Housing Finance: Comparison between South Korea and the US

Inho Song and Peter Chinloy

This study compares housing finance in South Korea(hereinafter referred to as "Korea) and the US. South Korea's unique system allows housing finance for homeowners and tenants. The US, similar to most countries, confines housing finance to owners. Derived are incidences from shocks in house prices and interest rates between zero and one. When incidences are zero, relative rents do not respond to shocks in interest rates and prices. When incidences are one, there are complete markets, including for tenants. Tenants are able to lay off 100% of interest rates and price shocks through the capital market.

Estimation is for the US with a mortgage-only market, alongside the Korean housing finance for 1960–2017. The Korean housing finance system satisfies market completion, with incidence of 97%. As confirmation of complete markets, rent-price ratio adjusts within a year. By contrast, the mortgage-only US has a price incidence below 20%, and adjustment takes 10 years. Interest rate incidence in Korea is between 42% and 53%. In the US, the mortgage-only market is sluggish, with interest rate incidence between 15% and 20%.

Keywords: Housing finance; Mortgage market; Rent-to-price ratio

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I. Introduction

Universally, housing finance is nearly concerned with buying and not renting. Buying a house involves mortgage, thereby requiring income and wealth. Owners have mortgages to assist in purchase. Tenants lack a capital market for rent. Such a market provides security of tenure, while compensating landlords.

This study introduces housing finance for landlords and tenants. A buying household selects a capital structure, weighted average over mortgage debt, and equity for the down payment. The cost of capital to buy is a multiple of the mortgage rate, depending on the loan-to-value (LTV) ratio, taxes, and equity cost of the down payment.

A complete capital market for tenants enables them to select a mix of rent and payments for debt service. Debt supports a lump sum payment to landlords. With no capital market, which is prevalent in most countries, tenants face a periodic rent payment, often at the beginning of the month. Shocks, such as unemployment, family matters, or a pandemic, reduce income. With rent payments fixed, the tenant housing market destabilizes during a downturn.

In a rental capital market, tenants are able to borrow up to 100% of the rent required, via a zero-coupon loan. The contract is between a lender and tenant. Landlords receive the loan proceeds as a lump sum without restriction on usage. This capital access is in exchange for periodic rent. Ratio of capital borrowed to house prices follows the LTV ratio, with imputed rent payments.

Tenants borrow in this rental LTV capital market, paying interest to lenders. Loan paid to landlords is repayable on termination of the lease. This contract describes at least one portion of the rental housing market in Korea. From the Korean Housing Survey in 2019, a quarter of all households and one-third of those living in greater Seoul are on this contract. Another tenant group pays periodic rent with a combination of loan. The remainder are homeowners, who are 54% of households in Korea. This proportion places Korea at approximately an average for developed countries. The reason is the extensive subsidized social rental housing in Europe.[1]

[1] The Organization for Economic Co-operation and Development compares

Tenants have a cost of capital allocated between payment to the financial market and rent. Cost of capital for tenancy is the rent times a multiple that depends on the interest rate and tenant LTV ratio. The more the capital market for tenants is complete, the lower the rent multiple. The capital market absorbs shocks, allowing for substantial volatility in rent-price and tenant LTV ratios. A macroeconomic shock in interest rates is accommodated rapidly.

This research tests the response of rents and house prices to macroeconomic shocks. Multiples in the owner and tenant capital markets have a one-to-one correspondence between the incidence of interest rate and appreciation shocks that determine the rent-price ratio. The greater the incidence, the more complete the capital market, allowing more rapid adjustment of rents and prices.

Incidences are proportions, constrained to lie between zero and one. When incidences are zero, relative rents do not respond to shocks in interest rates and appreciation. No markets or methods are available to lay off risk of rent shocks. When incidences are one, there are complete markets that absorb 100% of the interest rate and price shocks. Volatility increases in rents and prices when markets are considerably complete.

Costs of capital to buy and rent lead to a household's market condition for housing regardless of tenure:

$$\textit{Rent-price ratio} = \textit{Rate incidence} \times \textit{Interest rate} - \textit{Price incidence} \times \textit{House appreciation} \quad (1)$$

Cost of capital multiples are parameters determining incidences. As an estimating equation, interest rate and appreciation are replaced by their expectations. Rent-price ratio is the difference between interest rates and price appreciation.

The current study answers two questions on housing finance. The first is whether having markets for owners and renters leads to rent and house price flexibility. This question comes from estimating the rent-

developed countries' housing tenures. The comparison includes owners with and without mortgages, and renters with and without subsidies. Korea has a high rental tenure rate without direct subsidies, but with a capital market for tenants.

https://www.oecd.org/els/family/HM1-3-Housing-tenures.pdf

price equation. The greater the incidence proportion, the more flexible the housing market. The second is whether with owning and renting capital markets there is faster adjustment to a shock. This question is addressed by the co-integrating equation. These responses indicate how housing markets respond to shocks in inflation, interest rates, and macroprudential policy.

The US, similar to most developed countries, finances housing only for buying, with a mortgage. There is no housing finance for renters. The other has capital markets for borrowing to buy and rent. Korea has mortgage and rental capital markets.

In the rental capital market, there is a three-way arrangement among tenants, lenders, and landlords. Landlord–tenant lease is for a given term between six months and ten years, with two years being the most common. Negotiations generate a tenant LTV ratio as if renters were buying the house and a conventional periodic rent. Landlords choose a combination of cash rent and loan size at the beginning of lease. This flexibility enables landlords to receive sufficient cash to pay operating expenses, and invest the lump sum in more illiquid assets.

Tenant–lender contract funds the loan size. Contract is based on the tenant LTV ratio, including for no-rent leases. Loan is interest only, with the tenant making payments to lenders.

Lender–landlord arrangement pays the loan size to owners, with no restriction on the use of funds. On lease termination, landlords repay the principal to lenders.

Regulatory infrastructure backs the contracts by being recorded at land offices, having priority over mortgages, and with an overall mortgage plus tenant limit on the LTV ratios. A regulatory criterion is that the sum of the tenant and mortgage LTV ratios is below 80%. Loan size serves as a security deposit, encouraging responsible behavior by tenants.

In Korea, a quarter of households pay no periodic rent, funding the lease with the loan deposit. Another quarter rent with periodic rent, but most include a loan deposit in a hybrid contract. As many as 97% of tenant households use rental capital finance (S-J Kim and Hyun Song Shin 2013).[2] The other half are homeowners with access to a mortgage

[2] Half of the tenants pay no rent but interest only. The other half rent, but with several months of security deposits. By contrast, in mortgage-only regimes with no tenant capital markets, asking tenants to pay more than a month in

market. Housing finance is available for all households, regardless of whether they own or rent.

Interest-only rental loan innovation arbitrages an otherwise non-traded contract and enables the housing market to respond to monetary policy. The average rent-price ratio in the US is 4.5% annually from the Lincoln Land Institute. With no capital market, tenants make the rent payment monthly to landlords. With a tenant capital market, a monetary stimulus that sets two-year interest rates of 2% annually on an 80% tenant leads to reduced tenant payment of 1.6%. This payment is below the 4.5% on a rent-only contract. The capital market has a short-term bond instrument in real estate apart from mortgages. In this case, landlords have access to 80% of the value of the house as a lump sum.

For stock investments with long-term real annual return of 7% (Siegel 2014), landlords earn above the 4.5% on rent only. The rental capital market reduces the tenant payment and increases landlords' expected return. The contract matches lender assets and liabilities between deposits and loans because landlord–tenant leases are along the six-month to ten-year term structure.

Empirical results address the two questions of flexibility and speed of adjustment. Estimates are for the US and Korean housing markets and finance in 1960–2017. The US has two rent-price equations but only for separate measures of house appreciation. Korea has two rent-price equations. One is for the tenant LTV, in which renters finance the entire lease. The other is a rent-price equation, including tenants financing with hybrid debt contracts.

Rents and prices are relatively flexible in Korea. In estimating the rent-price ratio condition, the interest rate incidence is between 42% and 0.53% in Korea. Rent-price ratio bears 97% of house price shocks, which confirms a complete capital market.

From the co-integrating equations, the Korean housing market adjusts rapidly to shocks. Complete adjustment to an interest rate, inflationary or house price shock, occurs within a year. The speed is faster in the deposit-only rental market, where adjustment occurs within six months. In robustness tests, the longest adjustment time is three years.

prepaid rent is difficult.

Flexibility and speed of adjustment in Korea increase over time. In the most recent years, 100% of shocks in interest rates and inflation pass through to relative rents and prices.

Rents are less flexible in the US. Rent-price ratio incidence is between 15% and 20% of mortgage rate and price shocks. Rent-price ratios and rents have limited volatility, consistent with constrained tenants lacking capital market access. The differences are numerically and statistically different, and are confirmed by stacking the Korean and US equations.

The US housing market adjustment is sluggish. The housing market takes at least four years to as many as 20 years to adjust to a shock. There are costs of having incomplete capital markets for tenants, including higher and less variable rents. Low variability of rents exerts pressure on inflation measures, themselves sluggish and unresponsive to monetary policy.

The empirical results answer the two questions. On flexibility, the rent-price equations indicate that the Korean housing market exhibits a greater response than that of the US. Between half and all shocks in interest rates or inflation are reflected in the rents and prices of Korean houses. No more than one-fifth of shocks occur in less-volatile relative US rents.

From the co-integrating equations, the Korean housing market often adjusts to a shock within a year. The most extreme case is three years. The US housing market takes three to five years to adjust to a similar shock, with the most extreme case at 20 years.

The results may explain another paradox. The present value and market completion conditions fail in tests of markets in developed countries. These present-value conditions pass in Korea (Hwang, Quigley and Son 2006; Kim and Cho 2018), suggesting markedly complete markets.

Section II presents the background on housing finance. Section III derives capital market conditions to own and rent. Capital-pricing equations have multipliers on how buyers finance and tenants rent deriving the incidence equation. Section III also describes data construction. The total return to holding a house is in rental yield and capital gains, requiring rents and prices to be in currency. Section IV provides the empirical results. Lastly, Section V presents the conclusion.

II. Housing Finance Contracts

The US and virtually all developed countries offer housing finance only to homeowners via mortgage. Despite excluding tenants, the US mortgage market is dominated by the federal government, suggesting a market incompletion.

The Flow of Funds https://www.federalreserve.gov/apps/fof/ of the Federal Reserve Board reports the enterprise value of houses at $12 trillion in 2000 and $25 trillion in 2018. Mortgage debt was $5 trillion in 2000 and $11 trillion in 2018. Over half or $2.7 trillion in 2000 and over $6 trillion in 2018 of the debt is in securities backed by federal agencies. Another $2 trillion in 2000 and $3 trillion in 2018 are in portfolios or un-securitized loans generally with federal guarantees from the data provider Inside Mortgage Finance. Over 90% of the mortgage debt value after 2008 has explicit federal guarantees. Despite a homogeneous product, borrowers at mortgage origination pay different points and fees depending on information (Woodward and Hall 2012).

The exclusion of one-third of households that rent from housing finance leaves the rental market unable to lay off shocks. Rents and rent-price yields have low volatility. The implied annual standard deviation of US apartment rents is 1.7%, and 2.1% for the total return (Plazzi, Torous and Valkanov 2010).[3] Rent-price ratio has annual volatility of 1.2% to 1.5%. With homeowners having the option to rent, house prices have low volatility. Standard deviation of annual price appreciation over different metro areas in 1991–2010 is between 2.0% and 3.3% (Ghysels, *et al.* 2013). Annualized volatility is 17.0% for S&P 500, 22.5% for Russell 2000, 21.7% for MSCI international stocks, and 12.0% for government bonds in 1970–2018 from Ibbotson Associates.

Survey data confirm low rent volatility. The proportion of US rental single-family houses with increase on lease renewal is close to half during inflationary periods in 1974–1981 (Genesove 2003). Two-thirds of tenanted single-family houses had no rent increase for 12 months in 1999-2008 (Verbrugge, Dorfman, Johnson, Marsh, Poole and Shoemaker 2017; Gallin and Verbrugge 2019).[4] Low rent volatility

[3] Half of the tenants pay no rent but interest only. The other half rent but with several months of security deposits. By contrast, in mortgage-only regimes with no tenant capital markets

[4] Rents are sticky downwards because 44% of leases are for exactly one year,

is not confined in the US. In Japan (1995–2018), the residential rent component of the consumer price index (CPI) ranged between 99 and 101, showing virtually no volatility. At the micro level, rents in Japan are sticky and unresponsive to monetary policy (Diewert and Shimizu 2015; Diewert, Nishimura, Watanabe and Shimizu 2019).

Korea (1987–2018) shows greater rent volatility. Rents increased at over 10% annually during the 1987–1989 boom. There have been two episodes of rent decreases. After the Asian financial crisis, rents declined at an annual rate of 3% in 1999–2000. Rents decreased by 2% annually in 2004–2005. In the US (over the same period), nominal rents declined only once quarterly, which was in the last quarter of 2008 during the financial crisis.

The result of stickiness is that rent-price ratio as a dividend fails to satisfy the Campbell and Shiller (1988) present-value condition (Ghysels, Plazzi, Valkanov and Torous, 2013). The present-value condition fails in financial markets (Lettau and Van Nieuwerburgh 2008). However, the present-value and other complete market conditions pass in Korea (Hwang, Quigley and Son 2006). Kim and Cho (2018) apply a present-value model to Korean housing markets. Price-rent ratio depends on rent growth, and notably the riskless rate and excess returns from housing. Adding a bubble shock appears to capture movements in six regional markets.

LTV regulation as a macroprudential policy measure has a greater impact in a small open economy than in a closed one (Junhee Lee 2019). Regulation of LTV ratios has implications for owners and tenants.

Long-term real US bond returns are 3.3% annually (Siegel 2014), comparable to those for a house. The use of the 4.5% mean rent-price ratio for 1976–2016 from Lincoln Land Institute and subtracting 2% annually for operating expenses (Harding, Rosenthal and Sirmans 2007; National Apartment Association 2018) generates a 2.5% annual net yield. Shiller (2015) (updates at http://www.econ.yale.edu/~shiller/data.htm) finds US real house price appreciation of 0.4% annually in 1890–2018. The resulting real annual return to holding a house is 2.9% annually. Long-term real discount rate on real estate is 2.6% annually using completed 99-year leases in the UK and Singapore

raising the costs of moving (Crone, Nakamura and Voith 2010).

(Giglio, Maggiori and Stroebel 2015, 2016). These returns are potentially suppressed by the lack of liquidity for owners in mortgage-only contracts (Bekaert, Harvey and Lundblad 2007) and below the 7% annual long-term returns from holding stocks (Siegel 2015).

Rent stickiness and lack of volatility frustrates monetary policy. Housing accounts for 42% of the weight in the US CPI. Rent is used to price the housing services of owners and tenants. Constrained tenants reduce rent volatility and that of inflation. Korea is a possible exception. The year 2012 marks the beginning of worldwide stimulative monetary policy, including the whatever-it-takes policy of the European Central Bank (Acharya, Eisert, Eufinger and Hirsch 2018).

Kookmin Bank, which is the largest housing finance lender in Korea, constructs a time series index on the rental LTV ratio. In June 2012, ratio was 61.1% nationwide, but nearly 80% by 2018. LTV is a measure of surge in housing demand associated with quantitative easing.

III. Housing Finance: Model and Data

A. Model Setup

Housing finance covers separate decisions to buy and rent. Buying involves a balance sheet capital structure. Home buyers allocate purchase price between debt and down payment equity. Renting involves cash flow or income statement structure. Tenants divide the payment for housing services between debt service from a capital market and rent. When there is no tenant capital market, 100% of housing payments are paid in rents.

Buying's cost of capital involves a multiple applied to the mortgage rate. This multiple depends on the LTV ratio and cost of equity. Tenants' cost of capital has a multiple on rent.

Owning has an indicator 0. The capital market offers mortgage at interest rate m available with LTV ratio υ_0. Mortgage interest is deductible against any taxable income, taxed at rate τ. After-tax mortgage interest rate is $m(1 - \tau)$. Buying involves down payment with an equity cost at rate e and down payment or equity ratio of $1 - \upsilon_0$.

Cost of capital c_0 for buying a house is a combination between debt and equity as follows:

$$c_0 = zm = \upsilon_0 m(1 - \tau) + (1 - \upsilon_0)e. \tag{2}$$

Cost of capital for owning a house on the balance sheet calculation is the product of mortgage rate and a multiple. This owning multiple is $z = \upsilon_0(1 - \tau) + (1 - \upsilon_0)e / m$. Debt cost is $\upsilon_0 m(1 - \tau)$, which is the product of the LTV ratio υ_0 and after-tax interest rate $m(1 - \tau)$. Equity portion is $(1 - \upsilon_0)e$, which is the product of equity share and its cost.[5]

Owning multiple depends on the mortgage LTV ratio υ_0, taxes τ, cost of equity e, and mortgage rate m Higher tax rate reduces the owning multiple, thereby reducing the after-tax cost of debt. Higher cost of equity raises the owning multiple and more expensive to buy. Given that equity costs more than debt, e/m exceeds one. Owning multiple decreases in the LTV ratio.

Cost of capital for renting a house is as follows:

$$c_1 = kr = \upsilon_1 i + (1 - \upsilon_1)r. \tag{3}$$

Rental capital multiple is $k = \upsilon_1 i / r + (1 - \upsilon_1)$. Aligning with the term of the lease, the tenant selects a rental loan interest rate i along the term structure. The debt finance payment for the tenant is $\upsilon_1 i$. The portion of tenant payments not coming from the capital market is $(1 - \upsilon_1)$ at rental yield r. Cost of capital for tenants is the product of the rent and a multiple.

Rental capital multiple depends on the tenant loan-to-value ratio, rent, and interest rate. Higher interest rate raises the multiple, increasing the cost of capital for being a tenant. When $(i/r) < 1$, interest rate is lower than the rent-price ratio. This case is satisfied at 2% short-term interest rates and 4.5% rent-price ratio. Thereafter, a higher tenant LTV ratio reduces the rental multiple and cost of capital. Higher rents reduce the multiple, while increasing cost of capital.

The mortgage capital market establishes an owning multiple $z(\upsilon_0, \tau, e, m)$. The tenant capital market has a rental multiple $k(\upsilon_1, r, i)$. Higher multiples increase cost of capital to own and rent, thereby limiting access to the housing market. Armed with these capital market conditions for owning or renting, households go into the housing market.

Buying involves paying a price H of a house. The house's price at

[5] The 2017 Tax Cut and Jobs Act generally eliminated the US deductibility of interest for owning homeowners. Tax rate has become zero except for under 5% of income tax filers.

time t is $H_t = H_e^{-pmt}$. Discount rate is the cost of capital for buying $c_0 = pm$. The house's intertemporal pricing condition is as follows:

$$-\dot{H}_t = -\frac{\partial}{\partial t}\left[He^{-zmt}\right]. \tag{4}$$

Rental yield for a unit house price is r. Rent paid for a house worth H is $R = rH$. In the rental capital market, cost of finance is kR., which is the cost of financing this rent level.

There are capital markets to own and rent. Households' equilibrium condition between owning and renting is as follows:

$$kR = -\dot{H}_t = A + zmt - \dot{H}. \tag{5}$$

In particular, a results from the approximations in cost of capital. Dividing by the product of the house price and rent multiple kH:

$$r = a + \frac{z}{k}m - \frac{1}{k}h = \theta = \theta_m m - \theta_h h \quad \text{where } 0 \le \theta_m, \text{ and } \theta_h \le 1, \tag{6}$$

where θ is a constant and $a \equiv A/H$.

The second equality views the own and rent multiples to be parametric, thereby allowing estimation. Parameter θ_m is the ratio of the own to rent multiples in the housing capital market. Parameter θ_h is the inverse of the rental capital multiple.

Rent-price ratio is $r = R/H$. Rate of capital gains is $h = \dot{H}/H$. Rent-price ratio is nonlinear in the own and rent multiples. Estimation is linear under parameter constraints in the second equality.

Ratio z/k is the incidence of a shock in mortgage rates. Ratio $1/k$ is the incidence of house price appreciation. These proportions are constrained to lie between zero and one. The greater the proportions, the more the flexibility of rents relative to price. This increased volatility is a response of rents and house prices to shocks in interest rates and inflation.

When k is high, cost of capital to rent increases and the proportion or incidence of appreciation reflected in rents is low. With no market to lay off risk, rents and yields have low volatility. This condition occurs when there is no tenant capital market. In the limit, $k = 1$, and price incidence

is 100%. Shocks are shifted to rental yields but laid off in the capital market.

If cost k is high from a non-existent tenant finance market, then ratio z/k falls. Rents are sluggish without complete capital markets. This ratio is for the incidence of the housing finance market.

Incidence condition is as follows:

$$\textit{Rent-price ratio} = \textit{Finance Incidence} \times \textit{Mortgage rate} - \textit{Price Incidence} \times \textit{House appreciation.} \quad (7)$$

This condition summarizes the household's decision between owning and renting. Rent-price ratio is a weighted difference between mortgage rate and house appreciation. Weight on the mortgage rate is z/k, which is the price ratio in the owned and rental finance markets. Weight on capital gains is the inverse $1/k$ of the price of rental finance. Limited rental finance market raises k, forcing downward the effects of mortgage rates or appreciation on rents.

Weights on mortgage rate and capital gains are their incidences. Incidences are proportions of the risk occupants bear the rent-price ratio in the mortgage rate and appreciation.[6]

A complete housing finance market has $\theta_m = z/k = \theta_h = 1/k = 1$. Occupants of houses owning or renting, accept 100% of the risk from interest rates or price shocks and $r = m - h$. Polar opposite is 0% incidence or $\theta_m = z/k = \theta_h = 1/k = 0$. The same conclusions apply to rents because $R = \theta_m mH - \theta_h \dot{H}$. When incidences are zero, rents are fully sticky. No policy intervention moves rent.

The results have implications for the dividend growth model. When the rental market is complete, the cost of owning and renting is identical and $c_0 = c_1$. In dividend growth, rents increase at the same rate as house prices. Price of a house is $H = R(1 + h)/(c_0 - h)$, which is the one-period ahead rent divided by the cost of capital and its growth rate. Rent-price ratio is $(c_0 - h)/(1 + h)$, and a method of implementation is to take a logarithmic expansion (Campbell and Shiller 1988). Capital market completion determines the prices to buy and rent and

[6] Incidences depend on the depth of the mortgage and rental markets. Moreover, incidences are the elasticities of supply and demand with respect to shock. A limited rental loan market with high prevents tenants from absorbing shocks in interest rates and prices.

incidences on the mortgage rate and price appreciation.

B. Data

Implementation and estimation involve a comparison between the Korean and US housing markets. The US has a mortgage market lacks organized capital source for renting. Korea has capital markets for owning and renting. Principal indices for house prices in the US from the Federal Housing Finance Agency (FHFA) and Core Logic S&P Case-Shiller (Case-Shiller) use repeat sales. For rent-price ratio, the numerator is the residential rent index of CPI. The denominator is the FHFA and Case-Shiller repeat-sales index. The FHFA and Case Shiller are in index form and require conversion to currency to obtain rent price ratios.

The US has two rent-price estimating equations, with the FHFA and Case-Shiller series as denominators. Rent is the same. In Korea, there are two equations but reflect different markets. Rent-price ratio has numerator for contracts, in which tenants paying some rent but include hybrids in the capital market. Rental LTV ratio is dependent on tenants paying no periodic rent. Tenants have access to capital markets whether they pay some or no rent.

For the US, time series are quarterly for 1960 to 2016. Rent-price ratio requires the numerator and denominator to be in currency. The 1960–2010 Census quarters become benchmarks for currency-based rent-price ratios. Multiplying the residential rent index, FHFA, and Case-Shiller prices by interpolated benchmarks yields a currency rent and two price indices for each quarter. Individual volatilities remain preserved. Currency data allow the construction of dividend yield or rent-price ratio.

Tenant LTV ratio is a time series reported by KB Bank beginning in 1987. The time series is quarterly from 1987 to the end of 2017. Owing to lags, some empirical results start with a sample beginning in 1989.

The periodic rental market involves similar data construction to the US. The numerator in the rent-price ratio is the rental component of CPI. The denominator is a house price index from KB Bank. Benchmark rent-price ratios in currency are from the Korean Census of Population and Housing occurring in years ending in zero and five. Interpolation provides benchmarks for census years. Volatility of the rent-price ratio in currency is based on residential rent and house price index.

Mortgage rates in the US are for the Freddie Mac 30-year fixed rate series. In Korea, interest rate series from KB Bank is tied to a short benchmark term of three to five years. General inflation rates are from CPI in each country.

The result is four time series on rent-price ratio, two for each country. In the US, rent-price ratio is from currency data with denominators from the FHFA and Case-Shiller price indices. In Korea, there is a rent-price ratio, in which tenants pay some payments to landlords. A separate tenant LTV ratio is provided for no rent.

The preceding data allow estimation of (5), in which rent-price ratio depends on mortgage rate and capital gains, with incidence coefficients derived from capital markets for buying a house or renting one.

Mortgage rate and capital gains are replaced by their real expectations. Expected inflation is from a four-quarter best-fitting auto-regression. With expectations $\bar{p}$ for inflation, $\bar{m} - \bar{p}$ the real mortgage rate, and $\bar{h} - \bar{p}$ for real house price inflation, the estimating equation is as follows:

$$r = \theta + \theta_m(\bar{m} - \bar{p}) - \theta_h(\bar{h} - \bar{p}) + \theta_p \bar{p}. \tag{8}$$

With no money illusion, inflation coefficient is $\theta_p = \theta_m - \theta_h - 1$.

IV. Empirical Results

Estimates for the US are shown in Table 1. Estimation is by contemporaneous seemingly unrelated regressions with a co-integrating equation. The co-integrating equation uses the lagged rent-price residual to estimate an adjustment speed.

Estimation addresses the two questions posed. In the upper panel for the rent-price ratio, the closer the coefficients to one in absolute value, the greater is the flexibility of the housing market. In the lower panel, changes in the rent-price ratio is the speed of adjustment in the housing market to shocks.

In the US, there is limited flexibility in rents. With no tenant capital market, no more than one-fifth of interest rate and inflationary shocks pass through to rents. Adjustment speeds are sluggish, taking up to 10 years to recover after a shock.

The upper panel shows the incidence coefficients. The US relative rents reflect only approximately one-sixth of housing price shocks.

TABLE 1
UNITED STATES HOUSING MARKET: CASE-SHILLER (CS) AND FHFA (FH) PRICES

	CS 1987Q1–2016Q1	FH 1987Q1–2016Q1	CS 1981Q1–2016Q1	FH 1981Q1–2016Q1	CS 1971Q1–2016Q1	FH 1971Q1–2016Q1
Dependent: Rent-Price Ratio						
Constant	3.839	3.829	3.833	3.982	3.946	4.062
	(22.537)	(26.380)	(41.014)	(52.234)	(31.645)	(36.968)
Expected Mortgage Rate	0.210	0.177	0.191	0.159	0.122	0.101
	(9.507)	(10.115)	(9.972)	(10.318)	(4.944)	(4.665)
Expected Real Capital Gain	−0.182	−0.153	−0.179	−0.138	−0.142	−0.084
	(−6.267)	(−3.916)	(−6.607)	(−4.603)	(−3.998)	(−1.874)
Expected Inflation	−0.989	−0.631	−0.792	−0.570	−0.118	−0.048
	(−4.645)	(−3.532)	(−4.976)	(−4.421)	(−0.642)	(−0.289)
R^2	0.517	0.488	0.551	0.551	0.275	0.247
Co-Integrating Regression with Rent-Price Ratio Dependent						
Constant	−0.013	−0.009	−0.011	−0.007	−0.011	−0.010
	(−2.208)	(−2.631)	(−2.129)	(−2.237)	(−2.677)	(−3.729)
Change, Expected Mortgage Rate	−0.018	−0.004	−0.012	−0.003	−0.006	−0.002
	(−1.132)	(−0.399)	(−1.109)	(−0.482)	(−0.749)	(−0.332)
Change, Expected Real Capital Gain	−0.097	−0.059	−0.091	−0.057	−0.086	−0.056
	(−5.638)	(−4.338)	(−6.194)	(−5.010)	(−6.839)	(−5.929)
Change, Expected Inflation	−0.295	−0.157	−0.276	−0.176	−0.246	−0.169
	(−2.371)	(−2.112)	(−2.753)	(−2.861)	(−2.845)	(−3.108)
Adjustment Speed (Lagged Residual)	−0.056	−0.043	−0.053	−0.043	−0.022	−0.021
	(−3.781)	(−3.732)	(−4.189)	(−4.335)	(−2.826)	(−3.629)
R^2	0.394	0.301	0.382	0.290	0.319	0.292

T-statistics are in parentheses. Estimates are single-equation for the Case-Shiller and FHFA prices in the denominator. In the numerator is the cash rent based on benchmarks in the Census second quarters, and controlled to the residential rent index in the consumer price index. Adjustment speed is the coefficient on the lagged residual in the co-integrating equation.

Conclusion: Incidence of house price and interest rate shocks on rents and rent-price rates are between 8% and 21%. Rents are relatively unresponsive to shocks. Housing market adjustment is sluggish, taking between 20 and 50 quarters to respond completely to a shock.

All coefficients have the predicted sign. Coefficients of the expected real mortgage rate are positive. Those on the expected real house

appreciation and inflation are negative. All coefficients are in the boundary between zero and one in absolute value. They satisfy the condition as proportions and incidences.

Expected real capital gain coefficient is the incidence of real house price shocks. In five cases, relative rents change between 13.8% and 18.2% of the real house price shocks (*i.e.*, approximately one-sixth). The remaining case is 8.4% of house price risk and significant at the 10% level. For the Case-Shiller data, relative rents absorb between 14.2% and 18.2% of the real house price shocks. Across the same row for FHFA, relative rents change by 8.4% and 15.3% of the real house price shocks.

In the mortgage market, incidence coefficient ranges between 10.1% and 21.0%. Relative rents change by between one-tenth and one-fifth of interest rate volatility. The lowest t-statistic is 4.66. For expected inflation, the results depend on the period. Over the entire period, the housing market operates on real mortgage rates and appreciation, with no separate inflationary impact.

The lower panel estimates the co-integrating equation for the rent-price ratio. In the second-to-the-last row is the adjustment speed from the co-integrating equation. Adjustment speed is between 2.2% and 5.6% per quarter across the price series and dates. A full adjustment from a shock takes between 18 and 50 quarters or 4.5 to 12 years in the US rental market. The US housing market is sluggish, adjusting gradually to an external shock.

The Wald test for equality of mortgage rate and the negative of the real house price appreciation has a sum of 0.028 with standard error of 0.034 using the Case-Shiller data. For the FHFA prices, the test statistic for the sum of the mortgage rate and negative real appreciation is 0.0235 with standard error of 0.0399.

Incidences of mortgage rate and price appreciation on the rent-price ratio are the same (*i.e.*, one-sixth). Tenants take one-sixth of shocks in either mortgage rates or expected real house price growth.

Estimates for Korea are shown in Table 2. Estimation is by contemporaneous seemingly unrelated regressions of the rent-price and tenant LTV pairs, each with a co-integrating equation.

For the two questions, Korean relative rents are flexible, with incidence coefficients indicating that relative rents absorb between half and all of the shocks. Adjustment speeds to a shock from the co-integrating equation are within one year.

TABLE 2
KOREAN HOUSING MARKETS, RENT-PRICE (RP) AND TENANT LOAN-TO-VALUE (TLTV)

	RP 1989Q2–2017Q4	TLTV 1989Q2–2017Q4	RP 1989Q2–2016Q4	TLTV 1989Q2–2016Q4	RP 1989Q2–2016Q4	TLTV 1989Q2–2016Q4
Constant	1.395	1.217	1.398	1.239	1.669	1.569
	(15.858)	(9.176)	(15.109)	(8.929)	(17.552)	(12.365)
Expected Mortgage Rate	0.427	0.509	0.427	0.510	0.422	0.517
	(25.421)	(20.056)	(24.927)	(19.836)	(24.194)	(22.237)
Expected Real Capital Gain	−0.532	−0.729	−0.531	−0.716	−0.497	−0.676
	(−5.967)	(−5.419)	(−5.799)	(−5.216)	(−5.297)	(−5.399)
Expected Inflation	−1.072	−1.441	−1.069	−1.465	−1.078	−1.603
	(−6.5189)	(−5.519)	(−6.053)	(−5.529)	(−5.923)	(−6.596)
R^2	0.948	0.916	0.943	0.943	0.941	0.927
Dependent: Change in Rent-Price and Tenant Loan-to-Value						
Constant	0.001	0.011	0.004	0.006	0.003	0.008
	(0.090)	(0.244)	(0.243)	(0.124)	(0.181)	(0.179)
Expected Real Capital Gain Change	−0.500	−0.854	−0.505	−0.863	−0.296	−0.748
	(−3.496)	(−2.066)	(−3.517)	(−2.062)	(−1.698)	(−1.819)
Expected Mortgage Rate Change	0.412	0.500	0.410	0.506	0.378	0.504
	(25.969)	(10.598)	(25.696)	(10.513)	(19.972)	(10.712)
Expected Inflation Change	−0.137	−0.902	−0.128	−0.937	−0.048	−0.907
	(−0.966)	(−2.063)	(−0.893)	(−2.095)	(−0.274)	(−2.052)
Adjustment Speed (Lagged Residual)	−0.084	−0.356	−0.083	−0.352	−0.129	−0.317
	(−2.052)	(−4.623)	(−2.049)	(−4.426)	(−2.578)	(−3.974)
R^2	0.892	0.638	0.892	0.643	0.837	0.650

Table 2 shows contemporaneous, seemingly unrelated regression results for the rent-price ratio and LTV markets. T-statistics are in parentheses, testing against the null that the parameter is zero. In boldface are cases where the coefficient is not significantly different from one, with tenants taking 100% of the shock.

Conclusion: In all cases with a tenant loan-to-value ratio (TLTV), relative rent adjusts for 100% of price shocks. The results confirm a complete capital market for tenancy. Even in the conventional rental market, relative rent incidence is between 42% and 53% of the interest rate and price shocks. Housing market adjustment is rapid, taking between 3 and 12 quarters to adjust to a shock.

Odd columns, including the first and third, have dependent variables as rent-price ratios. Tenants pay some rent. Even columns have tenant LTV ratios with interest but no rent.

For interest rates, incidence ranges between 42.2% and 51.7% compared with between zero and 21.0% in the six US cases. Tenant loan-to-value ratio takes on over half of interest rate movements or between 50.9% and 51.7%. The capital market allows for relative rent or deposit volatility of half the interest rate change.

For house prices, incidence on relative rents is even higher. In the tenant LTV market, proportions in the three cases are 67.6%, 71.6%, and 72.9%. The last two cases are not significantly different from one. All expected real appreciation is reflected in the tenant LTV ratio. In the rental market, a hybrid with deposit capital, incidences on relative rent are 49.7%, 53.1%, and 53.2% for real house price shocks.

In the second-to-the-last row is the adjustment speed from the co-integrating equation. In the tenant LTV market, adjustment speed is between 31.7% and 35.6% per quarter. Adjustment occurs in three quarters. In the rental market, adjustment speed is between 8.3% and 12.9% per quarter. The Korean housing market takes between 8 and 12 quarters to adjust. Although Korea's housing market adjusts in one to three years, similar shocks in the US take up to 20 years to absorb.

Table 3 presents when the complete housing finance market emerged in Korea. The procedure involves repeat estimation of the rent-price and tenant LTV equations for different terminal years. The first terminal year is 2010, and it moves forward annually up to 2017. Estimation of the two equations is with contemporaneous, seemingly unrelated regressions for the rent-price and tenant LTV ratios.

By 2016, the housing finance market is complete. In the rental LTV, the dependent variable absorbs 100% of the price shocks. This situation continues at 100% in 2017.

In the market where tenants pay some rent, interest rate risk proportions range between 42.7% and 43.1%. Appreciation incidences are between 51.1% and 53.6% during the 2010 to 2017 sample.

The lower panel shows the results for the tenant LTV market. Incidence for interest rate risk is between 42.8% and 52.1%. For prices, incidence in 2016 is 71.6% and 72.9% in 2017 of house appreciation, with both coefficients not significantly different from one. Although the sample includes earlier years, the housing finance capital market was complete by 2016.

The housing finance capital market spillover into rents is shown in Figure 1. Figure 1 also shows confidence interval ellipses for equality between parameters.

The higher the eccentricity of the ellipse, the greater the probability of equality. C(7) and C(8) are the expected real appreciation and mortgage rate, respectively, in the LTV market. C(1), C(2), and C(3) are

TABLE 3
SPEED TO HOUSING FINANCE MARKET COMPLETION

	1989Q1–2010Q4	1989Q1–2011Q4	1989Q1–2012Q4	1989Q1–2013Q4	1989Q1–2014Q4	1989Q1–2015Q4	1989Q1–2016Q4	1989Q1–2017Q4
Rent-Price Ratio								
Constant	1.666 (13.42)	1.650 (13.42)	1.643 (13.93)	1.572 (14.04)	1.488 (14.19)	1.427 (14.62)	1.398 (15.38)	1.394 (16.13)
Expected Interest Rate	0.427 (22.32)	0.429 (23.55)	0.430 (24.82)	0.431 (25.05)	0.429 (24.93)	0.428 (25.01)	0.427 (25.38)	0.427 (25.87)
Expected Real Capital Gain	−0.536 (−5.527)	−0.535 (−5.629)	−0.536 (−5.750)	−0.522 (−5.625)	−0.511 (−5.502)	−0.519 (−5.633)	−0.531 (−5.906)	−0.53 (−6.07)
Expected Inflation	−1.266 (−6.304)	−1.274 (−6.537)	−1.281 (−6.769)	−1.240 (−6.613)	−1.163 (−6.308)	−1.102 (−6.133)	−1.069 (−6.164)	−1.071 (−6.299)
R^2	0.929	0.933	0.939	0.939	0.941	0.943	0.945	0.941
Tenant Loan-to-Value Ratio								
Constant	1.844 (10.38)	1.818 (10.69)	1.788 (10.91)	1.658 (10.51)	1.516 (10.18)	1.354 (9.472)	1.239 (9.092)	1.217 (9.338)
Expected Interest Rate	0.510 (19.29)	0.513 (20.36)	0.519 (21.51)	0.521 (21.50)	0.519 (21.18)	0.428 (25.01)	0.509 (20.19)	0.509 (20.41)
Expected Real Capital Gain	−0.686 (−5.11)	−0.683 (−5.19)	−0.685 (−5.29)	−0.661 (−5.60)	−0.644 (−4.88)	−0.669 (−4.95)	−0.716 (−5.31)	−0.72 (−5.51)
Expected Inflation	−1.909 (−6.88)	−1.922 (−7.12)	−1.949 (−7.14)	−1.886 (−7.144	−1.758 (−6.71)	−1.595 (−6.06)	−1.464 (−5.63)	−1.441 (−5.51)
R^2	0.896	0.902	0.909	0.910	0.910	0.910	0.912	0.910

Table 3 presents contemporaneous, seemingly unrelated regression results for the rental and LTV markets, estimated by seemingly unrelated regressions. Each column has a terminal year, moving from 2010 to 2017. T-statistics are in parentheses. Insignificance from 1 in absolute value, where tenants take 100% of the risk is in boldface.

Conclusion: By 2016, the housing finance market is complete. Rental LTV absorbs 100% of price shocks. Most estimates exceed the t-statistic hurdle of three in absolute value proposed by Harvey, Liu, and Zhu (2016).

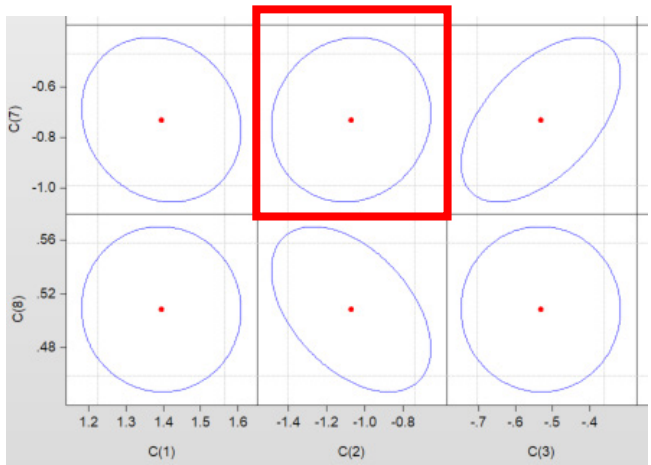

FIGURE 1
RENT AND LTV MARKETS
CONFIDENCE INTERVAL ELLIPSES, 1989Q2–2017Q4

Figure 1 shows confidence interval ellipses for equality between parameters. The more elliptical the shape, the greater the probability of equality. C(7) and C(8) are the expected real appreciation and mortgage rate, respectively, in the LTV market. C(1), C(2), and C(3) are the constant, expected general inflation and expected real appreciation, respectively, in the rental market.

the constant, expected general inflation, and expected real appreciation, respectively, in the rental market. The parameters of interest are C(3) and C(7), corresponding to real house price appreciation in the tenant LTV and pure rental markets. These are the most elliptical of any of the parameter pairs, suggesting a move toward equality of house price incidence in rental and LTV. With the LTV house incidence moving toward 100%, housing finance markets are complete. Homeowners, renters, and lenders have access to capital market.

Table 4 shows the differences in incidence across the housing finance regimes. The tests are for equality of housing finance parameters across markets. Period is held constant at 1989Q1–2016Q1. The four markets are for the US mortgage-only housing finance system with the Case-Shiller and FHFA prices. For Korea, there are the rent and tenant LTV markets, with mortgages and borrowing to finance tenancy.

Table 4 shows the results for the US. Table 5 has estimates for Korea. Although the results are in separate tables, the estimation is by

Table 4
Comparative Housing Markets, 1989Q1–2016Q1 US

	Case-Shiller	FHFA
Rent-Price Ratio		
Constant	4.06 (21.902)	4.006 (25.552)
Expected Mortgage Rate	0.196 (8.444)	0.167 (9.079)
Expected Real Capital Gain	−0.181 (−6.314)	−0.152 (−3.868)
Expected Inflation	−1.200 (−5.434)	−0.792 (−4.263)
R^2	0.532	0.487
Co-Integrating with the same Dependent variable; Rent-Price Ratio		
Constant	−0.015 (−2.174)	−0.009 (−2.143)
Change Expected Mortgage Rate	−0.022 (−1.141)	−0.003 (−0.313)
Change Expected Real Capital Gain	−0.113 (−5.787)	−0.072 (−4.759)
Change Expected Inflation	−0.369 (−2.514)	−0.232 (−2.726)
Adjustment Speed (Lagged Residual)	−0.022 (−1.515)	−0.012 (−1.088)
R^2	0.344	0.235

Estimation is with a co-integrating equation for adjustment speeds. Estimation is stacked for the four markets for the US and two house price series and the rent and LTV markets in Korea.

stacking together the US and Korean data.

In the US, rent-price ratio reflects 19.6% of the expected real mortgage rate shocks for the Case-Shiller data. For expected real house price appreciation shocks, the incidence is 18.1%. Coefficients of expected real mortgage rates and appreciation are equal. These estimates confirm that no more than one-fifth of shocks are reflected in US relative rents.

For the FHFA data, the results are slightly more sluggish. The real mortgage rate incidence on the rent-price ratio is 16.7%. Incidence of real house price appreciation is 15.2%, with the coefficients not significantly different from each other. Only one-sixth of shocks are borne by users in the rent-price ratio.

From the co-integration equation, the US adjustment speeds are 1.2% and 2.2% per quarter. Although signed appropriately negative, neither adjustment speed is significantly different from zero. In this mortgage-only housing finance market, rents are sluggish. US rents are generally unresponsive to interest rate and price shocks and show nearly no

Table 5
Comparative Housing Markets, 1989Q1–2016Q1 Korea

	Some Rent Rent-Price Ratio	No Rent Tenant LTV
Constant	1.673 (16.603)	1.637 (12.356)
Expected Interest Rate	0.421 (23.838)	0.519 (22.311)
Expected Real Capital Gain	−0.495 (−5.165)	−0.647 (−5.135)
Expected Inflation	−1.082 (−5.790)	−1.670 (−6.796)
R^2	0.940	0.924
Co-Integrating Regression with the Dependent Variable of Loan-to-Value Ratio(LTV)		
Constant	0.004 (0.209)	0.018 (0.390)
Expected Real Capital Gain Change	−0.292 (−1.652)	−0.712 (−1.712)
Expected Mortgage Rate Change	0.377 (19.674)	0.501 (10.530)
Expected Inflation Change	−0.049 (−0.278)	−0.882 (−1.973)
Adjustment Speed (Lagged Residual)	−0.129 (−2.558)	−0.332 (−4.055)
R^2	0.836	0.652

Estimation is with a co-integrating equation for adjustment speeds. Estimation is stacked for the four markets for the US and two house price series and the rent and LTV markets in Korea.
Conclusion: The incidence of interest rate and price shocks is between 15.2% and 19.6% in the US. In Korea, incidences are 42.1% to 64.7%. The US housing market takes 20 years or more to adjust to a shock. The fastest adjustment is where there is no periodic rent.

adjustment speed.

In Korea, Table 5 shows that estimation is for the rent-price ratio and tenant LTV markets. In the rental market, incidence is 42.1% of the interest rate and 49.5% of the appreciation shocks. Coefficients are not significantly different from each other.

Rent on a house is the holding cost less the asset's capital gain (Poterba 1984). Chinloy (1991) incorporates risk into the specification. The real return is the riskless rate plus housing's risk premium, less expected inflation, and all multiplied by the after-tax rate on ordinary income. The expected real capital gain is multiplied by the after-tax rate on capital gains. Cho, Kim, and Wachter (2010) estimate this user

cost for six large metro areas in Korea in Busan, Daegu, Gwangju, Seoul (Gangnam and Gangbuk), and Incheon. Estimates are for a single rather than a pooled equation, and without expectations and for a sample ending in 2007. The three-month certificate of the impact on the rent-price ratio of the three-month certificate of deposit is 0.01. The rent-price coefficient for house prices is −0.023.

In the LTV column, incidence coefficient for the rent-price ratio in the expected real house price appreciation is 64.7%. For interest rate risk, the proportion is 51.9% and the two coefficients are not identical. Adjustment speed is 12.9% per quarter in the rental market or eight quarters on a straight-line basis. For the LTV market with tenants borrowing, adjustment speed is 33.2% per quarter. In three quarters, complete adjustment to a shock takes place.

There are incidences for interest rates and prices in the two regimes: housing finance for everybody or a mortgage-only system. If incidences are equal, then $\theta_m = |\theta_h|$ for both markets. Four parameters collapse to one with three degrees of freedom. The chi-squared test for equality of incidences is 24.68. Thus, the housing market institutions are not the same in the two countries.

For the US alone, the null hypothesis of $\theta_m = |\theta_h| = 0$ is for capitalization of the mortgage market in prices. Placing the expected mortgage rate minus capital gains in the rent-price ratio equation, the coefficient is 0.0292 (0.0487) with the standard error in parentheses.

In the user cost, rent-price ratio is the difference between the mortgage rate and capital gains with 100% incidence on house occupants. From the US results, the incidence is not 100%. Using the higher of the two incidence estimates, the rent-price ratio is equal to 0.196 times the difference between expectations of the mortgage rate and capital gains. This robust result occurred when the US housing finance market was considered in isolation, as shown in Table 1.

Estimation in Table 4 is with seemingly unrelated regressions across the two markets and institutions. The estimation allows for comparison of incidences across the two countries. The capital gains incidence $|\theta_h|$ for the Case-Shiller US data is used as a benchmark and compared with its rent and LTV counterparts in Korea. The difference between the capital gains incidences in absolute value is 0.315 (0.099) for rent and 0.474 (0.129) for LTV or no payments to the landlord. Standard errors are in parentheses. The results indicate that the incidence coefficients are statistically different between the US and Korea. Incidences of

49.5% of price risk in periodic rent and 64.7% for tenant LTV exceeds the 19.6% in the US.

For the whatever-it-takes monetary policy period beginning in 2012, the initial loan-to-value ratio on Korean rental contracts is 61.1%. Bank of Korea's base rate is 3%, with tenant deposit interest rates priced 200 basis points higher at 5% annually. Cost to rent is the product of the interest rate and loan-to-value, or 3.1% annually. By 2015, the base rate fell to 1.5% annually, with the loan rate to 3%, and the LTV ratio increasing to 73.3%. The cost to rent on the interest only tenant contract is 2.2% annually, having fallen despite the increasing LTV.

In 2018, the annual base and rental loan rates remained at 1.5% and 3%, respectively, but the tenant loan-to-value ratio rate increased to 80%. Tenant rental cost is 2.4% annually by 2018, still less than half the 4.5% average for the US rent-price ratio.

In the same periods of 2012, 2015, and 2018 in the US, the 30-year fixed rate mortgage averaged 3.66%, 3.85%, and 4.54% annually, respectively. Rates eventually increased in the US, following a tightening of monetary policy beginning in 2017. In the same three years, the Case-Shiller house price index increased by 6.46%, 5.55%, and 4.45%. Real and nominal rates have the same effect since the incidence coefficients on the mortgage rate and house prices are identical in the US.

Using 0.16 as the common incidence, the impact on rent-price ratios in 2012 is $0.16 \times (3.66 - 6.46) = 0.16 \times 2.80$ or 45 basis points. Rent-price ratio falls about 10% from its sample mean. In 2015, a similar estimate is $0.16 \times (3.85 - 5.55)$ or 27 basis points, a decline of 6%. In 2018, the difference is $0.16 \times (4.54 - 4.45)$, which is essentially zero. Movements are one-sixth the size that would have occurred at 100% incidence. The impact on the rent-price ratio of policy changes are muted. Despite the muted response, the monetary tightening in 2017 is sufficient to eliminate the change in the rent-price ratio.

V. Conclusion

Under complete markets for housing finance, any household has access to capital regardless of the decision to own or rent. In such a complete market, mortgage and price incidences tend toward one.

In Korea, tenants have an alternative to pay interest only, with a rate matching the permanent lease term. Even when bumping into a 80%

limit on tenant LTV, at 2% the interest cost of housing is 1.6% annually. This interest only contract is below the average rent-price ratio in the US of 4.5% annually. Rent-price ratio absorbs 100% of price shocks by 2016, adjusting within a year. By contrast, the mortgage-only US has a price incidence below 20%, and adjustment takes at least 10 years.

Technology includes secured deposits, priority in claim, and allowing landlords the right to invest security deposits.

Specific innovations enhance a comprehensive mortgage market, such as Korea's. An entering tenant wants to ensure that there has not been a previous unpaid deposit. A blockchain recording system with non-fungible tokens allows security of the sequence of property transactions. Short-term securitization of the deposits pools the funds, allowing access to other private investments. Private equity funds and other entities can be created from tenant deposits. A blockchain system there assures lenders and tenants as to where the landlord's funds have been placed.

Incidences are one in absolute value, at least in price. Relative rent in Korea accommodates up to all the house price and half of interest rate risk by having a capital market. Adjustment often occurs within a year. In the US, incidence proportions are between 15% and 20%, and adjustment takes at least four years.

With simulative monetary policy and a mortgage-only regime, such as in the US, the impact of lowering interest rates largely increases the wealth of existing homeowners. Renters become considerably isolated and constrained. With housing finance for everybody, lower interest rates stimulate tenants. Leases and tenant LTV respond to short-term interest rates as does housing demand. With increased rent volatility, achieving an inflation target becomes considerably possible. There are benefits in social stability, household participation in the housing market, and reduced wealth inequality.

The results are for the aggregate economy. There are differences in other institutions and culture that affect housing markets. There are differences in regional performance within countries. The US mortgage market is centralized and standardized, thereby allowing securitization.

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