A Dynamic Approach for Evaluating the Validity of Mortgage Lending Policies in Korean Housing Market

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Abstract

Recent periodical boom and burst of house price have made mortgage lending issues become the main public interest in Korean real estate market. However, because mortgage-lending issues had not been discussed until then, housing market forecasting associated with mortgage lending has been difficult while using an empirical approach. Thus, comprehensive and systematic approach is required as well as validity of mortgage lending policies should be evaluated. In this regard, this research conducts a sensitivity analysis to validate the proposed policies and estimates the effects of current policies on LTV and DTI ratios with a comparison of another policies scenario. A causal loop and sensitivity analysis using system dynamics confirmed that LTV and DTI regulation is strong clout to housing market. However, to prevent transfer of potential mortgage borrowers to nonmonetary institutions, regulations in loans of nonmonetary institutions should be practiced in accompaniment with regulations of primary lending agencies.

Keywords: System Dynamics, Real Estate Market, Mortgage Loan, LTV

Body of Paper

Introduction

Recent periodical boom and burst of house price have made mortgage lending issues become the main public interest in Korean real estate market, focusing on their possibility of housing demand control. In this regard, there was a boosting policy decreasing both the LTV and the DTI to hold down the house price in Korean real estate market on October, 2008, on the contrary, there was also a restriction increasing both the LTV and the DTI for market activation on July and September, 2009.

However, because mortgage-lending issues had not been discussed in the context of the Korean housing market until then, housing market forecasting associated with mortgage lending has been difficult while using an empirical approach. Especially, there were few government-issued research materials on the mortgage market before 1999, even in reports from the Bank of Korea. Thus, intuitive and empirical approaches can overlook side effects of mortgage-lending policies in the housing and real estate financial markets. For example, it is expected that house prices and demand show little changes because mortgage loans of nonmonetary institutions (e.g. mutual savings banks, credit unions) can be activated, and potential mortgage borrowers move to nonmonetary institutions from primary lending agencies. Thus, comprehensive and systematic approach is required to have a better understanding of market policies, also, validity of mortgage lending policies should be evaluated compared to possible another policies.

To address this issue, Korean real estate and mortgage market dynamics model is developed using the system dynamics methodology. The dynamics model provides information to decision-makers through a comprehensive and systematic approach elucidated by a diagram representing feedback loops. Using this model, this research conducts a sensitivity analysis to validate the proposed policies and estimates the effects of the Korean governmental current policies on LTV and DTI ratios with a comparison of another possible policies scenario, for example, adjusting mortgage rate, regulating credit line and regulating loans of nonmonetary institutions.

The policy models are based on the price expectations of consumers as well as the law of supply and demand. Further, simulation models in this research are focused on only housing market and mortgage-lending agencies as well as their profit-seeking behavior, as the secondary financial market in charge of mortgage securitizations has not been activated in Korea, where it is hard to find data or correlations on influence factors related to the secondary market.

Previous Research

Policies' Trend in Korean Real Estate Market

House price and demand upturns in the last few years have been of concern in the Korean housing market, which has resulted from the boosting policies that invigorated mortgage-lending and housing demand. In response to this situation on July 7 and September 7, 2009, the government announced a series of comprehensive real estate programs that regulated mortgage lending of commercial banks, such as decreasing LTV and DTI, in order to control housing demand and stabilize house prices. According to these polices, LTV decreased by 50% in all metropolitan area, and DTI also decreased to 50~60%; the application regions of the law were extended to all of Seoul conurbations.

However, potential consumers, who weren't able to obtain housing loans from primary agencies, began to pay attention to loans of nonmonetary institutions such as mutual saving banks. With respect to these mortgage lending policies, it was predicted that most potential consumers might move to nonmonetary institutions to avoid these regulation, as these agencies were not be affected by DTI regulations. Accordingly, government implemented additional DTI restriction on loans of nonmonetary institutions on October 8, 2009.

Literature Review

Many studies have been conducted on housing price market models and real estate policy analysis. Hwang et al. (2006) extended the existing dividend-price ratio model using time-series analysis. Hott and Monnin (2008) proposed a rent model and a supply-demand model to estimate fundamental prices on real estate market, and assessed these models for long time out-of-sample forecast with a cointegration analysis and impulse-response functions. Gupta and Das (2008) predicted the downturns in the real house price growth using Bayesian Vector Autoregressive (BVAR) models. Although above-mentioned multivariate time-series analysis is useful for forecasting, there are some restrictions on treating many dependent variables as well as on analyzing dynamic cause-and-effect relationship between parameters in model.

Therefore, as Kim (2007) demonstrated, in order to have a better understanding of the real estate financial market and market policies, a comprehensive and systematic approach is required. Indeed, Lee et al. (2005) tried to analyze effects of polices that attempted to construct new administrative capital based on a system thinking by using causal loop analysis. However, to carry out a detailed analysis, quantitative approach using dynamic model is further required to forecast directions and sensitivity of polices on market.

In an effort to address this issue, dynamics models are developed using the system dynamics methodology; these models are based on the fundamental principles found in housing markets and emerge out of the economic activities of both consumers and financial agencies. For example, house price is mainly subject to housing demand according to Baumol and Blinder (2003). Conversely, housing demand is controlled by house price change (Baumol and Blinder 2003), stimulated by expected capital gain by owing housing properties (Fischer 2005), and by mortgage loans or mortgage rate (Garman and Forgue 2000).

Policy Model

Housing Investment Demand & House Price

Although house price is determined by the law of supply and demand and of the price expectation of consumers, this research assumes that housing demand generally plays a leading role in forming house prices. This is because the policy models in this research are constructed in order to analyze the effects of policies on over-demanded areas, such as capital regions in Korea. Also, this research assumes that the currencies of the housing and real estate financial markets are determined by profit-seeking behavior of participants in the real estate market.

Based on assumptions stated above, Fig. 1 represents main causal loops in policy model;

First, in regard to housing market, B1 Loop (demand → Perceived house price → House price → potential demand) shows the process of house price self-control due to demand change according to general market principles. Perceived house price, which is defined as the

consumer's perception of the possibility of price volatility before the actual house price is determined, is influenced by demand change. When perceived house price is transformed into house price as a result of housing transactions being activated, housing demand is controlled as a balancing feedback process of demand and price. Conversely, when housing demand is high, consumers expect future house prices to increase as shown in Loop R1 (demand → Perceived house price → expected profit from trading → potential demand). This reinforcing loop shows a snowball effect between house price and housing demand is caused by expected capital gain.

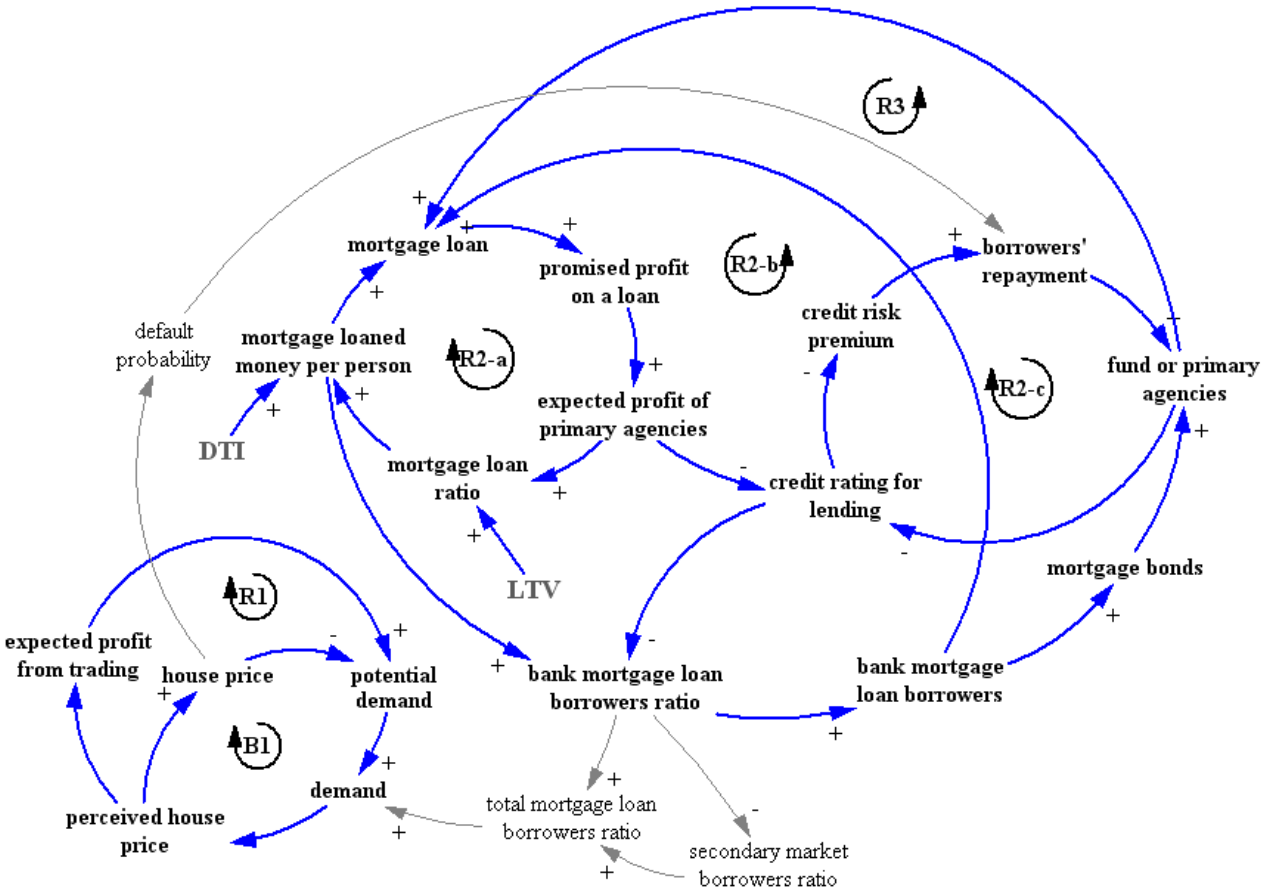

Fig. 1 Causal Loops in Korean Real Estate Market

Second, in real estate market, financial agencies tend to extend mortgage loans by raising the maximum mortgage loan ratio (Loop R2-a: mortgage loan → promised profit on a loan → expected profit of primary agencies → mortgage loan ratio → Mortgage-loaned money per person) and by lowering the credit rating that is acceptable for mortgage loans (Loop R2-b: mortgage loan → promised profit on a loan→ expected profit of primary agencies→ credit rating for lending→ bank mortgage loan borrowers ratio→ bank mortgage loan borrowers→ mortgage loan). Also, Loop R2-c shows the mortgage market's behavior of maximizing lending profit. If there are enough funds for loans, they adjust a possible grade

for borrowing or lending mortgage loans in order to make more profit, associated with the risk premium (Fund of primary agencies→ credit rating for lending→ credit risk premium→ borrowers' repayment). When liquidity for lending becomes insufficient in primary agencies, they tend to issue mortgage bonds like in the R3 Loop (Fund of primary agencies→ mortgage loan→ promised profit on a loan→ expected profit of primary agencies→ mortgage loan ratio→ Mortgage-loaned money per person→ bank mortgage loan borrowers ratio→ bank mortgage loan borrowers→ mortgage bonds).

Based on the causal loop diagram, this research has attempted to construct a simulation model as shown in Fig. 2 according to following formula;

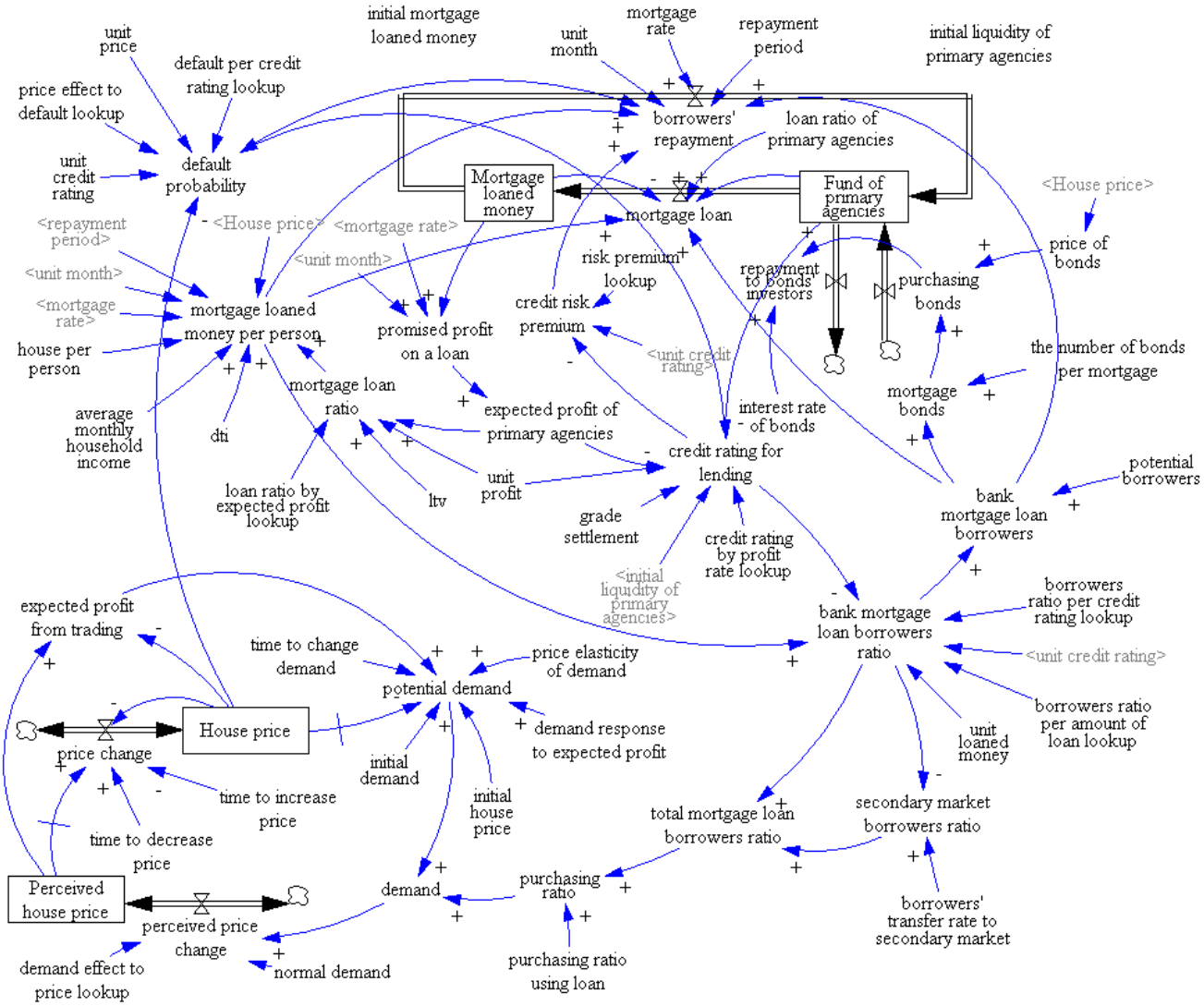

Fig. 2 Simulation Model

The expected profit from trading is defined as the householder's expectation that a profit will be produced through a future trade in houses.

expected profit from trading=
Perceived house price-House price
Units: Won

The ratio of mortgage loan to mortgage worth (*mortgage loan ratio*) of primary agencies is decided as the minimum value between the maximum LTV ratio permitted by government policy and the loan ratio of lending agencies. Also, the mortgage loan amount (*mortgage loaned money per person*) is decided as the minimum value obtained between the maximum DTI ratio permitted by government policy and monthly repayments calculated by lending agencies. The ratio of LTV and DTI are applied to policy model as the following formula:

mortgage loan ratio=
MIN(ltv,loan ratio by expected profit lookup(expected profit of primary agencies/unit profit))
Units: Dmnl

Mortgage-loaned money per person=
*MIN(dti*average monthly household income *12 *((1+mortgage rate)^(repayment period/12/unit month))*mortgage rate/((1+mortgage rate)^(repayment period/12/unit month)-1)*repayment period, House price*mortgage loan ratio*house per person)*
Units: Won/Person

Credit rating for lending (i.e. credit rating at which lending is acceptable) is determined by the expected profit of mortgage lending, which is the connected risk premium in proportion to the borrower's credit rating. Therefore, to make the maximum profit, primary lending agencies continually tend to lower the credit rating for lending, if they secure sufficient fund liquidity, as shown in the following formula:

credit rating for lending=
IF THEN ELSE(Fund of primary agencies>=initial liquidity of primary agencies, credit rating by profit rate lookup(expected profit of primary agencies/unit profit),credit rating by profit rate lookup(expected profit of primary agencies/unit profit)+grade settlement)
Units: Grade

Model Settings

The developed simulation models are set to have correlations between influential factors and national data as shown in Table 1. In detail, initial house price, initial demand, initial liquidity of primary agencies, initial Mortgage-loaned money, mortgage rate and interest rate of bonds are set as the values in July, 2008, when government policies were applied. Also, the repayment period and dividend yield were averaged based on values for the last five years.

Table 1 Data in Simulation Models

Independent Factors	Sources	Details	Value	Unit
initial house price	The Bank of Korea 2008, KB Bank 2008	Average house price in Seoul, Korea in July, 2008.	533,000,000	Won
initial perceived house price	The Bank of Korea 2008, KB Bank 2008	Average house price in Seoul, Korea in July, 2008.	533,000,000	Won
initial demand	Korean Construction Industry Strategy Research	An estimated volume of Average demand in Seoul, Korea, 2008.	89,000	Person
price elasticity of demand	Korean Housing Institute 2005	Price elasticity of demand in Korea is investigated as -0.37 to be average.	-0.37	-
purchasing ratio using loan	KB Bank 2008	65.4% of house consumers accommodate funds through mortgage loan.	65.4%	%
repayment period	KB Bank 2008	Desired repayment period of borrowers is investigated as average of 10.1 years in 2008.	121	Month
average monthly household income	KB Bank 2008	Average household income in Korea, 2008.	2,322,500	Won
loan ratio of primary agencies	The Bank of Korea 2008	Maximum mortgage loans of commercial & specialized banks from 2004 to 2008 in Korea.	33.25%	%
base rate	The Bank of Korea 2008	Call rate in Korea in July, 2008.	4.93%	%
mortgage rate	The Bank of Korea 2008	Mortgage rate in Korea in July, 2008.	6.92%	%

Policy Analysis

Policies Scenarios

Prior to sensitivity analysis, this research set up some policy scenarios to check the validity of governmental mortgage-lending policies by using a causal loop diagram. Some factors suggested to remarkably affect both house prices and the mortgage market are shown in Table 2.

First, the interest rate policy focuses on regulating the mortgage rate by adjusting the base interest rate in order to control housing demand. Second, regulating credit ratings for lending is defined as limiting lending agency activity that involves approval of loans for borrowers with low credit grades. Third, mortgage-lending policy associated with LTV and DTI concerns the regulation of the possible amount of mortgage loans. Finally, regulating loan of nonmonetary institutions is a government intention to control potential consumers who might move to loan of nonmonetary institutions by adjusting borrowers' transfer rate to nonmonetary institutions (Secondary lending agencies).

Table 2 Policy Scenario

Policies	Related Factors	Data Range	Explanation
Interest Rate Policy	Mortgage rate	5.39 - 7.25% (Minimum and Maximum Value of Korean Market from 2006 to 2009)	Governmental control through adjusting base rate.
Mortgage lending policy (Regulating Credit Line)	LTV and DTI	10 - 90%	Regulating possible amounts of mortgage loans.
Mortgage lending policy (Regulating Credit Rating for Lending)	Grade settlement	0.1 – 3 Grade	Regulating lending agencies' behaviors intended to lend loans to borrowers ranked low credit grade.
Regulating Loans of nonmonetary institutions	Borrowers' transfer rate to secondary market	50 – 90 %	By regulating amounts of loans of secondary lending agencies, adjusting borrowers' transfer rate to secondary lending market.

By changing independent factors, these hypothetical scenarios will significantly influence the behavior of reinforcing loops as represented in Table 3.

Table 3 Effects of Policies on Causal Loops

Loops / Factor	R1	R2-a	R2-b	R2-c	R3
	House Price	Amount of Loans	The number of Possible Borrowers	Credit Rating Adjustment and Risk Premium	Mortgage Securitization
Mortgage rate	↓	↑	↓	▪	▪
LTV and DTI	↑	↑	↑	▪	↑
Grade settlement (credit rating for mortgage loan)	↑	▪	↑	↑	↑
Borrowers' transfer rate to secondary market	↑	▪	▪	▪	▪

Sensitivity Analysis

(1) Interest Rate Policy (mortgage rate)

The interest rate policy focuses on regulating the mortgage rate by adjusting the base interest rate in order to control housing demand. This policy can be a little effective, both with respect to housing demand and house price control, by raising the cost of borrowing money through activation of R1 Loop and constriction of the R2-b Loop. However, this will be a passive policy because of giving a choice of loans to potential borrowers. Meanwhile, raising mortgage rates activates the R2-a Loop, bringing about an increase in lending agency profits contrary to R2-b Loop's changes.

To validate this scenario, this research conducts sensitivity analysis as follows.

Fig. 3 and Fig. 4 show the sensitivity of house prices and mortgage loans deducted from the SD simulation. As stated in the scenarios above, mortgage rate policy will cause few long-term changes in house prices and mortgage loans.

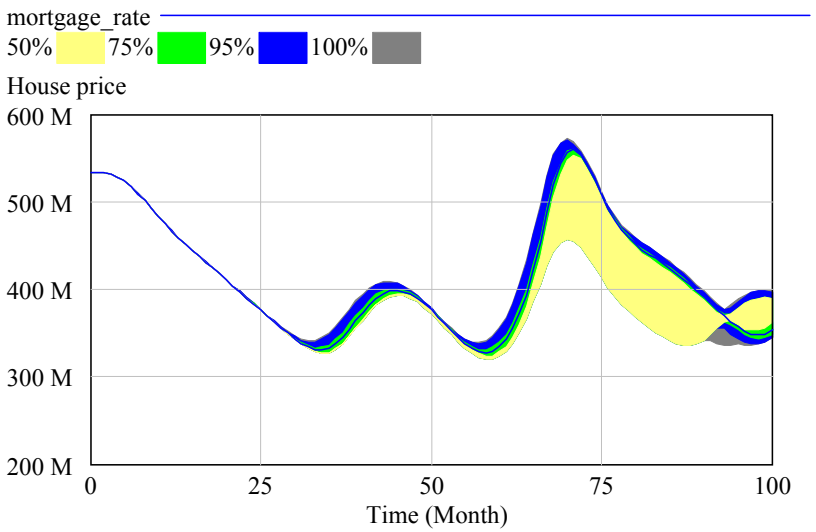

Fig. 3 Sensitivity Analysis: Effect of Interest Rate Policy on House Price

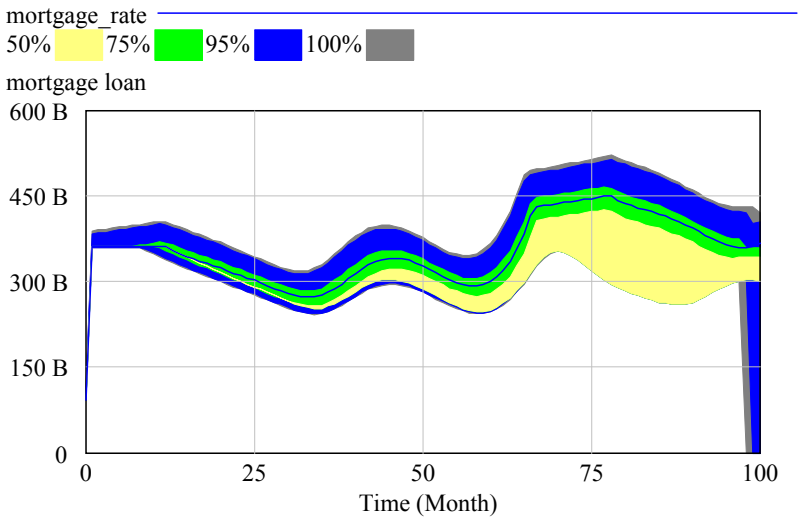

Fig. 4 Sensitivity Analysis: Effect of Interest Rate Policy on Mortgage Loans

(2) Regulating Credit Rating for Lending (Grade settlement)

Regulating credit ratings for lending is defined as limiting lending agency activity that involves approval of loans for borrowers with low credit grades. As mentioned previously in the explanation of the R2-c Loop, mortgage-lending agencies intend to extend possible borrowers' credit grading for loans related to an increase in the number of borrowers and risk premium of lenders for more profit. Thus, regulating credit rating for lending is remarkably effective in the R2-b and R2-c Loops, which activate mortgage loan expansion as well as the R1 Loop by changing housing demand. These results can be validated through sensitivity analysis as illustrated in Fig. 5 and Fig. 6. However, in practice, it is difficult to adopt a direct regulation on lending agencies because of various standards in credit rating assessment in the Korean financial market.

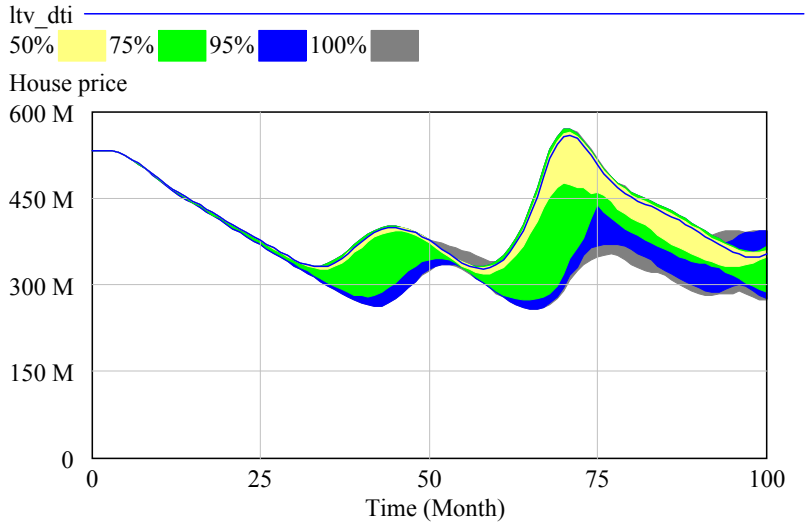

Fig. 5 Sensitivity Analysis: Effect of Credit Rating Regulation on House Price

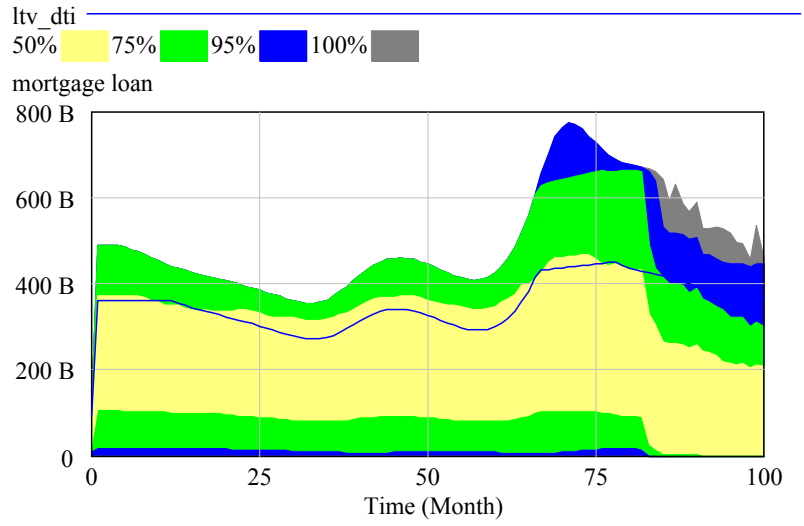

Fig. 6 Sensitivity Analysis: Effect of Credit Rating Regulation on Mortgage Loans

(3) Regulating Credit Line (LTV and DTI)

Mortgage-lending policy associated with LTV and DTI concerns the regulation of the possible amount of mortgage loans. This scenario is the main insight of this research. Regulation of LTV and DTI is directly related to the amount of loans possible for borrowers to receive arousing housing demand. In this regard, this policy has quite a lot of clout in the R1 Loop. Also, activation of mortgage lending will have a strong influence on financial market and mortgage securitization by stimulating R2-a, R2-b and R3 as illustrated in Fig. 3.

Fig. 7 and Fig. 8 show the effects of LTV and DTI policies on the housing market and on the real estate financial market. Through these results, it has been validated that mortgage-lending policies, especially when adjusting LTV and DTI, can cause long-term positive effects on house prices and mortgage loans.

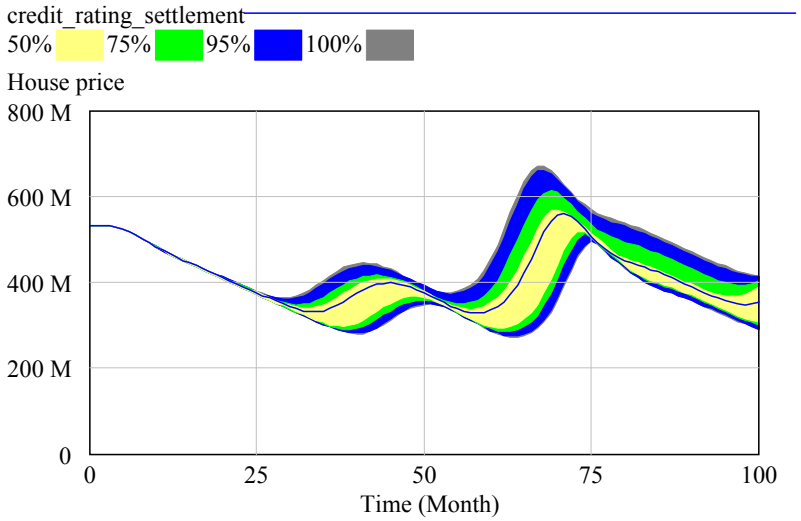

Fig. 7 Sensitivity Analysis: Effect of LTV and DTI Regulation on House Price

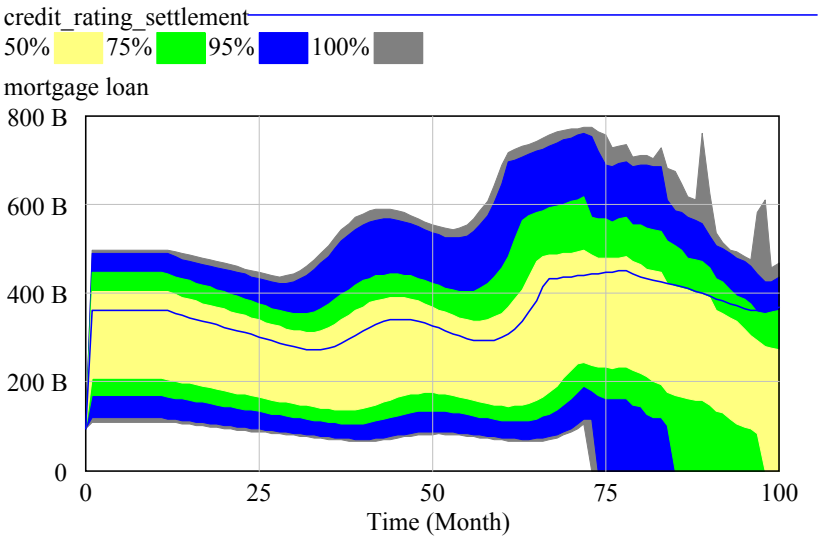

Fig. 8 Sensitivity Analysis: Effect of LTV and DTI Regulation on Mortgage Loans

(4) Regulating Loans of nonmonetary institutions

Regulating loan of nonmonetary institutions is a government intention to control potential consumers who might move to loan of nonmonetary institutions by adjusting borrowers' transfer rate to nonmonetary institutions. This scenario shows a price sensitivity of a governmental regulation on the DTI of nonmonetary institutions to prevent potential consumers' transfer to loans of nonmonetary institutions. By directly controlling actual housing demand in the R1 Loop, this scenario can be more effective than scenario 3 on holding down the price. As represented in Fig. 9, a significant deviation of house price is identified depending on the transfer rate to secondary market resulted from the DTI of nonmonetary institutions.

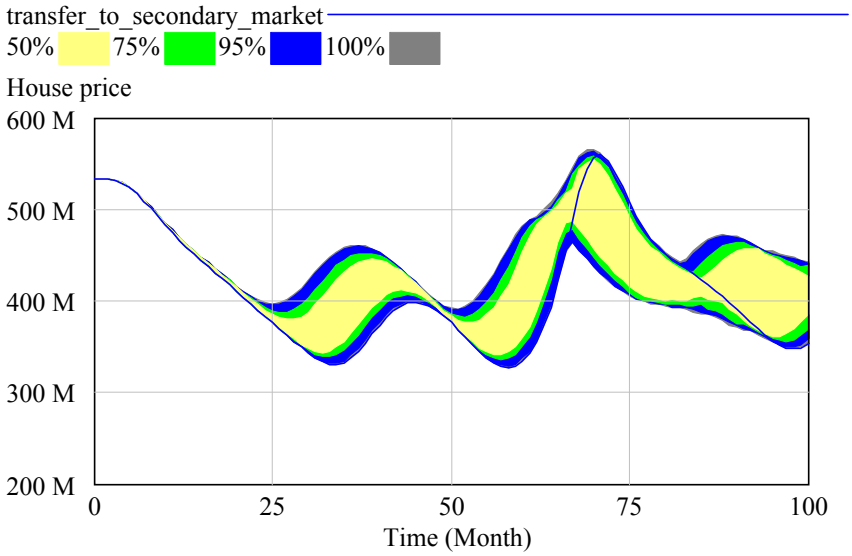

Fig. 9 Sensitivity Analysis: Effect of Regulating Loans of nonmonetary institutions

Validity of Mortgage-Lending Policies

In Simulation results, if other external rising factors to house price are excluded, regulations of LTV and DTI will stabilize house prices in the short term, because R1 Loop's operation can be temporarily interrupted by a wait-and-see attitude of potential demands. Thus, after a certain time when potential demands are gradually transferred to actual demands, R1 Loop will be re-operated by offsetting the policies effects. However, more tightened regulation can pushed rebounded point of house price back about 5-10 months. These results mean that mortgage-lending policies such as control of LTV and DTI can be considerably effective unless nonmonetary institutions' mortgage lending is activated.

On the other hand, the regulation of LTV and DTI ratios can result in the transfer of potential borrowers from primary banks to secondary agencies (nonmonetary institutions), such as mutual savings banks or credit unions, which have lower fund liquidity. Potential mortgage borrowers are transferred to loans of nonmonetary institutions after the implementation of mortgage-lending regulation, the effectiveness of government policies on house prices could be offset by an increase in demand caused by an increase in secondary

mortgage loans. Therefore regulations in loans of nonmonetary institutions should be practiced in accompaniment with regulations of primary lending agencies.

Conclusions

Utilizing system dynamics modeling, this research attempted to evaluate the validity of mortgage lending policies with a comparison of another possible policies scenario, for example, adjusting mortgage rate, regulating credit line and regulating loans of nonmonetary institutions, targeting housing demand. A causal loop and sensitivity analysis using scenario-based approach confirmed that LTV and DTI regulation is strong clout to housing market. However, the same regulations may cause potential mortgage borrowers to shift to the secondary market and thus offset the intended effect of regulations of house prices. Therefore, in order to prevent transfer of potential mortgage borrowers to loans of nonmonetary institutions, regulation in loans of nonmonetary institutions should be conducted also.

Through quantitative analysis using system dynamics simulation, sensitivity analysis can test the causal loops and validate these policies' effects as well as estimate the extent of policy consequences. Future research needs to expand simulation models to include real estate financial market and their investors; this will more effectively examine the impact of mortgage lending policies.

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