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The Effects of Conforming Loan Systems on Housing Finance Stability: A Panel Analysis of US, Japanese, and South Korean Mortgage Loan Systems

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Abstract

Amid growing concerns of a future housing crisis, this research addresses the factors that create stability within mortgage loan systems. Utilizing a review of extant literature, an econometric model is proposed for a panel analysis of three mature mortgage loan systems (those in Japan, South Korea, and the US) to determine factors that affect stability within each housing finance system. The results indicate that the prevalence of standardized fixed-rate mortgages with conservative loan-to-value and debt-to-income ratios inherently facilitates housing finance stability amid credit and interest rate dynamism. Larger derivatives markets for mortgages also bolster stability. Finally, recommendations are made for tightening policy gaps in South Korea's housing finance system.

Keywords

Conforming Loans, Fixed-Rate Mortgages, Government Sponsored Enterprises, Housing Finance Stability, Liquidity, LTV, DTI

1. Introduction

Remarkably, six financial crises between the 1970s and 2008 originated in declining housing prices (Reinhart & Rogoff, 2009). Extant literature points to excessive monetary easing, an unjustified supply of liquidity, and the disproportionate risk-taking of financial institutions (Reinhart & Rogoff, 2009; Kang & Park, 2013). Seeing this recurring issue, scholars, policymakers, consumers, and practitioners remain vigilant for the inevitability of future crises fueled by real estate fluctuations.

Before the next meltdown, it would be wise to outline the elements that build financial stability into a housing finance system. This paper examines stabilizing elements of three mature housing finance systems to provide recommendations before the next housing finance crisis. The recommendations are focused on South Korea but can be broadly considered by nations globally.

Housing finance is increasingly an integral component of most investment portfolios as mortgage-backed securities can be found in many diversified funds (pension funds, annuities, etc.). Comprehending the factors and conditions that build stability within a housing finance system will inevitably prove crucial as globalization proliferates. This study offers insight through an econometric examination and panel analysis of three national housing finance systems: Japan, South Korea, and the US which utilize government-sponsored mortgage-backed securities.

Scholars have examined policy in the mortgage sector; however, they have not examined the relationship between housing finance stability and the conforming loan systems. Furthermore, a collective study of the three nations (US, Japan, and South Korea) regarding housing finance has not yet been conducted. Despite the gravity of mortgage-backed securities to the financial welfare of a nation, few studies comprehensively and empirically examine the factors affecting mortgages and housing finance stability. Although several studies have examined loan-to-value (LTV), debt-to-income (DTI), and mortgage delinquency rates, they were generally limited to analyzing individual factors or a specific mortgage pool, not broadly over several nations. Those studies did not extend across the broader stability of the markets nor were they considered across several national policy alternatives. This study uniquely cuts across three mature mortgage markets to examine the policy options that effectively create financial stability in a housing finance system.

An econometric model is built with one dependent variable, housing finance stability—here non-performing loans (NPLs), and six independent variables based on extant literature: 1) Monetary easing; 2) Household spending; 3) LTV; 4) DTI; 5) The use of fixed mortgages; 6) The size of the national mortgage derivatives market. Since the three countries have vastly different mortgage systems, proxies were adopted to measure the variables being tested. The regression analysis is a panel analysis across the variables, time (1999-2015), and countries. The results indicate that indeed each variable significantly contributes to housing finance stability.

The remainder of this study is organized accordingly, a literature review places this study within the literature, underpins theory, and builds hypotheses. The methodology describes the operationalization of the variables and the methods of analysis. The data adoption, analysis, and results are covered within the analysis. A discussion relates the results to literature and policy recommendations while the conclusion summarizes the study contributions and recommends future endeavors.

2. Literature Review

2.1. Housing Finance Stability

Several factors affect housing finance stability during a crisis (Crowe et al., 2013) including household spending, LTV, DTI, mortgage type (fixed-rate versus adjustable-rate), the effectiveness of a housing finance derivatives market, and more. An LTV ratio of 70 indicates that 70% of the home value is mortgaged with a 30% deposit from the buyer. Belsky, Herbert, & Molinsky (2014) found that a 10% reduction in the LTV ratio corresponded to an 8% - 13% decline in housing price variation during an economic downturn. In other words, a lower LTV ratio (as could be stipulated by policymakers or loaning institutions) is associated with a firmer housing market. Thus, the LTV ratio should be measured when examining housing finance stability.

In practice, LTV ratios have been constrained by restrictions set by policymakers and enforced by financial firms; however, the levels and structures for doing this vary across nations (Crowe et al., 2013). Moreover, it is difficult to assess the degree to which these restrictions create financing stability; however, it is theorized that stricter LTV restrictions can help absorb credit and interest rate shocks during a crisis which can also reduce housing price fluctuations and bankruptcies (Crowe et al., 2013).

The DTI ratio is another important measure related to mortgages. The DTI ratio is the percent of gross income going to pay debt. Generally, US DTI ratios are not meant to exceed 33%; moreover, not more than 33% of a household's income should go to paying off debt. Here more debt means the consumer may have trouble if interest rates change. Higher DTI ratios were associated with greater volatility in housing finance markets and house price fluctuations during a crisis (Claessens, Kose, & Terrone, 2008). Moreover, short-term adjustable-rate mortgages (ARMs) were especially prone to increased exposure to interest rate shocks and credit shocks leading to the greatest volatility. Indeed, a lower DTI will reduce the impact of an income shock (Hur, 2010). Consumer spending also affects mortgage repayment. Higher consumer (household) spending constrains savings rates and affects a household's ability to make mortgage payments during a crisis. When a household spends less as a percentage, interest rates and credit shocks will be easily absorbed without upsetting the broader financial stability of a nation's housing.

Mortgage type also affects the natural absorption of credit and interest rate shocks during a crisis (Crowe et al., 2013). Short-term ARMs are generally refinanced every 3 to 5 years and maintain floating interest rates. This means the debt payment can dramatically change in a short time. Such fluctuations can have compounding effects creating a higher degree of volatility (Crowe et al., 2013). Developing nations frequently, initially rapidly expand home ownership through short-term ARMs making them more vulnerable to interest rate and credit shocks during a crisis; indeed, this was the case with South Korea before the Asian financial crisis in the late 1990s (Kang & Park, 2013). Realizing the associated volatility from short-term ARMs and the benefits of long-term fixed-rate mortgages

(FRMs), policymakers and practitioners in South Korea increasingly used FRMs after the 2008 financial crisis (Kang & Park, 2013).

Monetary policies affecting economic stability during a financial crisis can increase volatility in housing. FRMs also create some interest rate shocks for investors; that can dissuade financial firms from offering FRMs because of a lack of capital. Therefore, a strong derivatives market can be vital for assuring a steady supply of capital. Derivatives are options that can be used to cover interest rate shocks by MBSs.

Excessive leveraging and the expansion of ARMs were pointed out as contributors to the 2008 financial crisis (Crowe et al., 2013). In contrast to countries with a high proportion of FRMs, prices fell sharply in countries with a high proportion of ARMs; moreover, housing volatility remained high throughout the crisis for those same nations. Based on inherent housing volatility, it is crucial to study the regulatory requirements for mortgage loans, the proportion of long-term FMRs, and interest rate risk management methods.

2.2. History of Mortgage-Backed Securities

To promote housing ownership after the Great Depression, the US government established government-sponsored enterprises (GSEs including Fannie Mae, Freddie Mac, and Ginnie Mae) for government-supported securitization of mortgages. GSEs organized the sale of FRMs to financial institutions through the issuance of mortgage-backed securities (MBS). Japan and Korea also promoted home ownership; however, government-supported loans were limited. Most Korean and Japanese mortgages were ARMs provided by private financing institutions such as banks. Nevertheless, GSEs also emerged to manage liquidity risks associated with mortgages as is shared in Table 1.

Table 1. Government oversight of mortgages.

	Government		Government Sponsored Organization
	Mortgage Insurance Institute	Guarantee Institution	
Denmark	X	X	X
Germany	X	X	X
Netherland	X	X	X
Spain	X	X	X
UK	X	X	X
Australia	X	X	X
Canada	CMHC	CMHC	X
Japan	X	JHF	Possible
USA	FHA	Ginnie Mae	Fannie Mae, Freddie Mac, FHLB
Korea	X	X	KHFC

Claessens et al. (2008) quickly characterized the relationship between the 2008 financial crisis and the housing price plunge followed by Reinhart & Rogoff (2009). Others followed, and CoreLogic (2011) further described the causes of the subprime crisis. Geanakoplos (2010) found corroborating international evidence that higher leveraging led to greater volatility in housing prices. Warnock & Warnock (2008) argued that collateral disposal and bankruptcy laws were major contributors to efficiency and stability in the housing finance market. Crowe et al. (2013) analyzed the effect of LTV restrictions on housing price increase constraints indicating that higher LTV ratios were related to higher price fluctuations. Lea (2010) examined the structure of mortgage products in key nations by outlining the proportion of mortgage loans by the type of interest rate (fixed or adjustable) and the extent of government intervention in housing finance; furthermore, it was discovered that a higher rate of FRMs was associated with a higher LTV constraint and a more stable housing finance market. This was corroborated by an IMF study which found that a higher proportion of FRMs led to a lower rate of housing price shocks; moreover, higher housing prices were also associated with higher real gross domestic product (GDP) (Crowe et al., 2013).

Regarding mortgages in South Korea, Hur (2012) scrutinized the impact of LTV and DTI on financial stability and delinquency rates concluding that lower LTV ratios and DTI ratios were associated with greater stability. Kim (2013) conducted a stress test on the risk of defaulting on household debt. The test showed that consumers with a higher household debt repayment burden and a higher average consumption exhibited more cashflow problems. Personal cashflow issues resulted in greater financial instability in the housing finance system. DTI remains a central indicator of stability. Kim (2014) examined the effects of LTV and DTI regulations. Lee (2017) scrutinized the impacts of LTV and DTI on household debt and the macroeconomic ripple effects. It was recommended by Park (2013), that Korean policymakers introduce regulations to allow financial institutions to buy and sell interest rate derivatives to mitigate interest rate risks. Policy regarding the management of LTV and DTI has been scrutinized by scholars domestically in South Korea, the US, and Japan, but not collectively as in this study.

Kim (2007) states that the Japan Housing Finance Agency (JHF) announces the minimum base rate each month, which is the basis for calculating interest rates by lenders. The JHF fully bares the interest rate risk (a pipeline risk that occurs as the market interests rise between the time of the mortgage sale and the MBS issuance). South Korea's Korea Housing Finance Corporation (KHFC) avoids interest rate risk by using Korean treasury bond futures and interest rate swaps to evade passing those risks on to private lenders. Jeong (2010) notes that FRMs in Japan could rapidly rise based on the system that specializes in supply-only mortgages; moreover, it was suggested that Korea utilize smaller local lenders to expand the supply of standardized loans. Each nation utilizes GSEs to issue mortgage-backed securities through a system known as a conforming loan system.

2.3. Conforming Loan Systems

A conforming loan system is utilized to ensure loans conform to set restrictions to ensure mortgages meet standards before being securitized into mortgage-backed securities (MBSs). This creates a level of safety for investors (protection from liquidity risk) and safeguards security in the housing market (protection from price collapse) (Kim, 2018).

Conforming loan systems are managed variously across nations. In the US, the system of conforming loans for securitization is now orchestrated by GSEs including Fannie Mae and Freddie Mac. In Japan, the process is managed by the Japan Housing Finance Agency (JHF) through Flat 35 mortgages. In South Korea, it is organized under the Korea Housing Finance Corporation (KHFC) where the KHFC purchases and securitizes loans and sells MBSs. In each country specific measures of consumer credit, debt, and LTV are utilized to certify a standardized mortgage is being securitized for investors (**Figure 1**).

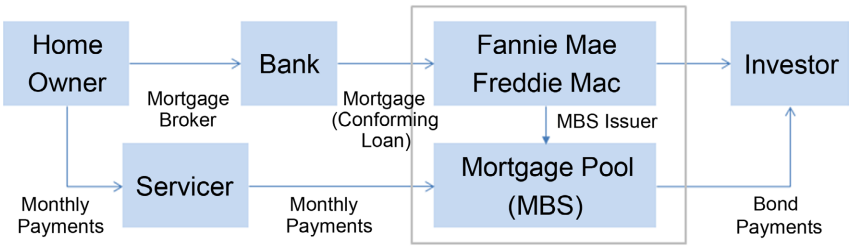

Figure 1. Securitization structure of U.S. conforming loan (Wiedemer, 2010: p. 82).

2.4. US Conforming Loan System

Since the 1970s, the U.S. has been supplying liquidity to financial institutions by purchasing conforming loans and issuing MBS. As indicated in **Figure 2**, the percentage of total mortgage loans secured through GSEs for securitization in 2021 was 54.5%, $2.63 trillion. The U.S. mortgage market was about $ 4.83 trillion in 2021 (Goodman et al., 2022: p. 8).

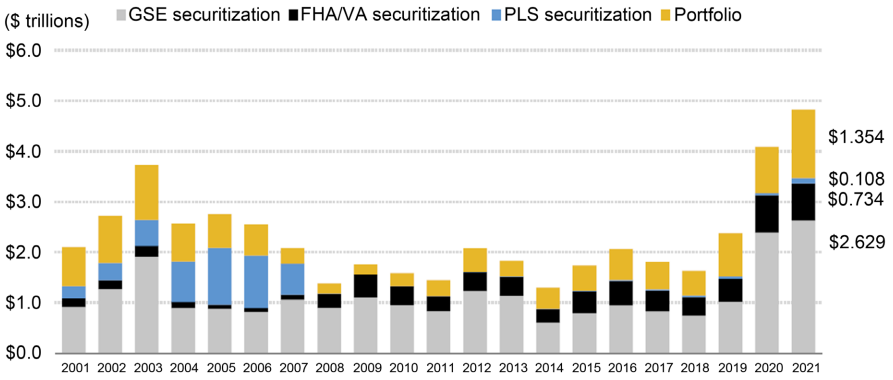

Figure 2. Mortgage loan supply trend for securitization in U.S. (Goodman et al., 2022: p. 8).

In the U.S., no universal regulations related to LTV or DTI exist; however, GSEs

acquire conforming loans at specified loan limits. Fannie Mae (FNMA, 2015) defines DTI and the credit rating of the borrower in detail through an LTV ratio. FNMA scrutinizes lenders in terms of repayment ability or credit rating. Based on the credit rating (FICO Score), the LTV is restricted to less than 75%, above 75%, and over 80%. Conforming loans proved safer than private bank loans during the subprime mortgage crisis. Delinquency rates and foreclosure rates were lower while investors enjoyed safer returns compared to subprime mortgage loans.

The United States is the only country where long-term FRMs accounted for 75.3% of loans for more than 30 years as shown in **Figure 3** (Goodman et al, 2022: p. 9). In most developed countries, mortgage maturities are usually less than 10 years, and it is not uncommon for interest rates to remain fixed until maturity. If mortgage rates are fixed for a long period of time, households can have stable consumption expenditures despite market interest rate shocks, and the volatility of the financial system is also reduced. Therefore, the long-term mortgage system in the United States is unique. The financial crisis was triggered despite a high proportion of fixed interest rates; moreover, the root cause lies in banks allowing 100% LTV ratios and relaxed subprime loan regulations.

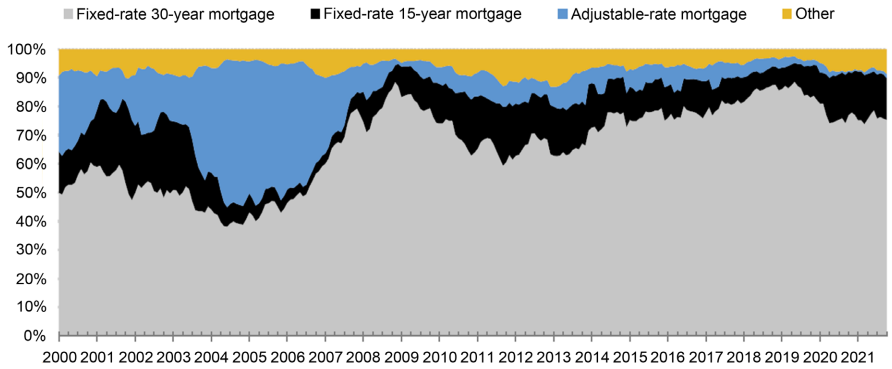

Figure 3. Interest rate types of mortgage securitized by GSEs (Goodman et al., 2022: p. 9).

Since the financial crisis, the U.S. has reformed its financial markets through the Dodd-Frank Financial Reform Act, and the Mortgage Reform and Anti-Predatory Lending Act; both acts include direct regulation of mortgage markets. The new concept introduced here is a qualified loan, which means full amortization within 30 years of maturity. Both FRMs and ARMs are recognized as qualified loans, but the ARM rate should be estimated in terms of the highest possible (as estimated at the time of the issuance of the loan) interest rate level within the first five years (Kang & Park, 2013: p. 165). As a result of these reforms, the proportion of traditional conforming loans that meet the requirements of qualified loans is expected to increase and the size of MBS issuance of GSEs will increase.

The high proportion of FRMs in the U.S. might be attributed to the development of a strong derivatives market for risk management. U.S. GSEs offer future purchase prices when they sign a mortgage purchase contract with a lending institution and

purchase mortgage loans at contract prices up to 90 days after the contract is concluded. However, if the lender cannot fulfill the contract, the GSEs will charge an additional fee to the lender. GSEs can announce real-time mortgage lending commitments because the MBS retail market and the interest rate derivatives market are active, facilitating mortgage market valuation and interest rate risk management. As of the end of 2016, over-the-counter (OTC) derivatives transactions worth $140.8 trillion, accounted for 38.2% of the global interest rate derivatives trading volume (Bank for International Settlements (BIS), 2017). As of the end of 2021, the balance of the OTC interest rate derivatives contract is $2.1 trillion, which is 32.6% of the global value.

2.5. Japanese Conforming Loan System

Japan's housing finance system was bank-led through indirect financing similar to South Korea, raising concerns that the financial risks of mortgage lending tend to be concentrated in private banks. The Government Housing Loan Corporation (住宅金融公庫), established in 1950, changed its name to JHF in April 2007, began to prioritize Flat 35s, a standardized and securitized mortgage. JHF has concluded agreements with 339 financial institutions to finance Flat35s, which they manage. The annual supply has grown from 5 billion Yen in 2003 to 18 trillion Yen in 2020 as shown in **Figure 4** over 17 years. There are two types of Flat35s, purchased loans and secured loans. Securitized FRMs are bought by the JHF from private financial institutions while the secured loans are guaranteed repayment of principal through a private loan from JHF.

The maturity of Flat35 is between 15 and 35 years. Repayment is divided into Principle Equal Partial Repayment or Principal Interest Equal Installment Repayment. The loan limit is more than 1 million yen and less than 80 million yen. LTV is up to 90%, and DTI is restricted by annual income: less than 4 million yen is restricted to 30% while over 4 million yen is 35%.

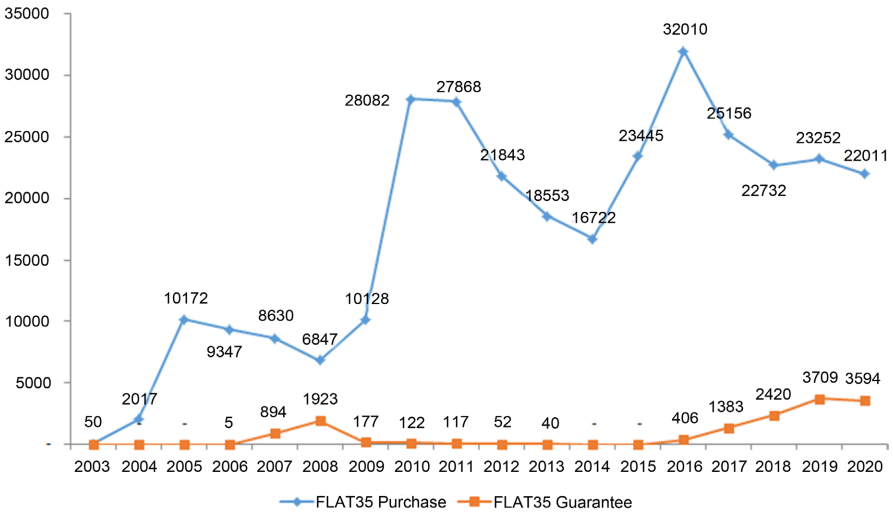

Figure 4. Flat35 supply trend (Source: Japan Housing Finance Agency, unit 100 million JPY).

The interest rate of Flat35 consists of the MBS issuance rate, JHF operating cost, and servicing fees of mortgage servicing institutions. When JHF notifies the lending institution of the minimum required interest rate that reflects the MBS issuance cost and operating expense, each financial institution autonomously fixes servicing fees to determine the lending rate. The borrower shall bear the expenses such as office fees, insurance premiums, mortgage fees, and stamp duties of the lending financial institution. Many private financial institutions participate in Flat 35 lending, resulting in inter-institutional competition, resulting in a yearly decline in servicing fees, contributing to the flat rate cut (Ministry of Land, Infrastructure, Transport and Tourism; MLIT in Japan (MLIT, 2010: p. 42)). The proportion of fixed-rate loans over the five-year maturity increased from 37% in 2012 to 61% in 2015, as a result of excluding expenses from interest rates and maintaining a low level of DTI (Japan Housing Finance Agency, 2015).

The expansion of fixed-rate loans in Japan appears to have been influenced by the development of the derivatives market. As of the end of 2016, the trading volume of the yen-denominated (JPY) OTC interest rate derivatives reached $41.7 trillion. This is an increase of 213.5% from $19.5 trillion in 2003, which accounts for 11.3% of global interest rate derivatives trading volume (Bank for International Settlements, 2017). As of the end of 2020, the outstanding balance of the OTC interest rate derivatives contract is $37.1 trillion, accounting for 7.96% of the global scale. Derivatives facilitated FRMs in Japan.

2.6. South Korean Conforming Loan System

In South Korea, where ARMs lending in the form of repayment on the maturity date is most common, housing prices have risen sharply as liquidity from monetary easing policy has flowed into the housing market after the 2008 financial crisis. In 2008, the Korean government began to improve the potential risk factors of household debt such as high growth of household lending and weak loan structures. The Korean Financial Supervisory Authority announced the "Comprehensive Measures for Family Land Leakage Landing" in June 2011 and the "Roadmap for Advanced Financial Loan Screening Method" in January 2017. By 2017, the South Korean government set a target for 45% of all mortgage loans to be FRMs (Financial Services Commission, 2017). As the proportion of FRMs decreased to 45.5% again after 2020 as shown in **Figure 5**, the Financial Supervisory Service reset the target to 52.5% at by the end of 2022.

In line with the policies from authorities, the Korea Housing Finance Corporation (KHFC) launched a "conforming loan" in March 2012, the standard procedure for a long-term FRM that can provide low-interest liquidation to financial institutions based on high credit ratings. KHFC supplied conforming loans worth 132 trillion won until 2021. Including the Bogeumjari Loans supplied as KHFC's product since 2004, a total of 368 trillion won worth of long-term FRMs were supplied to the market as shown in **Figure 6**. FRMs accounted for about 19.5% of total mortgage loans in Korea by the end of 2021.

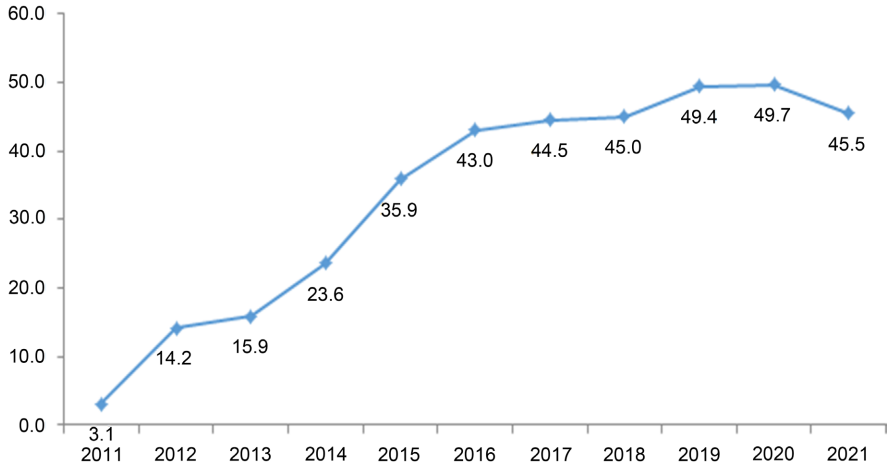

Figure 5. Proportion of FRMs in Korea (Source: Financial Stability Report, Bank of Korea, unit %).

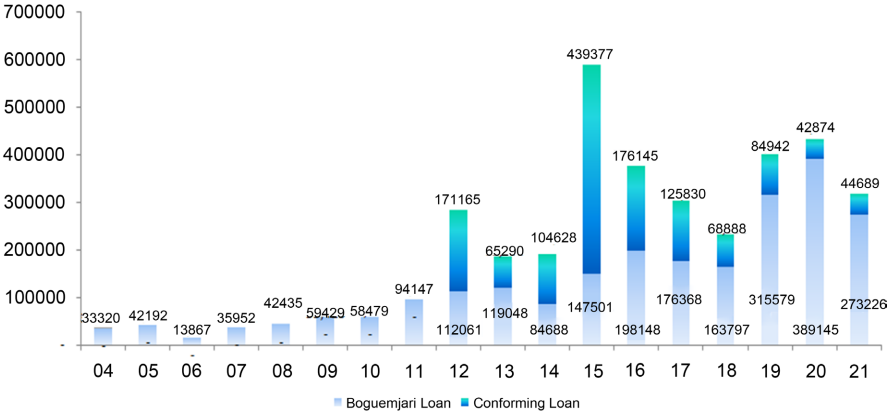

Figure 6. P KHFC's conforming loan supply trend[1] (Source: Korea Housing Finance Corporation, unit 100 million KRW).

The KHFC Conforming Loan was designed with a maximum DTI of 60%, a maximum LTV of 70%, a loan limit of less than KRW 500 million, and variable maturities of 10, 15, 30, or 40 years. However, according to the "Measures to Stabilize the Housing Market (2017.8.2)" by the Korean financial authorities, LTV and DTI allowances were limited to first-time home buyers. In addition, LTV and DTI were tightened to 40% for speculative buyers such as multi-tenant purchasers.

The Korean Conforming Loan differs from the U.S. and Japanese schemes in terms of market valuation and purchasing. U.S. GSEs and the Japanese JHFs use a variety of interest rate risk management methods to disclose the purchase price of mortgage loans in advance. In Korea, however, financial institutions first execute mortgage loans and sell mortgage loans at prices offered by KHFC at the time of the transaction. This is due to the lack of a market for derivatives to manage long-term interest rate risk. The primary method Korean financial institutions

[1]In order to expand long term fixed rate mortgage loans, the Korean government has established KHFC in March 2004 and has been supplying its own mortgage loan, Bogeumjari loan.

manage the interest rate risk of long-term FRMs in the derivatives market is with the 10-year Korea Treasury Bond (KTB) Futures. KTB Futures averaged a daily trading volume in 2016 of 7.2% of the outstanding balance of the long-term FRMs (Cho, 2016: p. 66). As of the end of 2021 that was 15.66%. This remains insufficient to facilitate the widespread use of FRMs by private banks.

3. Methodology

The only countries that operate their housing finance system using the conforming loan systems of government-sponsored institutions are the United States, South Korea, and Japan. Therefore, analyzing the correlation between the main elements of conforming loans and housing finance stability in these countries can provide very important implications for the stable growth of housing finance markets and national economies.

To test the factors contributing to housing finance stability across the three nations (US, Japan, and South Korea) an empirical model was built through the literature review (as provided above) and tested utilizing EViews Software. As the mortgage and housing sectors are structurally different with various measures of similar (yet different) data points, some variables were operationalized with proxies. Each paragraph section includes hypothesis support and the operationalization of the variables. The final econometric equation is presented at the end of this chapter.

3.1. Housing Finance Stability

The dependent variable is housing finance stability. It is measured as non-performing loans (NPL) as defined by the (Crowe et al., 2013). In banking, commercial loans are considered non-performing if the borrower is 90 days past due. This is a commonly utilized statistic recommended by the IMF to measure housing finance stability. Six independent variables are further hypothesized and operationalized to complete the equation. This data set can be collected from the Bank for International Settlements (BIS) and the financial supervisory authorities of each country.

3.2. Monetary Policy

Monetary policy is noted as a method for central banks to persuade or restrict consumer spending. This is also utilized to create stability within the housing finance market. During financial downturns, it is common for central banks to enact monetary easing (reduced interest rates) to induce spending. In other words, the supply of money is expanded and financing becomes cheaper for consumers, to increase the availability of money, interest rates are generally decreased. In this research equation, monetary easing is operationalized as M3 (broad money including currency, deposits, and other monies within a two-year maturity range). This kind of data can be derived from the OECD. When interest rates are acutely reduced to relieve pressure for consumers it can help reduce instability; however,

if interest rates remain reduced for too long, it creates long-term instability through a real estate bubble (Kang & Park, 2013). M3 is used to quantify the speed of monetary easing; faster easing means more stability; and longer easing means increased instability. It is hypothesized that monetary easing will create housing finance stability; thus, the first hypothesis is proposed:

H1: *Monetary easing will improve housing finance stability*.

3.3. Household Spending

Household spending, leading to an unstable or weak household cash flow, was found to negatively impact stability (Hur, 2010). Household spending data can be derived from the OECD. In this study, it is operationalized as a ratio of household spending over household credit. When household spending is higher relative to credit this implies that there is more household cash flow instability; thus, the second hypothesis is specified:

H2: *Restricted household spending will improve housing finance stability*.

3.4. Loan-to-Value

The LTV ratio is used by banks to ensure the consumer is sharing the cost of the house. The loan-to-value (LTV) ratio is a percentage that compares the amount of a loan to the value of the asset (house) being purchased. LTV information can be extracted from the BIS database. The LTV ratio is generally restricted to safeguard against default. Here it is hypothesized that LTV affects housing finance stability. When the value of the loan is more relative to the value of the home, there is inherently more risk associated with the mortgage; therefore, policies and practices that restrict LTV ratios enhance housing finance stability. LTV is operationalized as household credit divided by the housing price index. It is hypothesized that a restricted LTV will lead to a stable housing finance sector; consequently, the third hypothesis is defined:

H3: *Constrained LTV will improve housing finance stability*.

3.5. Debt-to-Income

The debt-to-income (DTI) ratio is the share of income used to cover debt payments. DTI data can be extracted from the BIS database. When more income is spent on debt, the financial stability of the consumer becomes increasingly more precarious. Here the DTI ratio is operationalized as the household debt repayment burden. The fourth hypothesis is stated:

H4: *An increasing debt burden will generate instability in housing finance*.

3.6. Fixed-Rate Mortgages

FRMs likely contribute to greater housing finance stability because the repayment rate does not change over time; conversely, the payments on ARMs do change over time. Increasing interest rates can drastically impact the cost of ARMs, making loan repayment impossible and adding to housing finance instability as was

shown in the 2008 financial crisis (Crowe et al., 2013). FRM data can be collected from the Bank for International Settlements (BIS), financial supervisory authorities and GSEs of each country. Nations with a higher proportion of FRMs display greater stability than those with more ARMs; accordingly, the fifth hypothesis is posited:

H5: *Fixed-rate mortgages lead to increased housing finance stability*.

3.7. Derivative Market

Derivatives refer to options (to buy or to sell) that hedge interest rate risks for investors. Larger derivatives markets (for mortgages) should strengthen housing finance stability. More available options should safeguard mortgage risks. When investors have access to options that protect from interest rate risk, investors are more willing to participate in the financing of mortgages; therefore, expanding capital in the housing finance market. Data regarding the size of derivatives markets can be taken from the BIS and financial supervisory authorities of each country. It is hypothesized that a large derivative market will lead to improved financial stability; the final hypothesis is stipulated as:

H6: *A larger derivatives market is associated with increased financial stability*.

3.8. Model

In summary of the postulated hypotheses, an econometric equation is proposed; the equation states that housing finance stability is a function of several factors posing a negative relationship including, monetary easing, household spending, LTV, and DTI with others relating a positive relationship including FRMs and the size of the mortgage-based derivatives market. The equation is illustrated below. The panel analysis is in the following chapter (Table 2).

Table 2. Hypotheses.

Hypothesis	Variable	Expected Influence (Sign)
H1:	Monetary Easing (Liquidity)	Negative (−)
H2:	Household Spending/Household Credit	Negative (−)
H3:	Household Credit/House Price Index	Negative (−)
H4:	Household Debt Repayment Burden	Negative (−)
H5:	GSEs Securitization for Fixed Rate Mortgage Loan/Household Credit	Positive (+)
H6:	Interest Rate Derivatives Size/Debt Securities Size	Positive (+)

$$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + \beta_6 X_{6it} + \beta_7 X_{7it} + u_{it}$$

i = countries (U.S., Japan, Korea); t = year of from 1999 through 2015.

$$Y = \text{Housing Finance Stability}$$

$$X_2 = \text{Monetary Easing}$$

$$X_3 = \frac{\text{Household Spending}}{\text{Household Credit}}$$

$$X_4 = \frac{\text{Household Credit}}{\text{House Price Index}}$$

$$X_5 = \text{Household Debt Repayment Burden}$$

$$X_6 = \frac{\text{GSEs Securitization for Fixed Rate Mortgage Loan}}{\text{Household Credit}}$$

$$X_7 = \frac{\text{Size of Interest Rate Derivatives Market}}{\text{Size of Debt Securities Market}}$$

4. Analysis

4.1. Data

The data was collected from the Bank of International Settlements (BIS), OECD databases, IMF databases, and the central bank databases of each country. The data was modified with a natural log function for improved examination with EViews Software. The log function increases the normality of the data for an accurate regression analysis; moreover, skewness and kurtosis are reduced by assuaging deviation.

Data from the 3 countries including the years 1999 through 2015 were used for this empirical analysis. Since the KHFC was established in 2004, Korean data remained limited from 2004 through 2015. Therefore, this model is constructed as an unbalanced panel data set with a total of 45 observations. Data up to 2015 were used in this study as it was confirmed that there were errors in the data for the years after 2015 in the data regarding the derivatives market published on the website of the Financial Supervisory Service. If and when data consistency is confirmed, a follow-up study should be performed with the latest numbers. The final model formula can be expressed as stated in Equation 2 and Table 3.

Table 3. Operationalization of the variables.

	Variables	Proxy variables	Transformed Variables	Data Sources
Y	Housing Finance Stability	Household NPL (Non-Performing Loan) Ratio (%)	Log (1/NPL)	Bank for International Settlements, Federal Reserve Bank of St. Louis, Japan Financial Services Agency, Korea Financial Supervisory Service
X_2	Liquidity	M3 Broad Money (Index)	Log (M3)	OECD
X_3	Household spending	(Household Spending)/ (Household Credit) (Million $)	Log (HS/HC)	OECD

Continued

X_4	LTV (Loan to Value)	(Household Credit)/ (House Price Index) (billion $, Index)	Log (HC)/Log (HPI)	Bank for International Settlements
X_5	DTI (Debt to Income)	Debt Service Ratio (%)	Log (DSR)	Bank for International Settlements
X_6	Weight of fixed rate mortgage on total mortgage	(GSEs MBS Outstanding Balance)/(Household Credit) (billion $)	Log (MBS_OB)/ Log (HC)	Bank for International Settlements, Inside Mortgage, Japan Housing Finance Agency, Japan Financial Services Agency, Korea Housing Finance Corporation
X_7	Diversity of interest rate risk hedging method	(Interest Rate Derivatives Market Size)/(Debt Securities) (billion $)	Log (Deriv.)/Log (DS)	Bank for International Settlements, Korea Financial Supervisory Service

4.2. Common-Effect Model

The pooled data were analyzed through a pooled ordinary least squares (OLS) regression also known as the common-effect regression analysis with EViews Software. Those results can be viewed in Table 4. The regression results were the same as expected in the hypothesis. Several independent variables were not found statistically significant including the control variable (C), household spending, and the derivatives market. Additionally, the significance values overall were unsatisfactory. It is not unusual for independent variables to impact each other in an OLS common-effect regression. A fixed-effect analysis can be adopted to estimate the results excluding those impacts; however, before that can be completed it is necessary to ensure that such a model is appropriate based on two tests: the Chow test and the Hausman test (Agung, 2014).

Table 4. Pooled OLS estimation results.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.51893	8.835152	1.530130	0.1343
LOG (M3)	−1.154764	0.481131	−2.400103	0.0214
LOG (HS/HC)	−0.126249	0.718930	−0.175607	0.8615
LOG (HC/HPI)	−0.735177	0.214608	−0.342568	0.0015
LOG (DSR)	−2.204956	1.018255	−2.165427	0.0367
LOG (MBS_OB)/LOG (HC)	0.372836	0.107398	3.471538	0.0013
LOG (DERIV)/LOG (DS)	0.368028	0.248292	1.441962	0.1575
R-squared	0.627217	F-statistic		10.65599
Adjusted R-squared	0.568356	Prob (F-statistic)		0.000001

4.3. Chow Test and Hausman Test

It is essential to confirm that the fixed-effect model is appropriate rather than the common-effect model; moreover, the Chow test and Hausman test can be used to approve its use (Nurrahmah et al., 2020). The Chow test examines the F-statistic to determine if dummy variables should be adopted or not. According to the number and p-value, dummy variables should not be adopted (Agung, 2014). The Hausman test looks at the Chi-square number to determine if the common-effect model or the fixed-effect model is suitable. The results affirm that a fixed-effect model is appropriate (Agung, 2014). (**Table 5**)

Table 5. Results of the chow test and hausman test.

Effects	Test	Statistic	d.f.	Prob.
Cross-section	F	25.622848	(2, 36)	0.0000
Cross-section	Chi-square	39.834418	2	0.0000

4.4. Fixed-Effect Model

The fixed-effect model returns improved results compared with the common-effect model. In the fixed-effect model, all variables are highly significant. Additionally, the R-squared value (explanatory power) is enhanced. This model is superior to the common-effect model (**Table 6**).

Table 6. Fixed-effect model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	53.89122	8.937771	6.029604	0.0000
LOG (M3)	−1.796935	0.324769	−5.532965	0.0000
LOG (HS/HC)	−3.173388	0.690986	−4.592551	0.0001
LOG (HC/HPI)	−4.321918	0.648322	−6.666316	0.0000
LOG (DSR)	−3.528222	0.864758	−4.080009	0.0002
LOG (MBS_OB)/LOG (HC)	1.343824	0.156113	8.608030	0.0000
LOG (DERIV)/LOG (DS)	0.843870	0.213628	3.950185	0.0003
Effects Specification		Cross-Section Fixed		
Weighted Statistics				
R-squared	0.852361	F-statistic		25.97976
Adjusted R-squared	0.819552	Prob (F-statistic)		0.000000

4.5. Results

The results of the regression are discussed here with the results visible in **Table 4**.

Firstly, the fixed-effect model was determined to be appropriate given the value of the cross-section F-statistic (25.62) which exceeded the critical value of 3.259 with the said degrees of freedom (2, 36) and the level of significance at 5% as shown in Table 5. Moreover, the random effect model was found to be inappropriate based on the tests above (Agung, 2014).

If cross-sectional weights assuming the presence of cross-sectional heteroscedasticity are considered for a more efficient estimation, the results in Table 6 are returned. When the fixed-effect model was adopted, all standard errors decreased and R-squared saw an 85.24% improvement. The results were additionally confirmed with significance below 5%.

5. Discussion

5.1. Implications

The results reinforce the notion that housing finance destabilizes as the liquidity expands in the long run. If liquidity acutely expands, the possibility of the repayment of loans increases. However, long-term liquidity elevates real estate prices and the expected future value of homes, further raising the demand for home purchases. This, in turn, rapidly increases the demand for residential mortgage loans, resulting in instability of the housing finance system. The lower level of lending rates accelerates the expansion of new lending rather than the repayment of existing loans, which increases the likelihood of an increase in NPL (Reinhart & Rogoff, 2009: p. 219).

As household spending increases relative to household credit, housing finance stability decreases. This is because the household cash flow diminishes, which hinders the ability to repay mortgage loans. In addition, the increased propensity to consume is not easily reversed even in a recession or a housing market decline.

As household credit grows faster than the speed of housing price increases, the housing finance system rapidly destabilizes. Regarding Japan, South Korea, and the US, this trend is evident because housing prices are closely linked to household debt.

A rising household debt repayment burden negatively influences housing finance stability. This means that as the repayment burden of household debt increases, the rate of bad debt also grows, which further hinders the stability of housing finance. Therefore, the results suggest that it is necessary to enhance DTI regulation of conforming loans to manage DSR, a parallel international indicator (Hur, 2010: p. 25).

When the proportion of FRMs in household credit increases, the stability of the housing finance system improves; thus, increasing the proportion of long-term FRMs seems crucial to protecting housing finance systems from interest rate shocks.

Further, the volume of interest rate derivatives plays a vital role in managing interest rate risk in a housing finance system. That is because risk management measures that mitigate the interest rate risk of lending are indispensable to

increasing the proportion of long-term FRMs through the issuance of MBS. A substantial interest rate derivatives market indicates that the toolbox for managing interest rate risks remains diverse. That also suggests that the financial system operates well as risks are dispersed by the market participants.

Differing intercepts across the three countries illustrate that the US (0.968) and Japan (2.556) are above average while South Korea (−4.913) is below average. The fact that the US is lower than Japan may indicate that the recovery from the global financial crisis is incomplete. Despite the high proportion of long-term FRMs, the subprime market shock, which offered excessive monetary expansion and excessive mortgage lending to low-end borrowers, may continue to negatively impact housing finance stability.

Japan may be above average because it rebuilt a superior and more stable housing finance market structure after the late 1990s housing bubble. Additionally, the cause may also be the result of more conservative mortgage regulations, such as applying a stricter DTI constraint, which is stronger than what is required by financial authorities.

Korea is ranked at the lowest level among the three nations. This might be because household debt growth was the fastest; regulations regarding DTI and LTV were not as strictly followed as in the other two nations since the foreign exchange crisis. In addition, it might imply that the conversion speed of existing mortgages to long-term FRMs was not fast enough to enhance housing finance stability. Nevertheless, this interpretation requires further analysis since this model only considers six factors affecting housing finance stability while excluding other causes.

5.2. Policy Recommendations

Based on the comparative empirical analysis, four suggestions for improving the conforming loan system in South Korea are put forward as Korea maintained the highest degree of instability among the three nations. Although Korea is highlighted, other nations can benefit from these suggestions.

First, long-term liquidity should be adjusted so that consumption growth does not accelerate faster than household debt growth. Liquidity induces economic growth by stimulating the economy in the short term; furthermore, it also acutely reduces the delinquency rates of mortgages. However, long-term liquidity stimulates the demand for loans and increases consumption above appropriate levels. That can reduce savings and household net worth which eventually leads to a decrease in the real value of real estate. Ultimately, there is a diminishing ability of the debtor to repay their mortgage, engendering insolvency in lending institutions and overall financial instability.

Second, it is necessary to conservatively manage DTI. In Japan, the JHF restricted Flat 35 mortgages beyond the regulatory recommendation. Flat 35 DTI rates are the strictest among the three countries. Conservative management of the borrower's repayment ability minimizes the possibility of a financial crisis that could be triggered by housing finance. In particular, the recent review by the

Korean Financial Supervisory Authority on the introduction of DSR, which takes into account the repayment burden of amortization and interest for the repayment of mortgages, is a desirable improvement.

Third, the government should expand the use of fixed-rate low-interest mortgages to ensure greater protection from interest rate and credit shocks. Additionally, this could help the country protect itself from external economic shocks.

Finally, the derivatives markets could be expanded to promote more options for lenders to protect from interest rate risks. A large derivatives market in the US and Japan induces investors to finance MBSs. Plentiful derivatives protect from risks and decrease the cost of lending. If derivative products such as structured securities that can manage the prepayment risk of mortgages are introduced, it could be of great help in fixing mortgage rates for the long term. The KHFC should facilitate the interest rate management of long-term FRMs. In the long term, it is necessary to establish a system in which securitization institutions and private financial institutions share interest rates as in the case of the United States (Kim, 2018: p. 120).

6. Conclusion

6.1. Contribution

Due to globalization, any effect from a domestic housing finance market collapse will no longer be confined to a domestic financial crisis. There is little disagreement among scholars about the impact of housing prices and mortgages on the economic growth of a country. The United States, Japan, and South Korea have established GSE securitization mechanisms to achieve stable economic growth through the enhancement of their respective housing finance systems; moreover, they have achieved this through conforming loans through the issuance of MBSs. In other words, the three countries have expanded the prevalence of long-term FRMs to establish greater housing finance stability.

This study analyzed the effects of those conforming loan systems on the stability of housing finance through an empirical analysis. Based on the modeling of macroeconomic proxy variables, hypotheses were tested and confirmed accordingly: 1) Long-term liquidity; 2) Higher household consumption; 3) Increasing credit; 4) Increasing debt burden; 5) Decreasing rate of FRMs; 6) A smaller derivatives market all lead to increasing instability in housing finance.

6.2. Limitations and Future Studies

This study exhibits limitations. First, the time-series data of this study are from 1999 to 2015; the global financial crisis is reflected in 2008. The effects are also differentiated by country; however, to derive a more generalized conclusion, it will be necessary to extend the length of the dataset. Follow-up studies are essential to corroborate the results and generalize the effects of conforming loans.

The unit root test and other tests were not performed during the analysis of the panel data set. In particular, frequently accompanying tests that verify the stationary

nature of the variables were not included in the analysis. The analysis in this study was limited because the time range of the data was not long enough and the data span for a specific country was insufficient. Despite this, the results were demonstrated as significant. Follow-up studies with supplementation of these points are required. As more data becomes available another study should be conducted with a wider array of tests utilized to confirm or deny findings with a more robust model that is more thoroughly developed and tested.

Additionally, since this study used the macroeconomic indicators available from international financial institutions as proxy variables, it would be necessary to complete a micro-analysis of LTV and DTI using data of conforming loans in each country as a follow-up. LTV and DTI can work differently depending on the market environment for each conforming loan system.

Finally, it is necessary to re-verify the validity and fit of the model by expanding and applying the model to other countries. This study limited the scope of the study to three countries with conforming loan systems. To increase the explanatory power of the model, it is necessary to apply this model to various housing finance systems in several other countries regardless of the operation of conforming loan systems.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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