text{RGDPCAP}(+), \text{OLD}(-), \text{POP}(+), \text{UNEMPLOY}(-), \text{RIR}(-), \text{FDI}(+), \text{LSI}(-) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Previous studies indicate that housing prices may be affected by the price of alternative investment assets. However, we do not incorporate this variable in order to avoid the endogeneity problem. The other reason is that there are too many alternative investments to consider, from stock, bond, futures, mutual funds, and commodities. Those securities may correlate with the housing market, though the relationship may be remote. Furthermore, there is no reference about which assets should be included. Because housing provides households the consumption function first, then investment function followed. Consequently, we focus on the variables that are closely related to housing price from the perspective of consumption. Finally, the capital markets within those eight Asia regions are very different. Singapore should have well developed markets, nevertheless Indonesia is still under construction. Consequently, we decide not to include alternative investments in the equation.

Methodology

3.4 Unit root test

Due to the limited number of observations in the time series, we conduct the panel unit root test proposed by Im et al. (2003) to verify whether the variables are stationary. Im et al. (2003) developed a computationally simple procedure for testing the unit root hypothesis in heterogeneous panels. They apply Monte Carlo methods to test the small sample properties of the proposed tests and find out that the t-bar test performs very well. Im et al. (2003) relaxes the assumption of a common autoregressive parameter in Levin et al. (2002). Moreover, this method can be implemented with an unbalanced panel dataset assuming that both the number of panels N and the number of time periods T are fixed.

3.5 Panel regression estimation

We implement a cross-country macro-analysis to examine the link between population aging, economic growth, and real house prices. Stock & Watson (2007) suggest that panel data can be used to learn more about economic relationships from the many different entities in the data set and from the evolution of the variables over time for each entity. We conduct a panel regression with time as a fixed effect. The time fixed effect is implemented to control for unobserved variables that are constant among countries but evolve over time, such as the boom and bust of business cycles.

Due to the potential heterogeneity among countries, we create a high income per capita dummy variable called ECON to capture country-specific economic development status. The sample countries are classified into two groups, the four industrialized economies and the rapidly developing economies. ECON equals 1 for the four industrialized economies because they enjoy a higher per capita income; otherwise, ECON equals 0. We treat this indicator variable as an entity fixed effect that varies across regions but not over time.

We summarize the regression model as follows:

$$RHPI_{i,t} = \beta_0+\beta_1 RGDPCAP_{i,t}+\beta_2 OLD_{i,t}+\beta_3 POP_{i,t}+\beta_4 ECON_i+\beta_5 UNEMPLOY_{i,t}+ \beta_6 FDI_{i,t}+\beta_7 LSI_{i,t-1}+\beta_8 RIR_{i,t}+\beta_9 \lambda_t+\varepsilon_{i,t} \quad (2)$$

In Equation (2), i refers to the country being observed and t refers to the year of the observation. β_0 is the regression intercept. λ_t indicates T-1 year dummies that capture the time fixed effect. We do not use the year T dummy to avoid perfect multicollinearity.

4. Empirical results

4.1 Unit root tests

The outcomes of the unit root tests indicate that most of the variables are stationary in first differences and that the unemployment rate and real interest rate follow an I(0) process in both tests. Therefore, the unemployment rate and real interest rate are treated as a log-level and a value-level variable, respectively. The other variables are log-difference variables.

4.2 Summary statistics

Table 2 presents the descriptive statistics for each country and the whole sample. The returns on real housing prices for countries with a high OLD, such as South Korea, Taiwan, and Thailand, are relatively lower than those for countries with a modest OLD, such as China and Hong Kong. There are two exceptions - Indonesia and Singapore. Indonesia suffers negative real housing returns that may be caused by the high inflation rate used to deflate housing prices, while Singapore enjoys positive real housing gains even though the OLD is high, which could be the result of the immigration policy implemented by the government to attract foreign investments.

Table 2 further reveals that countries with relatively higher POP are accompanied by higher

Table 2. Summary Statistics

Country		China	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Taiwan	Thailand	Overall
RHPI	*Mean*	2.34%	4.06%	-5.69%	-0.92%	2.51%	4.60%	0.52%	-0.96%	0.99%
	Std.	2.51%	15.62%	9.99%	6.66%	6.32%	13.79%	6.69%	4.69%	9.93%
RGDPCAP	*Mean*	8.50%	2.90%	3.70%	4.41%	3.65%	3.82%	4.36%	3.71%	4.38%
	Std.	2.62%	3.40%	4.51%	3.45%	3.92%	4.32%	7.15%	4.88%	4.67%
OLD	*Mean*	0.80%	1.53%	0.93%	3.32%	0.76%	2.21%	2.08%	2.42%	1.76%
	Std.	0.71%	0.84%	0.41%	0.97%	1.21%	1.28%	1.12%	0.75%	1.27%
POP	*Mean*	0.84%	1.02%	1.34%	0.61%	2.24%	2.50%	0.66%	1.00%	1.28%
	Std.	0.35%	0.67%	0.23%	0.21%	0.39%	0.73%	0.30%	0.29%	0.80%
UNEMPLOY	*Mean*	1.18	1.21	1.74	1.16	1.27	1.09	1.06	0.54	1.16
(Log-level)	*Std.*	0.24	0.58	0.51	0.31	0.23	0.33	0.48	0.44	0.50
FDI	*Mean*	4.80%	1.52%	4.58%	7.90%	3.22%	4.68%	3.34%	8.12%	4.77%
	Std.	13.28%	21.13%	38.21%	22.09%	15.53%	11.76%	18.47%	21.42%	21.34%
LSI	*Mean*	12.17%	-4.29%	4.39%	2.30%	4.53%	6.28%	0.08%	-5.00%	2.55%
(One-period lag)	*Std.*	10.30%	28.08%	37.53%	22.77%	12.44%	16.37%	22.25%	48.17%	27.47%
RIR	*Mean*	1.50	4.64	5.91	3.55	3.80	4.24	5.59	5.64	4.36
(Value-level, %)	*Std.*	3.77	4.71	8.39	2.52	3.78	3.75	1.64	2.93	4.50

*Note: All of the variables are in log-differences, except for the unemployment rate, which is at the log level, and the real interest rate, which is at the value level. RHPI is the real house price index. RGDPCAP is real GDP per capita. OLD is the fraction of the population aged 65 and older divided by the working age population aged 20 to 64. POP is the total population. UNEMPLOY is the natural log of the unemployment rate. FDI is the stock of foreign direct investment inflow over GDP. LSI is the land supply index with a one-period lag. RIR is the real interest rate.

real housing returns. For example, the POP of Hong Kong and Singapore are 1.02 and 2.50 percent, respectively, and their real housing returns are 4.06 and 4.60 percent, respectively. We also observe that the overall RGDPCAP is approximately 4.38 percent and the overall FDI is approximately 4.77 percent. These figures indicate that, on average, the sample countries enjoy promising economies and attract international investments.

4.3 Correlation analysis

We use the Pearson correlation matrix to test all variables. All of the correlation coefficients are well below ±0.8; hence, a perfect multicollinearity problem is not observed. We further apply variance inflation factors (VIFs) to investigate the existence of multicollinearity. Kennedy (2003) suggests that a VIF exceeding 10 may indicate a multicollinearity problem in the multiple regression. As most of the VIFs in our results are approximately 1.5 and the average is 3.98, there should be no multicollinearity problems.

Poterba (2001) and Ang & Maddaloni (2005) indicate that if most of the sample countries follow different demographic patterns, a cross-country analysis will generate more information about the relationship between the demographic factors and the dependent variable. Accordingly, we conduct a test to examine the correlations between the demographic factors of the eight sample economies. We find that most of the cross-country correlations for the OLD and POP are below ±0.8, indicating that the sample countries follow, more or less, different demographic patterns from each other. Thus, a cross-country analysis should increase the statistical power and generate richer information.

4.4 Estimation results

Table 3 reports the estimation results of Equation (2). The outcome of Model (1) is quite consistent with previous work, and all of the variables have their expected signs. The real GDP per capita growth rate and total population growth rate are positively and significantly correlated with real house price returns, while the OLD has an insignificant negative effect. In addition, the coefficient of the ECON is positive and significant. This indicates that Hong Kong, South Korea, Singapore, and Taiwan have higher real house prices than China, Indonesia, Malaysia, and Thailand. Glindro et al. (2011) and Ciarlone (2012) quantify unobserved institutional factors using the Heritage Foundation's "Rankings of Economic Freedom" and show that they positively affect housing prices. We then apply ECON, which is closely related to the economic freedom index, to control for unobserved institutional factors.

The intercept in Model (1) is large and statistically significant, implying that there are still some unexplained factors. We incorporate additional variables – the unemployment rate, foreign investment, land supply, and real interest rate – into the regression. Models (2) through (5) show that the effect of the OLD becomes negative and significant. Furthermore, UNEMPLOY has a strong negative effect on real house prices, which is consistent with the findings of Egert & Mihaljek (2007) and Ciarlone (2012). Foreign direct investment inflow has a positive, but insignificant, effect on real house price returns. This positive sign, as expected, is similar to the finding of Tillmann (2013), while the LSI is negatively associated with house price returns, though it is not statistically significant. This finding differs from Glindro et al. (2011) and Ciarlone (2012). The real interest rate has no effect on house price returns which is similar to Nguyen (2012). Overall, all coefficients are stable in Models (2) through (5).

The OLD exhibits negative signs, as expected, and with reasonably significant values. Using the results from Model (4) as an example, a one percent growth in the OLD leads to a 1.12 percent decrease in real house price returns. The elasticity of the total population is nearly twice that of the OLD, 2.41. A one percent increase in the unemployment rate causes a 0.04 percent decrease in real house price returns. As the real interest rate coefficient is not significant in Model (5) and Model (4) has a higher R-square, we apply Model (4) instead of Model (5) to perform robustness checks and to predict housing prices in the following. Due to data availability, we only have limited annual observations, consequently, the interpretation should be cautious.

Table 3. Regression Analysis

Variable	(1)	(2)	(3)	(4)	(5)
RGDPCAP	0.4839** (2.22)	0.5364** (2.48)	0.5614*** (2.66)	0.6442*** (2.92)	0.6448*** (2.88)
OLD (65+/20-64)	-0.5004 (-0.87)	-1.1520* (-1.90)	-1.2107** (-2.02)	-1.1234* (-1.89)	-1.1251* (-1.87)
POP	2.1208** (1.97)	2.1123** (1.98)	2.1241** (2.00)	2.4134** (2.22)	2.4150** (2.21)
ECON DUMMY	0.0328** (2.26)	0.0396*** (2.71)	0.0400*** (2.77)	0.0392** (2.58)	0.0400*** (2.68)
UNEMPLOY (Log-level)	-	-0.0373*** (-3.27)	-0.0397*** (-3.43)	-0.0376*** (-3.18)	-0.0377*** (-3.12)
FDI	-	-	0.0259 (0.72)	0.0295 (0.80)	0.0298 (0.80)
LSI (One-period lag)	-	-	-	-0.0141 (-0.63)	-0.0142 (-0.63)
RIR (Value-level)	-	-	-	-	0.0002 (0.09)
Intercept	-0.0449* (-1.66)	0.0063 (0.21)	0.0079 (0.26)	-0.0029 (-0.09)	-0.0035 (-0.11)
Obs.	162	162	162	153	153
Adjusted R-square	0.33	0.35	0.35	0.34	0.33
F-statistic	4.06	4.24	4.09	3.75	3.59
Durbin-Watson Statistic	1.55	1.60	1.58	1.56	1.56

* The t statistics are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. The standard errors are White heteroskedasticity-consistent standard errors and covariance. All of the variables are in log-differences, except for the unemployment rate, which is at the log level, and the real interest rate, which is at the value level.

* The dependent variable is the real house price index (RHPI). RGDPCAP is real GDP per capita. OLD is the old age population (individuals aged 65 and over) divided by the working population (individuals aged 20 to 64). POP is the total population. ECONDUMMY equals 1 if the country is Hong Kong, South Korea, Singapore, or Taiwan and 0 otherwise. UNEMPLOY is the natural log of the unemployment rate. FDI is the stock of foreign direct investment inflow over GDP. LSI is the land supply index with a one-period lag. RIR is the real interest rate.

4.5 Robustness checks

We apply different proxies to the OLD for robustness checks. OLD2 is the fraction of the total population aged 65 and older. OLD3 follows the United Nation’s standard definition of the old age dependency ratio, which is the number of individuals aged 65 and older divided by the number aged

15 to 64. OLD4 is calculated as the number of individuals aged 70 and older divided by the number aged 20 to 69. OLD5 is the number of individuals aged 70 and older divided by the number aged 25 to 69.

Table 4 indicates that the coefficient of the OLD becomes larger as its definition narrows. For example, the coefficient of OLD5 is -2.34, which is almost double that of OLD2 in Model (1) and

Table 4. Robustness Check – Alternative Old Age Dependency Ratios

Variable	(1)	(2)	(3)	(4)
RGDPCAP	0.6389*** (2.88)	0.6425*** (2.44)	0.5821** (2.56)	0.6028*** (2.75)
OLD 2 (65+/All)	-1.3906** (-2.08)	-	-	-
OLD 3 (65+/15-64)	-	-0.9975* (-1.80)	-	-
OLD 4 (70+/20-69)	-	-	-1.9182*** (-3.07)	-
OLD 5 (70+/25-69)	-	-	-	-2.3413*** (-3.71)
POP	2.1047* (1.89)	2.3607** (1.98)	1.4922 (1.29)	1.3549 (1.25)
ECON DUMMY	0.0373** (2.59)	0.0372** (2.51)	0.0519*** (3.52)	0.0568*** (3.86)
UNEMPLOY (Log-level)	-0.0377*** (-3.16)	-0.0361*** (-3.13)	-0.0444*** (-3.80)	-0.076*** (-3.97)
FDI	0.0304 (0.81)	0.0293 (0.79)	0.0278 (0.75)	0.0260 (0.70)
LSI (One period-lag)	-0.0165 (-0.73)	-0.0153 (-0.68)	-0.0135 (-0.62)	-0.0156 (-0.73)
Intercept	0.0155 (0.45)	-0.0032 (-0.10)	0.0354 (1.04)	0.0410 (1.32)
Obs.	153	153	153	153
Adjusted R-square	0.34	0.33	0.36	0.37
F-statistic	3.80	3.73	4.03	4.24
Durbin-Watson Statistic	1.57	1.55	1.61	1.66

* The *t* statistics are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. The standard errors are White heteroskedasticity-consistent standard errors and covariance. All of the variables are in log-differences, except for the unemployment rate, which is at the log level, and the real interest rate, which is at the value level.

* The dependent variable is the real house price index (RHPI). RGDPCAP is the real GDP per capita. OLD2 is the old age population (individuals aged 65 and over) divided by the total population. OLD3 is the old age population (individuals aged 65 and over) divided by the working population (individuals aged 20 to 64). OLD4 is the old age population (individuals aged 70 and over) divided by the working population (individuals aged 20 to 69). OLD5 is the old age population (individuals aged 70 and over) divided by the working population (individuals aged 25 to 69). POP is the total population. ECON equals 1 if the country belongs to the Four Asian Tigers and 0 otherwise. UNEMPLOY is the natural log of the unemployment rate. FDI is the stock of foreign direct investment inflow over GDP. LSI is the land supply index with a one-period lag.

those of all models in Table 3. This suggests that as households age, real housing prices decrease, which supports the lifecycle hypothesis. Similar to advanced economies, retired households in the eight Asian economies may intend to dispose their properties. In other words, the concept of housing being an important inheritance is no longer as strong as it used to be. This change should affect the real housing price trend in the future, and thus, it deserves greater attention. This conjecture is observed in Models (3) and (4), which show that the coefficient of the total population becomes insignificant when the percentage of people aged 70 and over increases.

According to Davis & Li (2003), a large saving-age cohort, defined as the fraction of the population aged 40 to 64, will positively affect real asset prices. Consequently, we include the WORK variable in the model to test whether the results for the old age dependency ratio are stable. In Table 5, Model (1) shows that the coefficient of WORK is positive, but not statistically significant. Model (2) indicates that the OLD is still significantly negative after the saving-age cohort is included and that the magnitude of the WORK coefficient remains unchanged. Thus, the negative effect of the OLD on real house price returns surpasses the positive effect of the saving-age cohort.

Overall, we find that the negative relationship between population aging rate and real house price returns is robust. We further derive future real housing price movements based on forecasted demographic data.

4.6 Real house price projections based on demographic effects

We use the expected future demographic changes to forecast real housing price returns over the next 25 years. The projections for the OLD and population growth are compiled from the UNPP (2011) using a medium-variant estimate. We hold all other control factors constant and assume that the economy is under constant natural unemployment. We then use the compounded annual changes in the demographic variables and the coefficients of Model (4) in Table 3 to estimate the demographic effect on future price movements.

Figure 3 presents the trend of the OLD for each region through 2035. This trend grows dramatically after 2010 and is projected to be two and a half times greater than the 2010 ratio by 2035. Hong Kong, Singapore, Korea, and Taiwan are expected to have higher ratios than Thailand and China, while Indonesia and Malaysia show the slowest aging process.

From the projected annual population growth rate provided by the UNPP (2011) (see on-line Appendix F), we observe that most countries enjoy positive but diminishing population growth. As the total population is a positive demographic factor, the decrease in population will lead to house price headwinds and the population dividend should fade out. The UNPP (2011) also shows that the overall growth rate of the OLD will continue to increase until 2035 (see on-line Appendix G). The combined effect indicates a good possibility of an asset meltdown.

Table 6 shows our forecasted annual changes in real house price returns for different periods. Generally, due to the deceleration of population growth and the rapid aging of the population, housing price returns are expected to fall, on average, by approximately 1.34 percent annually, which

Table 5. Robustness Check – Working Cohort

Variable	(1)	(2)
RGDPCAP	0.6546*** (3.13)	0.6282*** (2.93)
WORK (40-64/All)	0.3472 (0.24)	0.3538 (0.24)
OLD (65+/20-64)	-	-1.1241* (-1.87)
POP	2.8088** (2.41)	2.4924** (2.05)
ECON DUMMY	0.0289** (2.10)	0.0383** (2.53)
UNEMPLOY (Log-level)	-0.0268** (-2.39)	-0.0375*** (-3.14)
FDI	0.0224 (0.59)	0.0292 (0.79)
LSI (One-period lag)	-0.0190 (-0.82)	-0.0138 (-0.61)
Intercept	-0.0441 (-1.06)	-0.0106 (-0.22)
Obs.	153	153
Adjusted R-square	0.32	0.33
F-statistic	3.60	3.60
Durbin-Watson Statistic	1.53	1.55

* The *t* statistics are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. The standard errors are White heteroskedasticity-consistent standard errors and covariance. All variables are in log-differences except unemployment rate, which is at the log level, and real interest rate, which is at the value level.
* The dependent variable is the real house price index (RHPI). RGDPCAP is the real GDP per capita. WORK (40-64/All) is the working age population (individuals aged 40 to 60) divided by the total population. OLD (65+/20-64) is the old age population (individuals aged 65 and over) divided by the working population (individuals aged 20 to 64). POP is the total population. ECON equals 1 if the country belongs to the Four Asian Tigers and 0 otherwise. UNEMPLOY is the unemployment rate. FDI is the stock of foreign direct investment inflow over GDP. LSI is the land supply index with a one-period lag.

is approximately 1.67 times higher than that estimated by Takats (2012).[1] This is due to the larger coefficient of the OLD in our model and a faster expected aging process in our sample economies. The positive coefficient on ECONDUMMY offsets some of the negative demographic effect on housing prices in countries with a higher income per capita. Overall, the estimated partial negative demographic effect is the most severe in China, at approximately -4.14 percent per annum, while positive changes in real house price returns in Hong Kong suggest that housing prices are somehow immune to demographic headwinds.

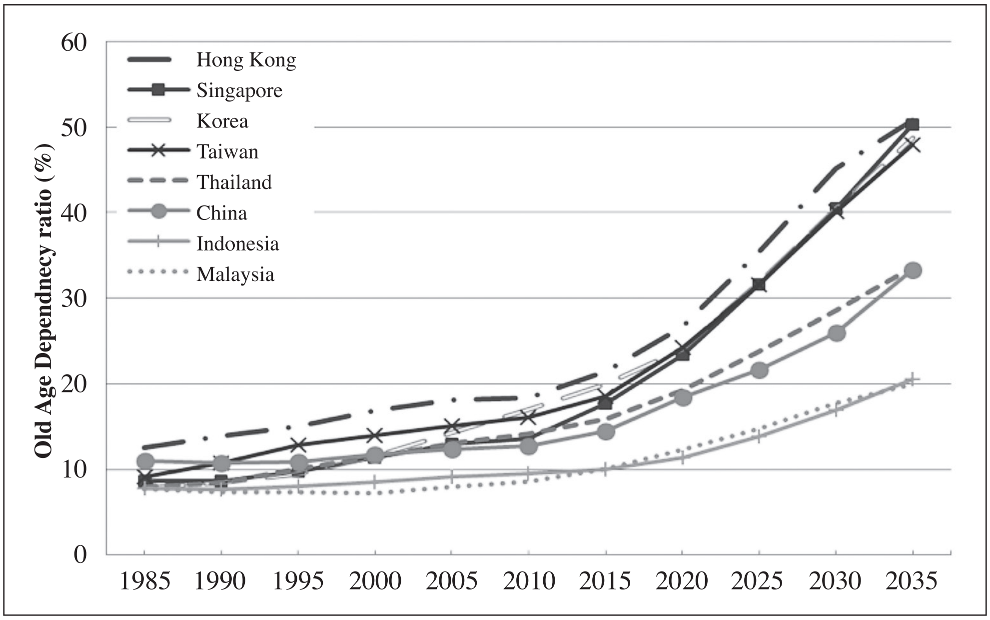

Figure 3. Estimated and Projected Trend of OLD

* Sources: United Nations World Population Prospectus (2011)

* Note: OLD is the old age dependency ratio. Estimates for OLD are from 1985 to 2010. Projections for OLD are from 2010 to 2035. The variant is based on a medium fertility rate.

These results should be interpreted with caution. First, we assume that other control variables remain unchanged, that is, the simulated results represent the marginal changes in housing prices based solely on demographic variations. However, demographic variation may be accompanied by personal income growth, and unemployment rates fluctuate over time. If macroeconomic factors outweigh demographic factors, real housing prices may continue to rise, especially in growing economies. Second, we assume that the demographic pattern is homogeneous within each country, though the population structure is different and dynamic within a country. Third, we apply historic and projected demographic data from the UNPP (2011). However, demographic movement is dynamic and stochastic; therefore, estimation errors from forecasting may occur. Fourth, as most Asian countries did not publish house price information until the early 1990s, the small sample size may limit the inference of our housing price projections.

Overall, the simulation results show that demographic headwinds will become a prominent negative influence on housing prices in the future. Nevertheless, as it is merely a marginal factor, we expect a thorough housing market meltdown to be unlikely.

5. Conclusion

The lifecycle hypothesis suggests that housing prices decline in response to an aging population. As there is empirical evidence to support this conjecture in advanced economies, the question arises as to whether it also holds for Asian countries with higher economic growth rates.

Table 6. Projected Real House Price Changes Based on Demographic Effect

Unit: %	*2011~2015*	*2015~2020*	*2020~2025*	*2025~2030*	*2030~2035*	*Mean*
China	-1.89	-4.95	-3.54	-4.22	-6.12	-4.14
Hong Kong	2.92	1.29	-0.45	0.25	2.65	1.33
Indonesia	1.22	-0.98	-2.71	-3.27	-3.45	-1.84
Korea	1.24	0.34	-2.14	-1.43	-0.65	-0.53
Malaysia	-0.02	-1.04	-1.16	-1.39	-0.18	-0.76
Singapore	0.55	-0.61	-1.26	-0.38	-0.10	-0.36
Taiwan	0.79	-1.80	-1.89	-1.64	-0.75	-1.06
Thailand	-1.57	-3.55	-4.27	-3.86	-3.72	-3.39
Mean	0.40	-1.41	-2.18	-1.99	-1.54	-1.34

*Sources: United Nations Population Prospectus (2011)

Due to rapid economic development, housing prices are relatively high in most Asian countries. Consequently, housing price control is one of the most critical issues faced by governments, where most policies have focused on depressing the housing market in the short term. However, changes in demographic structure have been ignored, and there are surprisingly few investigations of how population aging affects Asian housing markets in the extant literature.

We examine the effect of aging on real house prices in eight Asian economies – Hong Kong, Singapore, South Korea, Taiwan, China, Indonesia, Malaysia, and Thailand – between 1988 and 2011. The results indicate that population aging significantly and negatively affects housing prices after controlling for macroeconomic factors such as GDP per capita, unemployment rate, foreign direct investment, and land supply. We use data from the UNPP (2011) to simulate the potential decline in housing prices over the next 25 years. On average, real house price returns are expected to fall approximately 1.34 percent based on demographic variation alone. The estimated effect is the most severe in China at approximately -4.14 percent per annum, followed by Thailand at -3.39 percent. Indonesia is third at -1.84 percent, followed by Taiwan at -1.06 percent. Relatively mild effects are forecasted for South Korea, Malaysia, and Singapore. Hong Kong is the only economy with an expected positive effect at1.33 percent per annum.

The average price decline rate in our study is higher than the approximate 80 basis points estimated by Takats (2012). Although Asian economies are expanding faster than advanced economies, their populations are simultaneously aging, causing real housing prices to decrease at a faster rate. However, our results show that an asset price meltdown is unlikely. Finally, the estimated negative aging effect on housing prices is relatively mild in places with greater economic freedom.

Asian economies have seen significant growth over the past decade, which has resulted in rising house prices. Our evidence suggests that real housing price headwinds may occur in the future, and their negative effect may be larger than that seen in advanced economies. Given our results, house price control programs in Asia face greater challenges and should, therefore, be planned in a more sophisticated manner. The relaxation of the one-child policy in China on November 18, 2013, indicates that the government is trying to foster population growth to slow down the aging problem, which may, in turn, smooth out the future housing price decline.

Note

1: Takats (2012) forecasts that demographic headwinds will decrease average house price growth by around 0.8 percent per annum through 2050.

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