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Home Price Cycles:
A Tale of Two countries

Abstract

This study compares recent home price dynamics of two countries, Korea and the U.S., in terms of underlying determinants of price variations, over time and across locations, along with dynamic adjustment patterns of disequilibrating price shocks. In particular, 2-stage error correction models (2S-ECM) are fitted by using city-level panel data sets from both countries, covering the recent boom-busts. Three empirical findings are worth noting. First, while the income variables are fairly stable in their price effects in both countries, across different model specifications and across different time periods, there has been a regime shift in Korea in that the user cost for owning greatly increases its explanatory power in Korea after the 1997-1998 financial crisis. Second, unlike the recent upsurge in the U.S., an over-valuation of similar magnitude is not observed in Korea. Third, the speed of reverting to long-term equilibrium price level is shown to be faster in Korea. With further investigation due, this outcome may reflect the aggressive policy stance of the Korean government in maintaining the stability in home price movement. Using the empirical evidences at hand, several policy issues are discussed.

Keywords: House price cycles, serial correlation, mean reversion, housing policy
JEL Codes: R31, R22, E32, D12

I. Introduction

Under the efficient market hypothesis, asset prices should exhibit no price rigidity, nor long cycles of boom-bust patterns over time. Home price dynamics observed in different countries are far from fitting to this description, with high degrees of serial correlation and long-duration mean reversions toward fundamentals-driven equilibrium levels. (Case and Shiller (1989), Abraham and Hendershott (1996), and Capozza, Hendershott, and Mack (2004)) Provided that home equity represents the largest share in household wealth in most countries,[1] the cyclical home price pattern entails several obvious welfare implications, such as wealth and collateral effects on macroeconomy as well as credit risk consequence for, and, hence, the soundness of, mortgage lending institutions.

In that sense, the Great Home Price Cycles in the recent years observed in the U.S. and other countries warrant careful investigation, as to similarities and dissimilarities compared to prior cycles and their underlying determinants. Specifically, between 2002-2006, there have been strong home price booms among the OECD countries, average real annual HP growth rates reaching 18% in Spain, 15% in UK, 14% in Netherland, 11% in Ireland, and 8% in the US. Germany and Japan were about the only exceptions (Renaud and Kim, 2007) These upturns were also highly correlated, with the low interest rate environment, mortgage-MBS innovations and the international funding, & speculative bubbles are quoted as major underlying reasons (Mian and Sufi (2009), Shiller (2008), Wheaton and Nacheyev (2008)) Since 2006, there have been sizable and prolonged downturns in a number of countries (e.g., -33% in total in the US) by inflicting detrimental effects, e.g., negative wealth effect, rising NPLs, and worsening soundness of large financial corporations in the US and other countries.

The main objective of this study is to compare recent home price dynamics of two countries, Korea and the U.S., in terms of underlying determinants of price variations, over time and across locations, along with dynamic adjustment patterns of disequilibrating price shocks. In terms of empirical methodology, 2-stage error correction models (2S-ECM) are fitted by using city-level panel data sets from both countries, covering the period of 1988 to 2008.

[1] The shares amount to 34% in the U.S., 42% in Japan, 46% in Great Britain, and the whopping 88% in Korea. (Kyung-Hwan Kim (2008))

Korea represents an unique case in terms of housing policy and home price dynamics. In the policy side, maintaining home price stability is the top priority of the national government, for which various demand- and supply-side interventions were implemented over long period of time. The price movement in Korea, on the other hand, can be characterized as "high-risk low-return" in that, among 18 OECD countries compared, it records the lowest long-term mean growth rate, but one of the highest standard deviations. This outcome calls for an empirical investigation to assess the effectiveness of the promulgated policy goal of home price stabilization in Korea, to which the current study aims to contribute.

In terms of he price dynamics, three cycles of prices are observed in Korea since 1987: (1) a 27% total price appreciation (in real term) during the booming period of 1987-1991, followed by a steady price pattern (a slight decline) until 1997; (2) an 18% total decline during the financial crisis in 1998-1999, a rapid recovery during the two years afterward (until 2001), followed by a steep price increase in 2001-2004 with 21% total appreciation; and, (3) a relatively small price appreciation of 11% in 2005-2007, with a lowing price movement since the end of 2007. In the U.S., there are also three full cycles in home price dynamics since the mid-1970s: (1) a total 12% price appreciation in 1976-1980 (again, in real term), followed by a similar amount of price decline of 10% until 1985; (2) a total 15% price growth between 1986-1990, followed by a decline with about half of the appreciation, 7% drop in 1990 to 1998; last but not least, (3) a huge price appreciation of 50% between 1998 to the mid-2006, followed by the on-going price decline since then with about 20% decrease already recorded.[2]

The following represents key (and preliminary) empirical findings:

- The user cost (UC) of capital is negative and statistically significant in both countries. The magnitude of its impact in Korea has greatly increased in the 2000s.
- City-level variables (household income, employment, and pop density in the US, and UC, population, and housing imbalance) are generally significant, but sign changes are observed between the testing periods.

[2] The U.S. figures are from Cho (2008). The underlying home price index used for the U.S. is from the Office of Housing Enterprise Oversight (OFHEO).

- Macroeconomic variables (corporate bond spread, and the index of coincidental indicators in the US, and real GDP growth in Korea) generally show expected signs and fairly consistent over time.
- Extent of over-valuation (via-a-vis model prediction) is higher in the US (over 40% in Los Angeles in 2006) than in Korea (Gangnam, the location of the fastest home growth, with a little less than 20%).
- Although a wide range is observed, the serial correlation and mean reversion parameters show a "congergent-oscillating" pattern for most cities.

Several empirical findings are worth noting. First, while the income variables are fairly stable in their price effects in both countries, across different model specifications and across different time periods, there has been a regime shift in Korea in that the user cost for owning greatly increases its explanatory power in Korea after the 1997-1998 financial crisis. Second, unlike the recent upsurge in the U.S., an over-valuation of similar magnitude is not observed in Korea. Third, the speed of reverting to long-term equilibrium price level is shown to be faster in Korea, which may reflect the consequence, at least in short run, of the aggressive policy stance of the Korean government to maintain the price stability. Using the empirical evidences at hand, several policy implications are discussed, including welfare transfer across consumer cohorts (e.g., owners vs. renters), and macroeconomic consequence and financial market effect of home price cycle.

The rest of the paper consists of the following six sections: observed home price dynamics in the US and Korea (Section 2); literature survey on cyclical behavior of home prices (Section 3); computation of rent-to-value multiples in Korea and analysis of the result (Section 4); estimation of 2S-ECM and comparison of the results (Section 5); policy implications of the results (Section 6); and, concluding remarks (Section 7).

II. Home Price Cycles – Literature Survey

Home Price Cycles in the US

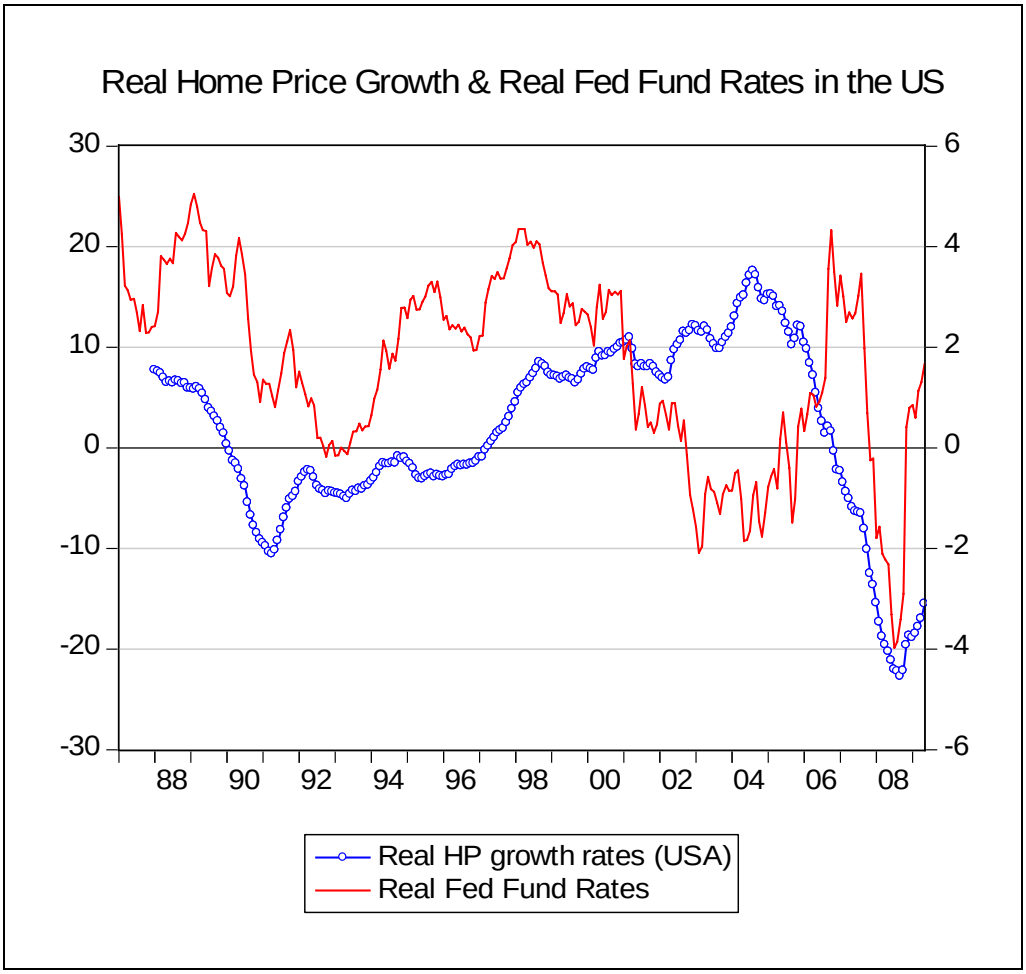
During the last 100 years or so (until year 2000), the real home price index in the US rarely moved, although there were several localized boom-bust cycles. (Shiller, 2008) However, the rise in home price since the early 2000s was a record-setting one, with total growth rate showing

three-four multiples of those of the earlier booms in the 1970s and 1980s. Among main drivers of such a strong upsurge, as elaborated by a number of recent studies (Mian and Sufi (2009), Cho (2009), Wheaton and Nacheyev (2008) among others) are the highly accommodative monetary policy (see the figure below), whole-sale mortgage funding via securitization, and expectations on continued future price appreciation.

As shown in the figure, the real Fed Fund Rate (FFR) was negative (below the inflation growth rate) between 2002 and 2005.[3] There was only once incidence in the last 40 years that the real FFR was negative for 2-3 years' time span, the mid- to late-1970s. In both occasions, home prices steeply rose in the middle of the prolonged negative short rate period. The difference between the two episodes, however, is the fact that the current home price booming (from 2003) was in the middle of already accumulated strong growth from 1998, while the 1970's case was from the sub-zero price growth.

Figure 1.

[3] During this period, the spreads between 1-year and 10-year Treasuries were floating around 250-300 basis points, strongly inviting the yield curve play (i.e., borrow-short-lend-long) among investors. There are growing evidences that the Wall Street IBs have also played this game: that is, they not only served as issues of CDO and CDO^2 but also as active investors thereof, either through affiliated hedge funds or through direct portfolio acquisitions of the securitiesFor example, UBS had a larger subprime MBS portfolio than the sum of them owned by their hedge funds. (UBS (2008))



As to why cycles occur in home price trends, literature advances several hypothesized causes, including development lags, expectations of agents (both in the supply side and in the demand side), and market elasticities (Grenadier (1996), and Wheaton (1999)) In recent years, the role of credit availability and mortgage lending terms are also being examined, as cycle-amplifying factor (Mian and Sufi (2009), Wheaton and Nacheyev (2008), Pavlov and Wachter (2008)) Furthermore, upside volatility works differently from downside volatility. For example, while those housing markets with inelastic supply tend to have a higher volatility during the boom, downturns can actually be more severe in elastic housing markets as there is a good chance of over-building therein (e.g., Miami and Las Vegas being examples). In addition, speculative bubbles, land use regulations, and development density can all work as contributing factors. (Abraham and Hendershott (1996), Capozza et al. (2004))

There is one particular up-pick in the recent surge in the U.S. home price, that is, the steeper price increase since 2003. As will be further discussed below, this outcome is largely caused by the monetary policy, the 3-year period of the highly accommodative interest rate policy. With Q2 2006 as the peak, the U.S. national home price has been declining, about 20% in total according to the Case-Shiller home price index.[4]

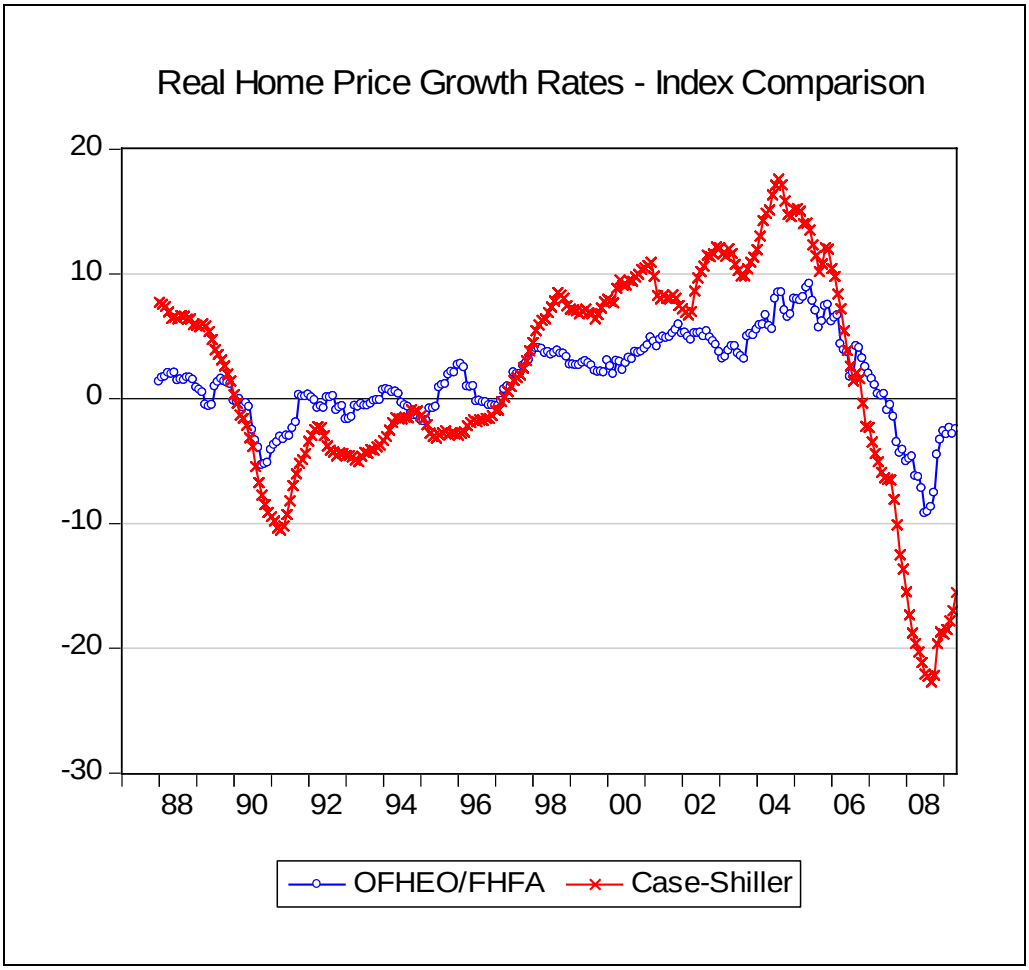
The consequence of the strong HP growth in recent years was the deteriorated housing affordability in many parts of the US. That is, as the HP growth outpaces that of household income, it became more difficult to purchase home for many households. The worsening affordability was particularly severe in certain coastal areas, e.g., Los Angeles, San Diego, Boston, New York, Washington, and Miami. In those areas, the home price-to-income ratios have become double digits, which was a rare event in the US where it has been stable around three historically. In response, the mortgage lenders in those areas developed and marketed so-called affordable mortgage products in a large scale, which started with very low initial monthly payments but entailed the risk of large payment shocks within 2-3 years.

Coming with this mega price appreciation in recent years, there was a quantity cycle of grand magnitude as well. The single-family (one unit) housing construction in the U.S. recorded a huge upsurge until the mid-2006. The total units delivered in the peak was the highest since World War II. After that, however, it had a nosedive until now, already recoding the lowest construction level after the war. The figure also shows that the downturn in the construction nicely coincides with the recession, shown as the shaded areas.

One issue that warrants more attention in assessing the cycles is the index estimation method, and the data used in so doing. (See the figure below for comparison between OFHEO HPI and Case-Shiller HPI, based on which the issue of appraisal smoothing and appraisal bias will be discussed.)

Figure 2.

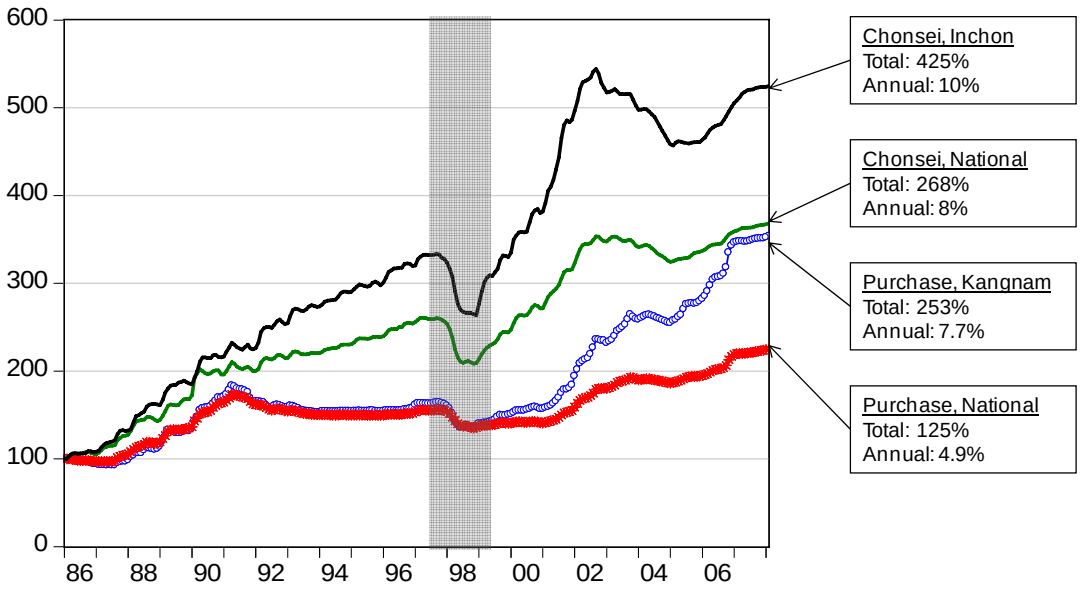
[4] The home price index used in Figure 3 is published by Office of Federal Housing Enterprise Oversight (OFHEO). The OFHEO's index has known bias factors in that it is based on the mortgage acquisition data by Fannie Mae and Freddie Mac, hence excluding the subprime mortgage loans, and also delete the investor homes, second loans and others in the index estimation process. Hence, it is generally believed that it HPI is smoothed, under-predicting the real volatility in HP.



Home Price Cycles in Korea

Between 1986-2008, the Chonesei price shows a much higher growth pattern compared to the purchase price. As shown in Figure 1, while the national purchase price had a total real growth of 125% (4.9% compounded annual growth rate, CAGR), the Chonsei price showed the total growth of 268% (8% CAGR), a 1.6 times higher growth than its counterpart. During the financial crisis, the Chosei price also showed a deeper downturn than the purchase price, indicating that it is more sensitive to the variations in macroeconomic variables.

Figure 3. Home Price Indexes in Korea, for Chonsei and Purchase (1986-2008)



Data source: Kookmin Bank

In terms of regional variation, the Kangnam area in Seoul recorded CAGR 7.7%, far exceeding those of other areas. The phenomenon of "Superstar City" fits nicely in explaining this outcome, as suggested by Gyourko, Mayer, Sinai (2006). That is, there are cities in the U.S. that show significantly higher price levels as well as longer-term mean growth rates than others, with examples being Los Angeles, San Francisco, New York, and Boston. There are several common characteristics of these markets: namely, these areas are unique, have strong attraction for housing demanders to reside, and have inelastic housing supply due to land use controls and already densely-developed areas.[5] The Kangnam area in Seoul also has superior living conditions compared to other metro areas in Korea, with the popular school districts, well-developed network infrastructure, and other cultural amenities. One can hypothesize that the high price level and growth in Kangnam are also caused by these demand-side attractions along with the inelastic housing supply.

[5] Under the title "Superstar Cities," Gyourko, Mayer, and Sinai (2006) examined home price trends in the U.S. during the last 50 years, and documented that main determinants of home price appreciation were inelastic supply of land and housing and the demand for certain locations themselves. Over time, as the location demand rises, the share of high income households also increases and, accordingly, demand for high-priced homes grows, which results in a worsening housing affordability.

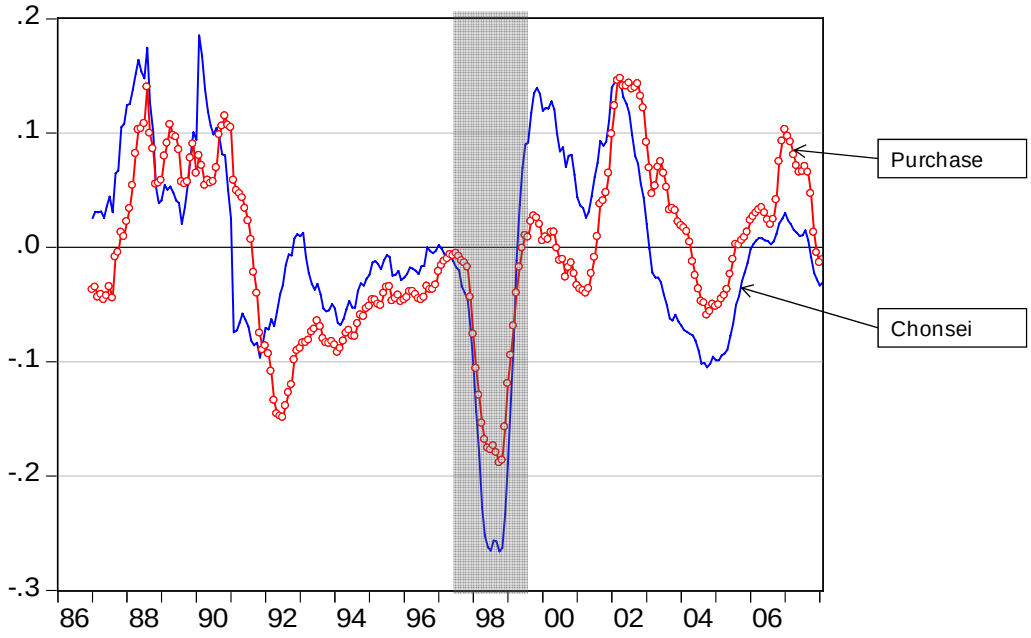
In terms of Chonsei price, Inchon recorded CAGR 10%, which is higher than any other metro areas in Korea. In particular, during 1998-2002, the annual Choensei price growth rate amounts 30%. The reasons for this extremely high growth rate would be a number of large scale development projects, including the new airport nearby (which is the largest one in Korea) along with various redevelopment and reconstruction projects. A 30% annual home price growth rate is also recorded in several geographical areas in the U.S. during the recent housing booms, e.g., San Francisco in the late 1990s during the dot-com bubble, and Las Vegas in the early- to mid-2000s. For major cities with significant size, that level of annual price growth is close to the maximum observed in the U.S.

Figure 4 shows the demeaned (excluding the long-term means) purchase and Chonsei price growth rates in Korea. During the late 1980s, both price trends show strong growth with more than 10 percentage points above their respective long-term means, and there were no noticeable difference between the two trends. During this period, the housing supply ratio (total housing units in stock divided by total number of households) was about 64%[6], resulting in excess demand in both owner and rental housing markets. This excess demand along with the very favorable macroeconomic surroundings was behind this strong upward movement in the prices. After this up cycle, there was a government-initiated construction drive, "the 2 million new housing supply," and the price trends were below long-term means until 1996. During this period of stagnated price trends, the purchase price declined more than the Chonsei price, possibly caused by the supply of owner housing units in a larger quantity than that of rental properties.

Figure 4.

[6] Including one-person households

Real Home Price Growth Rates in Korea, Demeaned (1986 – 2008)



During the financial crisis in the late 1990s, the Chonsei price dropped more than the purchase price, which also rose more during the subsequent recovery period in the early 2000s. The result shows that the change in the macroeconomic environment affected the rental market more than the owner market during this period. However, after 2002, the purchase price growth is above the Chonsei market, which may reflect the rapidly expanding the housing finance system in Korea during that period. The liberalization of mortgage lending along with the low interest rate environment enabled the rapid growth of mortgage debt outstanding in Korea, from about 10% of GDP before the crisis to 35% to date. This implies that the home owning opportunity has risen for more consumers, and that the financing costs have also been lowered.[7] Had there been speculative housing demand during this period, that would also have been lowered the Chonsei price, as that would have worked as a boost to the supply of Chonsei properties. In the 2003-2005 period, the purchase price is below its long-term mean. Considering that it was in the middle of the global low interest rate environment, this outcome would have resulted from various policy measures

[7] The mortgage market in Korea has grown dramatically after the financial crises, both in terms of size and in terms of the composition of the lending system. First, the MDO ratio to GDP, which was hovering around 10% before the crisis, is not about 35%, about same level to Japan, France, and Hong Kong. Furthermore, the National Housing Fund, the government-run lending institution that dominated housing-related lending in the 1990s, is now marginal in its market share, and private lending institutions take over 90% of total lending.

instituted by the Korean government to suppress housing demand, under the slogan of house price stabilization and protection of low income households from unaffordable home values.[8]

The price boom during the 2000s is caused by the improving macroeconomic conditions after the financial crisis, along with the financial liberalization in the mortgage market. The low interest rate environment was another contributing factor to the price increase, as one can hypothesize. The expansion of the mortgage lending enabled more consumers to purchase home, which shifts the demand curve for housing space further upward and, given a supply schedule, also the equilibrium rent from R3 to R4. Furthermore, the increase in mortgage lending reduced the borrowing from non-institutional lending sector (e.g., curb debts) and, hence, decreased the financing cost in home purchase. This implies a lower discount rate, i, which translates a higher asset value fro a given expected rental stream from the property. Accordingly, the asset value of housing increases in a large proportion due to the demand shift and the reduction in the cost of capital for home owning.

In the above analysis, the supply elasticity works as an important determinant of the magnitude of price changes in response to demand shock. That is, under an elastic supply schedule, an unexpected increase in population or employment in a given geographical area will entail a large price increase, which has been the case in the U.S. and other countries. As one evidence, the coastal areas in Southwestern region of the U.S. (California in particular) and the Northeastern corridor from Boston to Washington DC tend to show a more cyclical home price changes than other regions, due to high inflows of population, inelastic supply, and restrictive land use regulations by local governments.

However, during the declining period, the construction time lag and erroneous construction decisions can create an excess supply, which can push the downturn further.[9] Among the currently price-declining areas in the U.S., Florida and Arizona are the typical areas of over-supply of housing, which also show the largest price drops since 2006. Once home price turns downward, it is usually the case that the downturn lasts for a long time, 4-5 years on the average. This is because of the tendency that, in the initial phase of the downturn, the adjustment is

[8] The key regulations implemented during this period include the "October 29" policy measures (2003, with the comprehensive real estate tax, increase in transfer tax for those who own more than 3 units), the mandatory quota for building small-size units (2003), quotas for building rental housing (2005), taxing on development profits (2006), application of price caps for privately-delivered units (2007).
[9] See Wheaton (1999).

generally made with a reduction in new construction, while the existing home owners delay sales, which prolongs the process of quantity-clearing in the market. This tendency also increases the serial correlation in the home price trend, that is, raising the price rigidity in both upward and downward price changes.[10]

Beside the demand-supply imbalance as discussed above, expectation on future price appreciation also works as an amplifier of cyclical price behavior. In a theoretical sense, this can be termed as a bubble, which is found to be prevalent in the housing market. For example, using a survey data, Case (2008) and Case and Shiller (2004) report that this kind of demand for future capital gain is the primary motivation for home purchase, even in the areas where home prices do not show a high appreciation historically. However, testing a bubble empirically is generally viewed as infeasible due to the nature of joint test, the existence of the bubble and the specification of testing model.[11]

Local Price Dynamics – A Comparison

In terms of regional variations, a comparison is made as to the extent of regional variations in home price changes in Korea vs. those in the U.S. A simple econometric model is employed, as specified below.

(1) $h_{i,t} = \alpha_i + \beta_i h_t^n + e_{i,t}$

The dependent variable in equation (1) is log growth rates of real home price changes in city i and time t ($h_{i,t} = Log(H_{i,t}) - Log(H_{i,t-1})$), and the national home price change is included as the right-hand-side variable. In the above specification, α represents a permanent excess return in the local home price trend, while β (same as the market β concept in the corporate finance) shows the correlation between local and national home price changes. Table reports the results of the estimation based on city-level home price data from both countries.

Table 1.

[10] See Case (2008).
[11] A survey of studies on housing bubble and the efficient market hypothesis is done by Cho (1996).

Estimation of SML Model, Comparison of Korea and the U.S.

	Korea			US	
CITY	α	β	CITY	α	β
GANGNAM	2.66%	1.3990	LOSANGELES	6.24%	1.5272
INCHEON	0.24%	1.0475	SANDIEGO	5.88%	1.5077
ULSAN	0.56%	0.9964	NEWYORK	6.26%	1.0734
BUSAN	-0.99%	0.9740	SANFRANCISCO	7.06%	1.0733
DAEGU	-1.20%	0.9199	MIAMI	5.86%	0.9205
GANGBUK	-0.98%	0.8937	BOSTON	6.69%	0.9184
GWANGJU	-2.55%	0.6787	LASVEGAS	4.35%	0.8753
DAEJEON	-1.75%	0.5649	CHICAGO	4.73%	0.7210
Mean	-0.50%	0.9343	SEATTLE	6.93%	0.6793
STD	1.62%	0.2501	MILWAUKEE	3.93%	0.5106
			DETROIT	4.55%	0.4231
			ATLANTA	4.85%	0.0859
			DENVER	5.87%	0.0660
			DALLAS	4.15%	0.0627
			CLEVELAND	4.96%	0.0329
			HOUSTON	3.59%	0.0267
			AUSTIN	4.13%	-0.1781
			Mean	5.30%	0.6074
			STD	1.12%	0.5341

The results show that the Korean cities exhibit lower α but higher β compared with the U.S. cities. In particular, the average β for the Korean cities is 0.93, about 30% higher than the U.S. average 0.6. This implies that the sub-national home prices in Korea are more closely linked to the national home price, than the local home price changes in the U.S.

As mentioned earlier, α in equation (1) represents a permanent excess return to holding home as an investment asset. For the U.S. cities, Los Angeles, San Diego, New York, San Franscisco, the Superstar Cities as characterized earlier, show higher α than other cities included. In the case of the Korean cities, Kangnam is the only area that has α greater than unity, far exceeding other areas in its magnitude.

III. Measuring Home Price Cycles

ECM and Its Parameters

There has been a long tradition of measuring asset price dynamics via an error correction model (ECM), for non-housing assets (Poturba and Summers (1988) and others) and for housing assets. (Abraham and Hendershott (1996), Malpezzi (1999), Capozza et al. (2004)) Typical ECM has the following two stages of estimation, a model of price level ($H_{i,t}$ for log price at location i and time t) level) and (2) that for h (log price change):

(2) $H_{i,t} = f(X;\theta) + e_{i,t}$

(3) $h_{i,t} = \alpha \cdot h_{i,t-1} + \beta \cdot (H^{*}_{i,t-k} - H_{i,t-k}) + \delta \cdot h^{*}_{i,t}$

The first-stage can be viewed as a reduced form price equation derived under the assumption of market equilibrium (i.e., quantity demand being equated to quantity supply at time t). As such, it includes shift variables from both demand-side and supply-side as market fundamentals (X). Usual shifters included are (following Meen (2009), Capozza, Hendershott, & Mack (2004) among others):

- User cost of capital (UC) for owning
- Household income – positive & usually significant
- Leverage – availability of mortgage credit (Mian and Sufi (2009))
- Construction cost, a regulatory index, developable land
- Demographics (e.g., population growth) & macroeconomic factors

The three right-hand side variables in the second-stage estimation measure persistence of log price change (via α), speed of mean reversion (β) (i.e., how fast the past gap, time t-k, between the fundamentals value from the first stage, H^{*}, and the realized value dissipates), and contemporaneous adjustment of price shock by change in equilibrium prices (δ).

Under the efficient market hypothesis (EMH), $\alpha = 0$ and $\delta = 1$ (i.e., the price change follows a random walk, and any shock is instantaneously and completely adjusted). Empirically, however,

α is positive and statistically significant, as reported by Case and Shiller (1989) ($0.25 \leq \alpha \leq 0.5$ depending on the city in the sample) and by Abraham and Hendershott (1996) ($\alpha = 0.4$). Under EMH, there is no guidance as to β, as any price shock has no persistence. Empirically, a range of 0.1 to 0.2 is reported by Abraham/Hendershott (1996), and Capozza et al. (2004). By solving a difference equation, Capozza et al. also define four regimes of price dynamics based on α and β:

	$\alpha < 1$	$\alpha > 1$
$(1 + \alpha - \beta) < 4\alpha$	Convergent-oscillation	Divergent-oscillation
$(1 + \alpha - \beta) > 4\alpha$	Convergent-no oscillation	Divergent-no oscillation

Capozza, Hendershott, and Mack (2004) and Abraham and Hendershott (1996) also report that the coastal areas mentioned earlier, in the Southwest and Northeast regions, exhibit higher AR (high price rigidities) and longer MR (longer times taken to revert to long-term equilibrium levels) than other locations in the U.S. The current study utilizes the 2-Stage Error Correction Model as in Capozza et al. (2004) with the data from Korea and the U.S., and compare the outcome. In so doing, I incorporate the most recent home price boom-bust in measuring these cycle parameters for both countries.

Measuring the User Cost

The user cost (UC) variable requires further explanation. As discussed by Himmelberg et al. (2005) and others, UC represents an after-tax cost of owning home, including various economic and institutional factors such as real mortgage interest rate (r^m), expected inflation (π^e), income tax rate (t_i), property tax rate (t_p), depreciation rate (as a proportion to the value, δ), and expected future price appreciation (g). Following Mishkin (2007) and Quigley and Rafael (2004), a full specification of the user cost is shown below.

$$(4)\quad \frac{R_{i,t+1}}{P_{i,t}} = (r_t^m + \pi_t^e)(1 - t_I) + t_p(1 - t_I) + \delta_{i,t} - E_t[g_{i,t+k}] = \mu_{i,t}$$

In the above, $P_{i,t}*\mu_{i,t}$ represents imputed rent of owner home. In Korea, this variable is directly observable from the market, thanks to the Chonsei system. [12] That is, by using average Chonsei deposit for a typical housing along with prevailing market interest rate, one can easily compute annual rent for the housing assumed. Hence, a time series UC can be created for each city in Korea. Its inverse, P/R, is equivalent to PRM as discussed below.

In terms of data, average transaction values for 30-pyong (1 pyong being 3.3^2) apartment in each city, separately for Chonsei and for purchase, as of December 2006 is computed.[13] Next, using the purchase and Chonsei price indices for the whole country and each city, monthly time-series of purchase values and Chonsei values are created, covering 1986-2007. Finally, by multiplying Chonsei value and 3-year corporate debt rate (because that's the interest rate series covering the whole period) in each month each city, annualized rental payment series is computed. Table below shows summary statistics computed this data base.

Table 2. Results of Average Home Value and PRM Estimation (10,000 KRW)

	A. Price		B. Rent		C. PRM (A/B)		D. UC (B/A)	
	1987-1999	2000-2008	1987-1999	2000-2008	1987-1999	2000-2008	1987-1999	2000-2008
Korea	17,839	22,715	1,184	815	15.8	29.0	6.5%	3.7%
Seoul	26,446	38,413	1,740	1,203	16.0	33.6	6.5%	3.3%
Gangbuk	24,004	28,847	1,320	876	19.3	34.7	5.4%	3.1%
Gangnam	26,896	46,045	2,107	1,513	13.4	31.9	7.7%	3.6%
Busan	21,990	23,531	1,593	934	14.5	26.2	7.2%	4.0%
Daegu	20,616	21,770	1,470	895	14.7	25.3	7.1%	4.2%
Deajeon	16,821	21,695	1,052	786	16.9	28.5	6.2%	3.7%
Gwangju	25,249	22,385	1,808	947	14.6	24.4	7.1%	4.2%
Incheon	15,233	21,032	888	735	18.4	29.9	5.7%	3.6%
Ulsan	18,427	20,083	1,504	877	12.9	23.7	8.0%	4.5%

Data sources: Kookmin Bank; Bank of Korea; Korea Real Estate Analysis Association (2007)

The average purchase-Chonsei rate in Korea in 1987-1999 was 2.1 (178 million KRW over 84 million KRW), which decreased to 1.67 (227 million over 136 million) in 2000-2007, a about

[12] As Chonsei market exists, it is more feasible to estimate user cost of capital in Korea. See Hwang, Quigley, and Son (2006) for testing an efficient market hypothesis by using a property-level data set of Chonsei and purchase prices.
[13] Data source is Lee, Lee, and Park (2007).

20% decline in the ratio. This shows, as explained in Section 2, the Chonsei price in Korea has risen faster than the purchase price after 2000.

On the other hand, the average rent computed with the market interest rate was 11.8 million KRW in 1987-1999, which also decreased in 2000-2007 to 8.2 million, a more than 30% drop. The low interest rate in the second time period largely explains this drop in rent. As a result, PRM (P/R) increased between two time periods, from 16 to 29, while user costs had a significant drop from 6.5% to 3.7%. This result is an evidence showing that the financing cost for home owning has dropped substantially in the 2000s, compared to the earlier time period, with over 40% reduction on the average. Underlying causes to this outcome would include the low interest rate environment, the expansion of the mortgage lending system, and the heightened expectation on future home price growth (at least, in some localities).

Regionally, while the Kangnam area shows the highest level of purchase price, its PRM is 31.9, which is lower than 43.7 of Kangbuk (in the 2000-2007 period). This result indicates that the former not only has the high purchase value but also a high rental value as well. The lowest PRM is shown in Ulsan with 23.7 (12.9)

IV. Results and Findings

In this section, the first stage model is estimated with a panel data set covering the seven geographical areas in Korea (five metropolitan areas excluding Seoul plus two sub-areas of Seoul, Kangnam and Kangbuk). The advantage of the panel data is that it can overcome the problem of a short time series data, and that the parameter estimates can become more robust due to the use of local market variables. The fundamentals variables used in the first state are listed below. [14]

The fundamentals variables (X) used for Korea include: log average purchase price (in location i at time t), $H_{i,t}$, the left-hand side variable; user cost of capital, as explained in Section III, $UC_{i,t}$; total housing units divided by total number of households, $Housing\_Imbalance_{i,t}$; change in total

[14] Regional housing unit and household statistics are from the Korean Census Bureau; Per capita income and MDO statistics are from Bank of Korea. Various extrapolation and interpolation methods are used to unify the time span and observation frequencies.

population, $\Delta Population_{i,t}$; the real annual GDP growth rate, GDP_growth_t; change in housing construction volume, $\Delta Construction_t$; and, the fixed effect of locations.

The fundamentals variables for the U.S. include: log average purchase price (in location i at time t), $H_{i,t}$; the user cost of capital, non-varying across cities, UC_t (following Capozza et al., UC = (MortgageRate + PropertyTaxRate)*(1 − IncomeTaxRate) − ExpectedInflation + 0.03); log household income, $Household\_Income_{i,t}$; log total employment, $Employment_{i,t}$; population density, $Population\_density_{i,t}$; spread between AAA vs. BBB corporate bond, as a proxy for macro credit risk, $Bond\_Spread_t$; the index of coincidental indicator, $I\_Coincident_t$; and, the cross-sectional fixed effects.

Table 3. Stage-One Results - US

	Model 1 (87-07)	Model 2 (87-07)	Model 3 (87-99)	Model 4 (00-07)
Constant		-4.2063	-1.7875	-13.5977
		(-8.99)	(-5.99)	(-15.75)
User Cost (Log)	-0.9805	-0.0208	0.2128	-0.8120
	(-10.44)	(-0.44)	(6.23)	(-16.85)
Corporate Bond Spread (AAA vs. BBB)	-0.0335	0.0050	0.0110	-0.0219
	(-5.42)	(1.75)	(4.22)	(-6.22)
Index of Coincidental Indicators (Log)	-0.2979	0.6992	0.0584	0.4921
	(-2.68)	(7.40)	(0.78)	(2.60)
Household Income_i (Log)	0.6830	0.8490	0.9228	1.0280
	(15.36)	(10.80)	(17.75)	(10.34)
Employment_i (Log)	0.2046	0.1492	0.3558	0.6218
	(6.31)	(4.06)	(11.09)	(6.82)
Population Density_i	0.0002	0.0006	-0.0005	0.0031
	(5.14)	(9.14)	(-6.30)	(16.67)
Fixed Effect	No	Yes	Yes	Yes
R-squared	0.5882	0.9231	0.9681	0.9779
S.E. of Regression	0.4043	0.1750	0.0866	0.0932
Akaike Info Criteria	1.0285	-0.6416	-2.0450	-1.8929
F-Statistic		2097.2460	3240.3220	2957.0260

UC is negative and significant in 2000-2009 (but not so in 1987-1999), and its magnitude also increased in 00-07. The city-level variables (income, employment, and pop density) are mostly significant and have expected signs. The income elasticity slightly increased in 2000-2009, from 0.92 to 1.03. Other variables – Corporate Bond Spread and Index of Coincidental indicators – generally have expected signs. Finally, Over 40% over-valued (via-a-vis model prediction) in Los Angeles at the recent peak; See the over-/under-valuation chart.

Figure 5. Over-/Under-Valuation – US Cities (Scale: -40% to +45%)

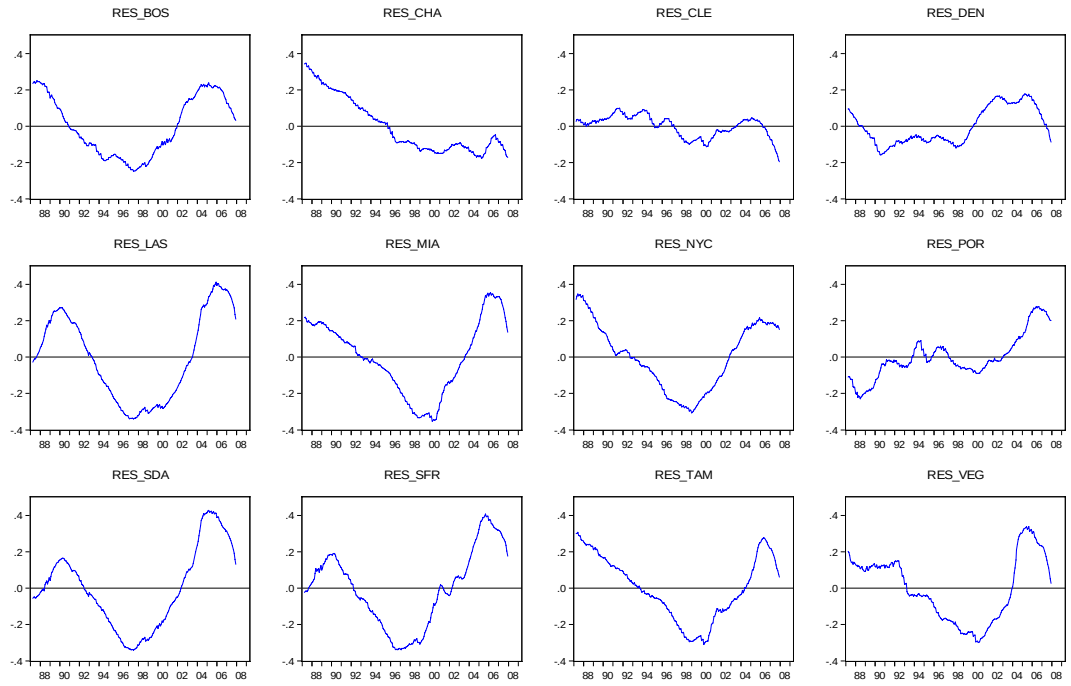


Table 4. Stage-One Results - Korea

	Model 1 (1992-2007)	Model 2 (1992-1999)	Model 3 (2000-2007)
Constant	13.2372	13.2206	11.2501
	(193.29)	(366.10)	(60.21)
Real GDP Growth Rate	0.0030	0.0018	0.0012
	(23.94)	(13.61)	(8.54)
Δ Construction Volume	-0.2649	0.1563	0.2023
	(-4.29)	(6.67)	(2.05)
User Cost of Capital_i	-1.3215	1.4346	-6.6811
	(-5.12)	(15.61)	(-11.23)
Δ Population_i	5.8599	-1.2150	-1.4530
	(8.54)	(-4.55)	(-0.74)
Housing Imbalance_i	-2.4969	-2.2127	1.3171
	(-19.75)	(-23.30)	(5.15)
Fixed Effect	Yes	Yes	Yes
R-squared	0.8210	0.9754	0.9371
S.E. of Regression	0.1119	0.0324	0.0734
Akaike Info Criteria	-1.5337	-4.0001	-2.3687
F-Statistic	538.0079	2229.4250	893.8480

UC becomes significant and has a much larger impact in 2000-2007 (one percentage point decrease in UC increases HP by 6.68%), indicating a regime shift in the Korean housing market after the financial crisis (a large and market-oriented mortgage lending sector as a possible reason). The city-level variables - housing imbalance (= total housing units / total number of households) and population change - are either not significant or do not have expected signs. Housing imbalance is significant and rightly-signed in 1992-1999, but not so in 2000-2007. Only Gangnam has over-valuation by about 20% in 2006-2007, which is still lower that some of the US cities; See the over-/under-valuation chart.

Figure 6. Over-/Under-Valuation – Korean Cities (Scale: -25% to +25%)

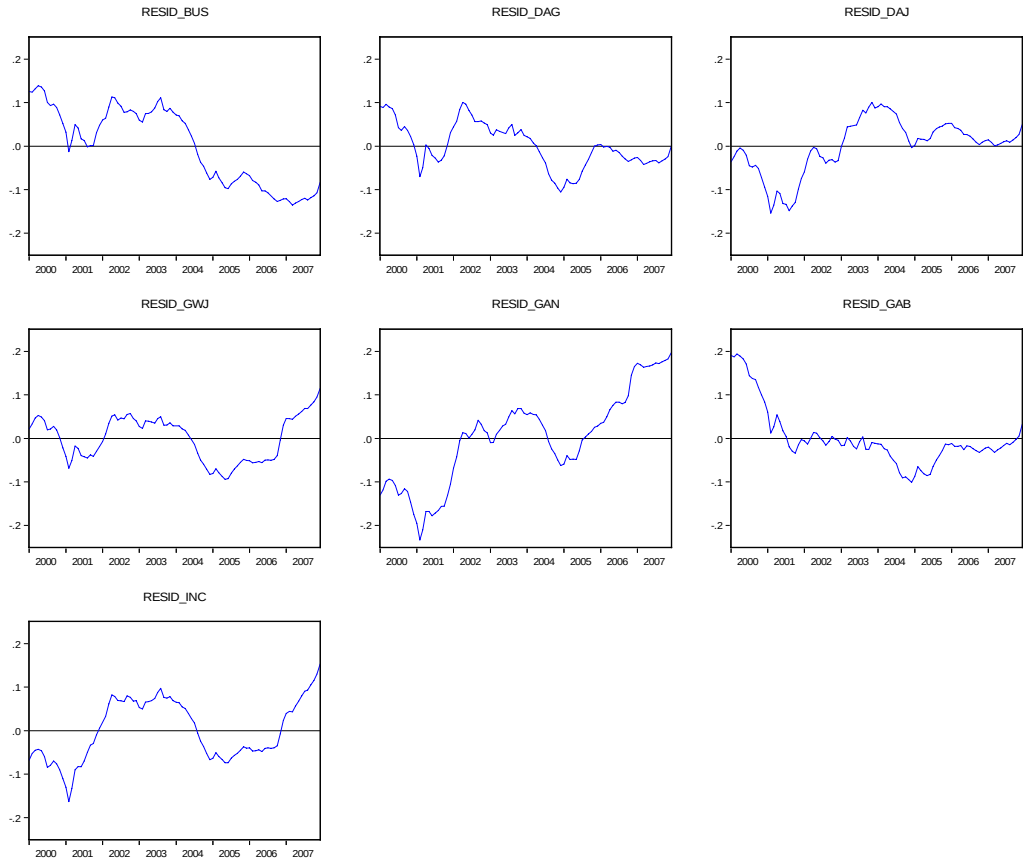


Table 5. Second-Stage Results – U.S.

	α	β	R-squared	Convergence	Oscillation
Boston	0.7858	0.0161	0.6763	Convergent	Oscillate
Charlotte	0.1786	0.0049	0.0448	Convergent	No Oscillate
Cleveland	0.5098	-0.0220	0.2577	Convergent	No Oscillate
Denver	0.7800	0.0199	0.6162	Convergent	Oscillate
Los Angeles	0.9495	0.0170	0.8248	Convergent	Oscillate
Miami	0.9503	0.0166	0.7503	Convergent	Oscillate
New York	0.8444	0.0161	0.7842	Convergent	Oscillate
Portland	0.6044	0.0066	0.3447	Convergent	No Oscillate
San Diego	0.9290	0.0166	0.7762	Convergent	Oscillate
San Francisco	0.7870	0.0181	0.5798	Convergent	Oscillate
Tampa	0.8502	0.0166	0.6960	Convergent	Oscillate
Las Vegas	0.7862	0.0200	0.5550	Convergent	Oscillate

footnote: "Convergent" if α < 1; "Explosive" otherwise

"Oscillate" if (1+α-β)^2 < 4α, "Non-oscillating" otherwise

Table 6. Second-Stage Results – Korea

	α	β	R-squared	Convergence	Oscillation
Busan	0.9530	0.0409	0.8148	Convergent	Oscillate
Daegu	0.9925	0.2536	0.7654	Convergent	Oscillate
Daejeon	0.9964	0.2463	0.8452	Convergent	Oscillate
Gangbuk, Seoul	0.8983	0.0421	0.7349	Convergent	Oscillate
Gangnam, Seoul	0.9367	0.1864	0.6822	Convergent	Oscillate
Gwangju	0.9195	0.1090	0.8081	Convergent	Oscillate
Incheon	1.0979	0.4036	0.8770	Explosive	Oscillate

footnote: "Convergent" if α < 1; "Explosive" otherwise

"Oscillate" if (1+α-β)^2 < 4α, "Non-oscillating" otherwise

Wide ranges of α are observed in the US (from 0.17 for Charlotte to 0.95 in Los Angeles and Miami), showing higher levels in the coastal cities (Los Angeles, San Diego, San Francisco, and

Boston). αs among the Korean cities are generally higher than those for the US cities, and are tightly distributed (from 0.89 for Gangbuk to 1.09 for Incheon).

The US cities exhibit low βs, with a 1-2% range, while those in Korea are much higher and widely dispersed, between 4-40%. This outcome may reflect the Korean government's aggressive policy actions (for the last 30 years or so) to stabilize home prices. (Further analysis will be performed to investigate this possible linkage.) Most cities have the "Congergent-Oscillating" shock adjustment patterns (exceptions being Charlotte, Cleveland, and Portland in the US, and Incheon in Korea).

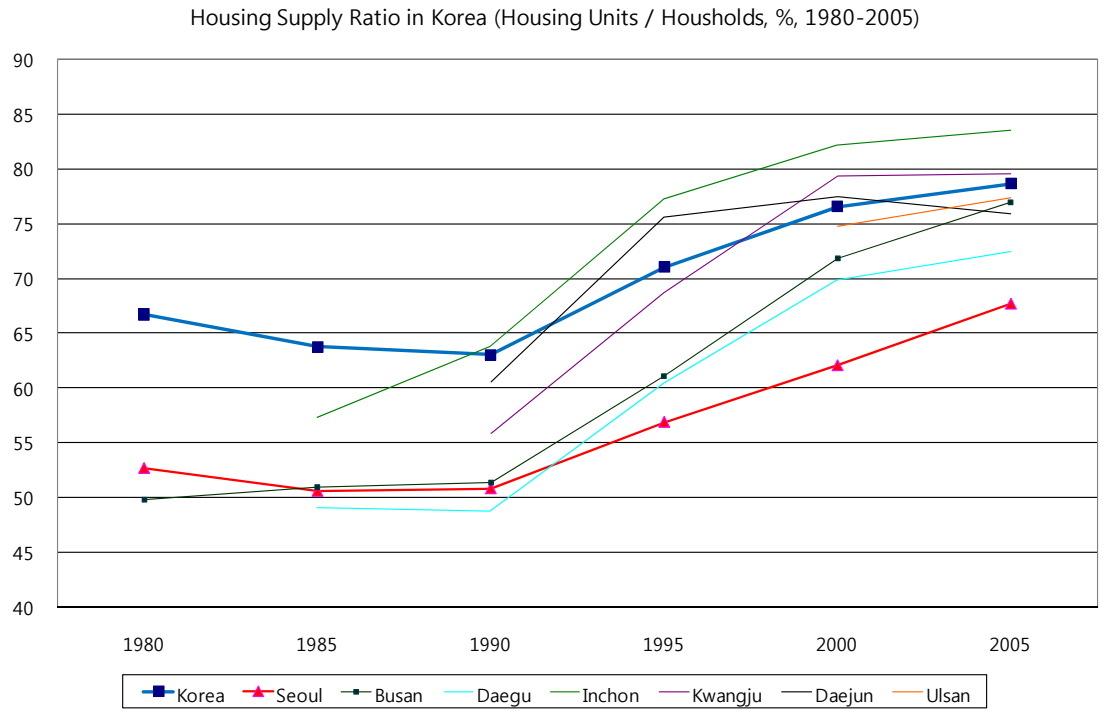
V. Policy Implications

The econometric analyses in the prior section provide empirical evidences showing that the Korean housing market had a structural change after the financial crisis in 1997-1998, with macro-financial variables such as user cost and household income becoming more important determinants of home prices. Main policy implication of this finding is that, in pursuing the policy goal of "home price stabilization," ramifications of the home price cycles on macroeconomic variables should be considered, in addition to the policy concern on housing affordability for low-income and other target households. Related to this, several policy issues are discussed in this section.

First, ensuring housing welfare for low- and moderate-income households require affordable level of home price along with its stable trend. However, as discussed by Quigley/Rafael (2004), a pre-condition for affordable housing for target consumer cohorts is ensure a sufficient and stable supply of appropriate housing, such as low-cost rental housing, in appropriate locations and in incentive-compatible housing attributes for them. Related to this issue, although the housing supply ratio in Korea has been steadily increasing since the early 1990s , it is still 79% nationally (as of 2005, and when including one-person households), and 68% in Seoul. Therefore, the total housing stock is relatively lower compared to other OECD countries, and it is particularly so for rental housing units. Therefore, a stable supply of various housing types, both for owners and for renters, should be pursued, for which making the supply schedule more elastic through relaxation of housing-related regulations is needed. That is, the supply curve in Figure 3 needs to be flatter

so that demand shock in housing should have a more quantity effect rather than a large price effect.

Figure 7.



Second, as the mortgage finance system has been established in Korea, its prudent use will be another enabling factor to have stable home price behavior. In particular, it is imperative to sort out real consumers, i.e., resident-borrowers, over those with investment purpose, and to develop mortgage products that fit to their preferences and repayment capabilities. To this end, analyses on mortgage choice and demand patterns, on efficient and stable funding methods (e.g., MBS vs. Covered Bond), on managing embedded risks will all be needed.[15] Furthermore, a framework for sound banking supervision will also be required. Besides the lending institution's portfolio level risk indicator (e.g., Basle type capital requirement), special risk assessment on particular loans with high risk can be considered. For example, Gramlich (2007) argues that the subprime mortgage debacle could have been averted, had the existing regulation on "high-cost loans"

[15] See Cho (2008).

applied properly. That is, as required by HOEPA[16] of 1994, mortgage lenders are obliged to perform a set of special risk assessment for high-cost loans, defined in terms of spreads between lending rates and benchmarking Treasury rates. Specific tests required include level of payment shock, documentation levels, amount and duration of prepayment penalty, and so on, all of which represent typical risk attributes in the subprime and Alt-A lending sectors. The problem was that the threshold spread was set too high, as 8% to be exact, so that only 1% of subprime loans issues were covered by this regulation. Were the cutoff 5%, about 50% of subprime loans would have covered; with 3%, virtually all covered.

Finally, as reported by Leamer (2007) ("House is the Business Cycle") and others, housing policy-makers should consider the role of real estate sector in broader business cycle, in particular, the fact that residential investment is shown to be the most visible leading indicator of recession. In Korea, the residential construction sector has been in a downturn since the early 2000s. As shown in Figure, the new housing units built in Korea shoed a upward trend from the low point of 300,000 in 1998 until 2002. Since then, it has been in the steady downward trend until 2006. In the case of Seoul, the construction level experienced extreme growth rates, 110% annual growth in 1999 and -50% growth in 2004. This kind of extreme variation in residential construction level is detrimental, not only to stabilization of housing market but also to that of a broader macroeconomy.

VI. Concluding Remarks

As a next step, a further investigation on correlation between the gap (the MR term), UC, and other fundamentals variables will be performed, to shed light on what cause the gap in the first place and what role UC and other fundamentals play in building up or dissipating the gap. Also, the linkage between price and quantity cycles in both countries will be analyzed.

Future theoretical and empirical studies on housing market and policy will have to follow, in particular, on the following three research areas. First, the linkage between housing market and macroeconomy will be a rich research field to tackle. Specifically, besides the wealth effect and the income effect as discussed in the study, topics in this area also include the collateral effect of housing (for small business lending), linkage to macroeconomy through taxation, among others.

[16] Home Owner Equity Protection Act.

Second, related to the mortgage market, topics would include mortgage choice, causal relationships between economic variables such as home price, interest rates, household income and mortgage defaults, and banking supervision to minimize systematic risk in the lending. Third, the ECM used in this study is in the category of reduced-form home price model. It will be fruitful to develop a dynamic structural model to incorporate demand-supply sides of housing market more in detail, based on which we can predict the course of market adjustment more properly in response to a shock.

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