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Welfare implications of credit rationing for financial consumers: An empirical investigation on the case of the Korean residential mortgage sector

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A B S T R A C T

Credit rationing through borrowing constraints has long been an important research topic in the literature, in the context of managing financial risks (i.e., financial stability) as well as of expanding financial service to more marginal borrower segments (i.e., financial inclusion). This study empirically investigates the role of borrowing constraints in the residential mortgage lending sector in Korea, by utilizing a discrete tenure choice model to test the constraining effects of two particular lending restrictions on households' home owning decisions - the wealth and income constraints as measured by the maximum loan-to-value (LTV) ratio and that of debt-to-income (DTI) ratio. Using the household-level micro data from Korea, we report that: the lending restrictions exhibit negative effects on the propensity to own; those constraining effects are also shown to increase for younger borrower cohorts; and, the magnitude of the effect of wealth constraint is larger than that of the income constraint, which is consistent with the findings from the prior studies. Using the empirical findings, we discuss policy implications of relevancy, in particular, as to how to balance between two often competing policy objectives - ensuring financial stability and extending financial inclusion - in the context of the residential mortgage lending sector in Korea.

Keywords: Credit rationing, borrowing constraints, housing tenure choice, and consumer welfare

Ⅰ. Introduction

Credit rationing by financial service providers to deal with the problem of information asymmetry, and resulting exclusion of certain consumer segments from a particular lending sector, have long been a topic of investigation in the economic literature.[1] The rationing, caused by the information asymmetry as to the creditworthiness of borrowers, is generally implemented through imposing various underwriting criteria such as consumer credit scores, maximum loan-to-value (LTV) and debt-to-income (DTI) ratios along with other lending restrictions. In the residential mortgage lending sector, there has also been a series of studies that empirically test the effects of borrowing constraints on households' tenure decisions (Linneman and Wachter (1989), Duca and Rosenthal (1994), Linneman et al. (1997), Gyourko et al. (1999), Barakova et al. (2003), Dieleman et al. (2003), Dawkins (2005), and Boehm and Scholttman (2009), Johnson and Li (2010), Andrew (2012), Barakova et al. (2014), and Acolin et al. (2016)). Three typical constraints examined by these studies include the wealth constraint (caused by an LTV cap), the income constraint (driven by a DTI cap), and that caused by the creditworthiness constraint (set by a limit in minimum consumer credit score). The main hypothesis tested by this strand of the literature is that, ceteris paribus, those credit constraints tend to reduce the propensity to own, and that the wealth constraint generally exhibits a larger

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constraining effect on the ownership decision.

Given this backdrop, this study aims to investigate and document the effects of borrowing constraints in an emerging market context by utilizing a household-level data set from Korea. In so doing, we attempt to institute several enhancements in performing the empirical investigation in this line of research: first, a constant-quality housing is assumed in formulating some of the key variables (e.g., the relative costs of owning vs. renting); second, differential effects of the constraints across different consumer cohorts (i.e., different age and income groups) are estimated to examine cohort-specific effects of the lending restrictions included; and, the interactive effects of the wealth constraint (measured via LTV) and of income constraint (via DTI) are also explored. The results of our empirical analyses show that: two borrowing constraints tested show binding effects on the propensity to own, that is, compared to the unconstrained households both the moderately- and highly-constrained households exhibit the lower propensities to own; as indicated by the regression coefficients, the magnitudes of the wealth effects are far larger than those of income constrains; and, when interacted with the age cohorts, the effect of the wealth constraint shows a larger impact on the young borrower cohorts. The usual determinants of the propensity to own show the expected signs with statistically- significant coefficients: the higher the permanent income, the larger the family size, the older the age cohort, the propensity to own gets higher; on the other hand, the higher the user cost (or relative cost of owning), the lower the propensity becomes. However, contrary to our expectation, the latter year cohort (i.e., year 2014) shows the lower propensities own, ceteris paribus, compared to the earlier one (i.e., year 2006), despite the fact that the residential mortgage market in Korea experienced a substantial growth during the time period.

Our results indicate that the policy makers should be cognizant, and should attempt to balance, two policy objectives that are often competing to each other: ensuring financial stability vs. extending financial inclusion. During the last two decades, the Korean government has been using LTV and DTI caps as important policy instruments to stabilize the housing and mortgage markets in Korea, which are nearly universally applied to all consumers cohorts in a given geographical area. The level of the maximum lending level specified by the regulation is often very restrictive. For example, , a 40 percent maximum LTV in certain locations defined as “speculative zones” (the areas designated by the regulators as the real estate markets being overheated) is applicable regardless of income or wealth level of a particular borrower and of whether one is a first-time home buyer or not. The main implications of our findings are: first, the market stability driven lending restrictions, as those in Korea, can work as an unnecessarily high constraint for less wealthy and younger consumer cohorts for them to become home owners; and, there should be a more elaborate policy design such that those two competing policy objectives can be balanced between those two dimensions - financial and real estate market stability and inclusion of marginal consumer cohorts to the financial service sector.

The rest of the paper consists of the following four sections: a critical survey of prior studies (Section 2); the empirical analysis (data and variables, testing model, and results); a policy implication as to the optimal LTV level; and, concluding remarks.

II. Literature Survey

A. Theoretical Underpinning

In a dynamic sense, household’s tenure decision is made in a highly complex utility maximization framework. Following Cho (2017), a representative consumer with perfect foresight maximizes a forward-looking expected utility function with two arguments - housing as a durable good, h, and a non-durable consumption good, c (a numeraire) - subject to a series of constraints:

$$\max_{c,\,h} \quad E_t\left[\sum_{i=1}^{\infty}\beta^i u(c_{t+i}, h_{t+i})\right] \tag{1}$$

$$C_{t+i} + R_{t+i}h_{t+i} + S_{t+i} \le y_{t+i} + \Sigma_j \alpha^j_{t+i} \cdot W^j_{t+i}, \tag{2}$$

$$M^*_{t+i} \le M^{\max}_{t+i}(BC^{LTV}_{t+i}, BC^{DTI}_{t+i}, \Phi_{t+i}) \; iff \; \tau = 1 \tag{3}$$

$$l_{t+i} = 0 \;\; if \;\; t+i > \tilde{T}; \;\; otherwise \;\; l_{t+i} > 0 \tag{4}$$

where β is a discount factor. The housing consumption at a given future time period i, h_{t+i}, is a weighted average

[1] See Stiglitz and Weiss (1981), de Meza and Webb (1987), and Waller and Lewarne (1994) for theoretical exposition related to the credit rationing.

housing consumption between owning with the propensity to own, τ, and renting with probability (1- τ), i.e., $h_{t+i} = \tau \cdot h^{o}_{t+i} + (1-\tau) \cdot h^{r}_{t+i}$.[2] The optimization is subject to three constraints.

First, the budget constraint (equation (2)) consists of three arguments - consumption (housing rent, (R, per-period per-unit rental price of housing service, multiplied by quantity of housing service, h), and savings; The three terms in the left-hand-side should be equal or less than labor income ($y_{t+i} = l_{t+i} \cdot w_{t+i}$ with l and w being labor supply and market wage) and return from accumulated wealth from both housing and non-housing assets ($W^{j}_{t+i} = W^{h}_{t+i} + W^{n}_{t+i}$, j = h, n). Under no leverage (at this point), the housing wealth is equivalent to per-unit asset price of housing, P^{h}, multiplied by its quantity, $W^{h}_{t+i} = P^{h}_{t+i} \cdot h_{t+i}$.

Second, the tenure decision is influenced by borrowing constraints (equation (2)). That is, given optimal housing demand, h^{*}, the leverage amount M^{*} is determined, which should be less than or equal to the maximum loan amount, M^{max}, set by three particular borrowing constraints (BC). Two particular BC relevant to this study are a maximum collateral rate (or a maximum loan-to-value, LTV, ratio), BC^{LTV}_{t+i} and a maximum debt (or mortgage) payment to income ratio (or per-period debt payment-to-income, DTI, ratio), BC^{DTI}_{t+i}, which is determined by the risk appetite of mortgage lenders or by the regulatory constraints as was the case in Korea. There is a set of other mortgage underwriting criteria, Φ_{t+i}, (other than the LTV and DTI limits) such as mortgage products offered, consumer credit ratings, and documentation requirements to verify income, wealth, and employment.[3]

Third, there is a labor supply constraint (equation (4)) such that, upon reaching a retirement age $\tilde{T}$, the labor supply (and, hence, the wage income) becomes zero and the consumer will have to be dependent upon other income sources (e.g., public and private pensions, or self-financing out of accumulated wealth).

[2] τ is a latent variable, which is proxied as one if a household owns in empirical study on the tenure choice.

[3] It is well-documented in the recent literature that these leverage constraints tend to be pro-cyclical, i.e., being relaxed in an ebullient stage of housing market cycle but becoming more stringent in a crisis stage.

B. Empirical Literature

Empirical implementation of the consumer's choice as to housing tenure, i.e., owning vs. renting, involves with estimation of a discrete choice model, usually in a static sense, with several sets of typical explanatory variables, including the relative price factors (e.g., user cost of capital for owning or price-to-rent ratio), the income variables (a permanent, rather than transient, household income), and the demographic variables (e.g., household head's personal attributes such as age, birth-year, marital status, and education level, as well as family size).

As to the role of borrowing constraints, Linneman and Wachter (1989) demonstrate that the households' tenure choice is influenced by permanent income, relative cost (i.e., user cost of capital for owning), demographic variables (marital status, size of household, and so on), as well as borrowing constraints (both wealth and income constraints in purchasing or refinancing home mortgage). Subsequent studies use a similar model to further investigate effects of various socio-economic factors on ownership decisions (Gyourko et al. (1999), Linneman et al. (1998), Megbolugbe and Cho (1996), Goodman and Kawai (1988)).

There are two strands of micro studies from the above first-generation literature. First, a series of studies attempt to explain the observed gap in owning propensity between racial groups. (Dawkins (2005), and Gyourko et al. (1999)) For example, Gyourko et al. report that substantial differences in homeownership rates among racial groups (white vs. African American in particular) are explained by the differences in proportions of wealth-constrained households and in locations of residence (central cities vs. suburbs in particular); Gabriel and Rosenthal provide evidence that household characteristics, rather than borrowing constraints, are dominant factors producing the ownership gaps, and suggest that improving financing options would be less likely to be effective in eliminating the gap. Dawkins finds that location characteristics associated with the supply of affordable owner-occupied housing directly affect the racial gaps in owning.

Second, a number of studies investigate tenure transition patterns of different consumer cohorts, e.g., from renting to first-time owning, from owning back to renting, from owning low-quality housing to high-quality (i.e., filtering up), and so on. (Boehm and Scholttman (2009) and (2004)), and Dieleman, Clark, and Dierlou (1995)) Dieleman et al. (1995), one of the first in this line of

research, provide evidence that age, family status (marital and presence of children), income, and employment status impact transition probabilities of returning to rental tenure and, subsequently, their likelihood of becoming homeowners again. Boehm and Scholttman (2009) and (2004) provide further evidence, using a more sophisticated econometric model along with two eleven year longitudinal compilations of households from the Panel Study of Income Dynamics, that the observed differences in tenure transition probabilities between white vs. non-white households largely disappear after controlling for gaps in education, income, net worth and savings.

Linneman et al. (1997) study the impact of borrowing constraints with micro-simulation estimates. Besides the income and wealth constraints, market variables such as income, household head age, race, marital status, and family size are used. Similar to previous studies it concludes that wealth constraints have a bigger impact on homeownership than borrowing constraints. The simulation analysis shows the effect of changing the wealth constraint is nonlinear and larger at higher LTV levels and income ratios. Min et al. (2012) did an empirical study of the impact of borrowing constraint, specifically in Korea. By using household level micro data with variables of housing price-rental deposit ratio, income, age of household age, and family size, it concludes that income or/and wealth constrained households show a lower tendency of owning, and the wealth constraint has a stronger impact on homeownership as in previous studies. In policy simulations, they find that relaxing the LTV ratio will have a greater increase on the probability of owning than easing the income constraint.

Bourassa and Yin (2006) research tenure choice differences between the U.S. and Australia, focusing on subsidy policies. Key explanatory variables are housing cost, household characteristics, and subsidies. Results show that the former two variables do not explain differences in homeownership rates. On the other hand, subsidy policies have only a minor impact. Bourassa et al. (2013) researched the impact of mortgage interest deduction policies on homeownership. This study quantifies the effect of the mortgage interest deduction and imputed rent taxation and uses the relative cost of owning and renting, borrowing constraints, real income, and tastes as control variables. It concludes that mortgage interest deduction generally does not improve the homeownership rate, as it is capitalized into the housing price, especially when supply is inelastic.

III. Empirical Analyses

A. Data and Summary Statistics

The main data source used is the Korea Housing Survey for three years- 2006, 2010, and 2014, the bi-annual survey on housing characteristics published by the Ministry of Land, Infrastructure and Transport. The home price indexes and average mortgage rates are from Korea Appraisal Board; And all monetary values are translated to the real values as of the end of 2006 based on the consumer price indices (CPI) published by Bank of Korea. The list of all the variables used along with description of each is in Table 1, and summary statistics thereof are in Table 2.

B. Construction of Key Variables

Following the estimation procedures of the existing literatures, two prior steps before estimating the tenure choice equation are done. First, the permanent income(*pinc*) equation is estimated based on the specification below:

$$ln\_hinc = f(fsize, age, age^2, ln_{wealth}, D_{region}, D_{edu}, D_{occu}, D_{job\ type}, D_{sex}) \quad (5)$$

Current income can be biased as it can include a transient component in individuals' earning, and the home purchase ability is likely to be correlated with life-long potential income. The log of household income is regressed on family size, house head age and square of age, natural log of net house wealth, region, degree of education, sort of occupation, type of jobs, and sex of house head. We estimated the natural log of house income, '$\widehat{ln\_hinc}$', using equation(6).

Second, the borrowing constraint variables (BC_i) are constructed, for which the optimal home value (HV_i*) is estimated to discern constrained vs. unconstrained households. The specific steps are as follows. First, the income constraint (LC_i^I) and wealth constraint (LC_i^W)

Table 1. Variable Descriptions

Variable	Definition
Year	year of survey sample (2006, 2010, 2014)
region	region of household (17 regions at city and province level)
ownership	house ownership (binomial variable, renter = 0, home owner=1)
Hinc	house income
Pinc	permanent income (estimated)
hprice	house price
rent_area	rent price per area(in square meters)
nwealth	net wealth of household
htype	house types (1= detached, 2=multi-family detached, 3=detached with small business 4=apartment, 5=townhouse, 6=multiplex, 7=commercial building, 8=studio, 9.=shanty, 10=others
Fsize	number of family in household
Age	age of house head
Sex	gender of house head
young	young house head cohort (house head older than 40 =0, under 40 =1)
education	degree of education (elementary=1, middle=2, high=3, over university degree=4)
occu	form of job occupation of house head
gap_inc	degree of income constraint (unconstrained =1, moderately constrained =2, highly constrained =3)
gap_wealth	degree of wealth constraint (unconstrained =1, moderately constrained =2, highly constrained =3)
own_to_rent	ratio of owner's cost to rent cost (calculated based on individual region and year)

Table 2. Selected summary statistics

Variable	Obs	Mean	Std.	Min	Max
Ownership	83,406	0.5929	0.4912	0	1
Hinc	78,625	269.88	345.85	0	21,650
hprice	48,539	17,311	2,1814	20	403,850
rent_area	22,573	7.2035	8.0907	0.01	210.02
Nwealth	80,929	16,199	41,026	-242,310	6,100,000
Fsize	83,406	2.8904	1.3318	1	15
Age	83,366	53.3775	15.5059	1	102
Sex	83,405	0.1949	0.3961	0	1
Young	83,406	0.2136	0.4098	0	1

variables are built based on the formula below:

$$LC_i^I = \frac{\delta \times Y_0}{i \times \alpha_m} \quad and \quad LC_i^W = \frac{W_0}{1-\alpha_m} \tag{6}$$

δ = *front end ratio (marginal debt payment to income)*

i = *mortgage (interest) rate*

α_m = *LTV ratio*

Y_0 = *current income*

W_0 = *current net wealth*

The wealth constraint (LC_i^W) implies the maximum value of house that a person can purchase, investing net asset as an equity and LTV ratio of purchase price as a mortgage loan. As a same context, the income constraint (LC_i^I) implies the maximum value of house that a person can purchase, using a capitalized permanent income.

Third, a sub-sample of households is created such that their observed home values are less than the maximum values given the two borrowing constraints defined above - the wealth and income constraints.

$$HV_i \leq BC_i \quad (7)$$

where, $BC_i = \min (LC_i^I, LC_i^W)$

Fourth, we build the optimal house value (HV_j^*) equation ($HV_j^* = \pi(Z_j, \phi, ; v_j)$) based on the subsample (j) in which households are not constrained by borrowing constraint(BC_i). Specifically, we regressed the log of home price on the log of permanent income, age of house head, family size, ratio of ownership cost to rent, level of education, sex of house head, type of house, region, occupation of house head, and job type of house head as equation (8).

$$ln\_hprice = f(ln\_pinc, age, fsize, own\_to\_rent, D_{edu}, D_{sex}, D_{htype}, D_{region}, D_{occu}, D_{job\ type}) \quad (8)$$

Fifth, we calculate the optimal home value HV_i^* that meets the needs of individual family characteristics assuming they don't have financing constraints: $HV_i^* = \widehat{H_i} = \pi(Z_i, \phi, ; v_i)$, where, Z_i is a set of explanatory variables, ϕ is a vector of regressions, and v_i is random disturbance. The regression is based on households that has no borrowing constraints ($HV_i < BC_i$).

$$BC_i^I = g(HV_i^* - LC_i^I) \text{ and } BC_i^W = g(HV_i^* - LC_i^W) \quad (9)$$

Finally, the degrees of income and wealth constraint variables (BC_i^I and BC_i^W) for all households are defined as the following three levels - highly constrained (3), moderately constrained (2), and unconstrained (1), as shown below:

degree of income constraint (gap_i)	$HV_i^* > LC_i^I$	highly constrained =3
	$0.7 \times LC_i^I < HV_i^* \leq LC_i$	moderately constrained=2
	$HV_i^* \leq 0.7 \times LC_i^I$	unconstrained =1
degree of wealth constraint (gap_w)	$HV_i^* > LC_i^W$	highly constrained =3
	$0.7 \times LC_i^W < HV_i^* \leq LC$	moderately constrained =2
	$HV_i^* \leq 0.7 \times LC_i^W$	unconstrained =1

C. Empirical model and estimation results

The tenure choice equation of the following probit model is estimated as below:

$$Probit(own = 1) = f(X_i, gap_i, gap_w; \beta) + \epsilon_i \quad (10)$$

X_i : set of variables

gap_i : degree of income constraint

gap_w : degree of wealth constraint

(1= unconstrained, 2= moderately constrained 3= highly constrained)

Three model outcomes are shown in the Table 3 as the main results. Model (1) includes all the control variables along with two time dummies (one for year 2010, another for year 2016, and 2006 data being the reference group) but without the borrowing constraint variables. Model (2) includes all the controls plus both income-constraint and wealth-constraint variables but without time dummies. Model (3) includes all the variables in the second model plus the two time dummies.

Remaining two model outcomes are summarized in the Table 4. The model (4) includes the wealth-constraint variables interacted with the age group cohorts without the permanent income variable. The Model (5) includes the wealth-constraint variables interacted with the year cohorts. However, interpreting the interaction terms of probit models is not straightforward because it is non-linear: the marginal effect of interacted variables is not equal to the correlation coefficient of interaction term. The statistical significance cannot be determined from the z-statistic reported in the regression output, either. That is why we made linear OLS estimations for model (4) and (5), with which we can investigate the impact of interaction terms.

All the usual determinants of the propensity to own show the expected signs that are statistically significant: as shown in Table 3, the higher the permanent income and the larger size of family number, the higher is the propensity to own. On the other hand, the higher user cost (or relative cost of owning) and the younger the age cohort, the lower the propensity becomes. Contrary to our expectation, the two latter year subsamples (2010 and 2016) show lower ownership propensities compared to the 2006 subsample, which is consistent in all three models (Models 1, 3, and 4). As a possible reason for the last result, we conjecture that, although the mortgage market expanded during our study period (which should lower the user cost for average consumer), the market-wide lending restrictions through LTV-DTI caps along with the location-driven regulations ("speculative zones") might have lowered the propensity over time.

As expected, the borrowing constraint variables reduce the propensity to own. Compared to the unconstrained

Table 3. The impact of borrowing constraint to tenure choice(Probit Models)
(Dependent variable: Tenure status, one if owning; Pooled sample estimation with 2006, 2010, and 2014 surveys)

VARIABLES	Model (1)		Model (2)		Model (3)	
	ownership	marginal effect	ownership	marginal effect	ownership	marginal effect
ln_pinc	0.544***	0.158***	0.0443*	0.000936	0.141***	0.0301***
	(0.0167)	(0.00552)	(0.0232)	(0.00820)	(0.0241)	(0.00848)
own_to_rent	-0.131***	-0.0502***	-0.115***	-0.0497***	-0.115***	-0.0423***
	(0.00820)	(0.00292)	(0.00888)	(0.00336)	(0.00901)	(0.00330)
Fsize	0.0237***	0.0247***	0.173***	0.0727***	0.148***	0.0649***
	(0.00599)	(0.00215)	(0.00697)	(0.00262)	(0.00714)	(0.00268)
Age			0.0404***	0.0154***	0.0443***	0.0168***
			(0.000688)	(0.000255)	(0.000722)	(0.000266)
Sex			-0.192***	-0.0788***	-0.152***	-0.0683***
			(0.0220)	(0.00822)	(0.0223)	(0.00831)
1.gap_inc			-		-	
			-		-	
2.gap_inc			-0.0290		-0.127***	
			(0.0226)		(0.0232)	
3.gap_inc			0.0499**		-0.0868***	
			(0.0243)		(0.0252)	
gap_inc				-0.0199***		-0.0478***
				(0.00410)		(0.00432)
1.gap_wealth			-		-	
			-		-	
2.gap_wealth			-0.838***		-0.843***	
			(0.0235)		(0.0236)	
3.gap_wealth			-1.753***		-1.711***	
			(0.0233)		(0.0234)	
gap_wealth				-0.357***		-0.351***
				(0.00425)		(0.00428)
6.year	-				-	
	-				-	
10.year	-0.315***				-0.338***	
	(0.0138)				(0.0159)	
14.year	-0.218***				-0.412***	
	(0.0160)				(0.0190)	
year		-0.00703***				-0.0196***
		(0.000720)				(0.000876)
Young	-0.851***	-0.340***				
	(0.0135)	(0.00466)				
htype(note2)	controlled	controlled	controlled	controlled	controlled	controlled
Constant	-1.545***		-1.701***		-2.081***	
	(0.0739)		(0.133)		(0.137)	
Observations	56,516	56,516	56,516	56,516	56,516	56,516

Note1) Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Note2) We controlled house types, which coefficients are statistically significant under 99% of confidence level

Table 4. The impact of borrowing constraint to tenure choice (Linear OLS Models)
(Dependent variable: Tenure status, one if owning; Pooled sample estimation with 2006, 2010, and 2014 surveys)

VARIABLES	Model(4)		Model(5)	
	Probit ownership	OLS ownership	Probit ownership	OLS ownership
ln_pinc			0.117***	0.0422***
			(0.0241)	(0.00539)
own_to_rent	-0.0881***	-0.0263***	-0.111***	-0.0277***
	(0.00676)	(0.00209)	(0.00915)	(0.00230)
Fsize	0.0455***	0.0130***	0.152***	0.0331***
	(0.00423)	(0.00126)	(0.00713)	(0.00163)
Age			0.0436***	0.0106***
			(0.000712)	(0.000165)
Sex	-0.192***	-0.0590***	-0.160***	-0.0255***
	(0.0133)	(0.00414)	(0.0225)	(0.00504)
6.year *x* 1.gap_wealth			-	-
			-	-
6.year *x* 2.gap_wealth			-0.648***	-0.224***
			(0.0342)	(0.0114)
6.year *x* 3.gap_wealth			-1.481***	-0.468***
			(0.0312)	(0.00749)
10.year *x* 1.gap_wealth			-0.232***	-0.0567***
			(0.0175)	(0.00456)
10.year *x* 2.gap_wealth			-1.263***	-0.415***
			(0.0398)	(0.0116)
10.year *x* 3.gap_wealth			-2.090***	-0.565***
			(0.0340)	(0.00622)
14.year *x* 1.gap_wealth			-0.277***	-0.0702***
			(0.0201)	(0.00520)
14.year *x* 2.gap_wealth			-1.263***	-0.419***
			(0.0539)	(0.0160)
14.year *x* 3.gap_wealth			-2.340***	-0.610***
			(0.0522)	(0.00715)
6.year	-	-		
	-	-		
10.year	-0.361***	-0.105***		
	(0.0116)	(0.00339)		
14.year	-0.237***	-0.0698***		
	(0.0132)	(0.00393)		
0.young *x* 1.gap_wealth	-	-		
	-	-		
0.young *x* 2.gap_wealth	-0.980***	-0.329***		
	(0.0271)	(0.00980)		
0.young *x* 3.gap_wealth	-0.794***	-0.264***		
	(0.0119)	(0.00370)		

Table 4. Continued

VARIABLES	Model(4)		Model(5)	
	Probit ownership	OLS ownership	Probit ownership	OLS ownership
1.young *x* 2.gap_wealth	-1.601***	-0.538***		
	(0.0368)	(0.0106)		
1.young *x* 3.gap_wealth	-2.108***	-0.622***		
	(0.0232)	(0.00462)		
htype(note2)	controlled	controlled	controlled	controlled
Constant	1.530***	0.990***	-2.013***	0.00499
	(0.0214)	(0.00568)	(0.136)	(0.0313)
Observations	83,405	83,405	56,516	56,516
R-squared		0.258		0.396

Note1) Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1
Note2) We controlled house types, which coefficients are statistically significant under 99% of confidence level

households ('1.gap_w' for the wealth constraint, the reference group), both the moderately- and highly-constrained households exhibit lower ownership propensities. In Model (2) and (3), the coefficients for wealth-constrained households are around -0.8 for '2.gap_w' and -1.7 for '3.gap_w'. When year is not controlled, the income constraint seems not binding as shown in model (2), whereas it becomes significant when it is controlled as shown in model (3): -0.127 for '2.gap_i' and -0.086 for '3.gap_i' for the income-constrained households[4]. As indicated by the coefficients, the magnitudes of the wealth effects are far larger and effective than those of the income constraints.

When interacted with the age dummy, it is also shown that the wealth constraints have a larger impact on young borrowers. In Model (4), the variable '0.young *x* 1.gap_w' is an interaction of 'old (not young) cohort' with the '1.gap_w' (unconstrained borrowers) is the reference group used. The impacts of wealth constraint in young cohort at all three constraint levels, [-0.266, -0.538, -0.622], are shown to be higher than those of old cohort, [0, -0.329, -0.264], based on which we conclude that the wealth constraints tend to have different effects for consumer cohorts with different lifecycle stages, and that they tend to create a larger binding constraint for young households in their tenure decisions. One result to note is that for old age cohorts the mild wealth constraint in fact inflicts a bigger negative impact (the coefficient -0.329) than that of the high constrained (the coefficient -0.264), which may imply that older-age borrowers tend to have a relatively more extensive social or business network that can mitigate the borrowing constraint. Conceptually, the wealth constraint should be less binding as the net wealth increases, which our data confirms: while the average net worth of the old age cohorts amounts to 181 thousand KRW, that of the young cohorts is only 92 thousand KRW.

When interacted with the survey years, it is shown that the impact of the wealth constraint becomes larger in 2010 compared to the base year of 2006 ('6.year *x* 1.gap_w' in Model (5)). Specifically, the coefficient for '10.year *x* 1.gap_w' is -0.0567, implying that those households with no wealth constraint have a lower propensity to own in 2010 than in 2006. Between the two later years in our sample, the sizes of impact are similar: [-0.0567, -0.415, -0.565] for 2010 vs. [-0.0702, -0.419, -0.610] for 2014. As expected, the more constrained, the higher the reduction in the propensity: [-0.224] for the moderately-constrained (6.year *x* 2. gap_w) and [-0.486] for the highly-constrained (6.year *x* 3.gap_w). In sum, our results indicate that there is no statistically valid evidence of reductions in the impacts of borrowing constraints as the residential mortgage market expands, as in the case of Korea during our study period.

[4] The DTI was selectively adopted from 2009 in Korea, and thus the effect of income constraint may not be consistent to ownership rate.

IV. Discussion and policy implications

For the purpose of taming the housing price boom-busts, the Korean government has long been instituting a series of policy measures to stabilize the real estate markets since the take-off stage of the sustained economic growth from 1960s. Those anti-speculation measures include the tax regime (for purchasing, holding, and reselling housing and other real estate assets), the rationing mechanisms for newly-constructed housing units, and even the price regulations on new apartment (or multi-unit) properties. After the Asian Financial Crisis, the lending restrictions in the residential mortgage sector become a new policy instrument employed by the government, implemented in combination with the geographically-designated "speculative zones" (i.e., Seoul and other urban areas for which the government suspects an overheated housing market). For example, there are nationwide LTV caps, 60% for the commercial banks and other lenders and 70% for the government agency that securitizes the fixed-rate residential mortgages, which become more restrictive with a 40% maximum in the speculative zones. The DTI restrictions, which vary between 40% to 60%, also work similarly in that they get more restrictive in the seemingly overheated housing markets. Both LTV and DTI constraints also interact with other factors, such as lender type (commercial banks vs. mutual savings banks), mortgage product types (fixed-rate vs. adjustable rate; amortizing vs. non-amortizing), and property type (high-priced property vs. medium-/low-priced property).

Our results indicate that both lending restrictions have a negative impact on the consumers' propensity to own with the LTV constraint having a larger detrimental effect for the wealth-constrained financial consumers, and that the magnitudes of their impacts grow over time and inflict a bigger constraining effect on the owning propensity for the constrained households. That is, the effect of the borrowing constraint as the binding restriction on consumers' decision to own did not diminish despite the fact that of the Korean -mortgage market increased its size quite dramatically during our study period. To the contrary, it is proved that the mortgage rationing became worse for the wealth constrained groups and younger households. These findings bring our attention to a potential social cost of the way that those lending restrictions are implemented in Korea. That is, those restrictions are not only very much constraining, particularly for those young households who do not accumulate enough wealth, but also making no differentiation based on socio-economic characteristics of consumers (e.g., their life-cycle stages, previous home ownership experience - or first-time home-buyer status, and income and other conditions). Hence, given these implications of our results, we propose a more refined regulatory approach that can be suitable to different consumer cohorts.

It is generally the case that younger house heads have smaller net assets and thus, tend to have bigger constraint than older ones, while they tend to have higher current income and longer remaining career. As a result, a proper policy design in regulating those borrowing constraints should reflect applying optimum level of LTV ratio (α_m) to individual mortgage lenders, especially to younger house heads, considering the income and wealth prospects in life cycle. To further investigate this issue, we show below that the degree of borrowing constraint for a household is determined by the smaller of the wealth and income constraints as shown in equation (6). The amount of income constraint decreases, whereas that of wealth constraint increases as the LTV ratio (α_m) increases based on the equation (7). As a result, the borrowing constraint amount reaches the highest level when the LTV ratio (α_m) makes the two constraints equal ($LC^I = LC^W$), which is illustrated in Figure 1. That is why the optimal (or minimum) level of constraint occurs where the two curves intersect, from which we can derive the optimal LTV numerically as follows:

$$\alpha_m^* = \frac{1}{1+\frac{i}{\delta}\times\frac{W_0}{Y_0}} \tag{11}$$

Using the summary statistics from our testing sample (for mortgage interest rate, household income and wealth, and mortgage payment amount), the optimal LTV ratio (α^*_m) computed are 0.83 and 0.71 for young and old cohort respectively[5]. This result suggests a financial policy that a higher LTV level (hence, less constraining lending

[5] The young and old house heads have average household incomes of 33.0mil and 32.16mil KRW, the average net wealth of 92.46mil and 180.91mil KRW respectively based on the subsample. We used the summary statistics together with average front-end ratio of 35% and 2.5% of borrowing rate to calculate the optimum LTV ratio of 0.83 and 0.71 for young and old house heads.

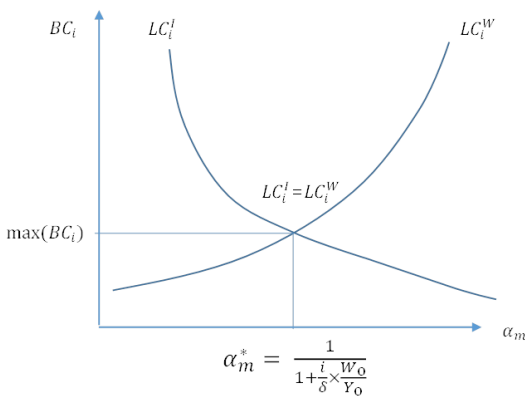

Figure 1. Determining the optimal LTV level

restriction) supposed to be applied to the younger households compared to the older consumer cohorts to optimize the level of the borrowing constraint.

Second, in terms of regulating the mortgage lending sector, our results imply that the policy makers should be cognizant, and should attempt to balance, two policy objectives that are often competing with each other, namely, ensuring financial stability versus extending financial inclusion. During the last two decades, the Korean government has taken a very hands-on approach in using LTV and DTI caps as important policy instruments in the mortgage market. The regulatory approach has been tilting toward stabilizing the housing and mortgage markets in Korea. That is, highly restrictive lending limits were universally applied to all consumer cohorts in a given geographical area, with the very constraining LTV maximum, e.g., the 40 percent maximum LTV in certain locations as defined as "speculative zones", which is applicable regardless of income or wealth of the borrower and of whether one is a first-time homebuyer. Our empirical results indicate that those regulations were overly restrictive for less wealthy and younger consumers for them to realize their dream of home ownership, suggesting that there should be a more elaborate policy design such that those two competing policy objectives can be balanced between those two dimensions - financial and real estate market stability and inclusion of marginal consumer cohorts in the financial service sector.

V. Concluding remarks

Housing is a special economic commodity, not only because it represents one of the most basic necessities (offering shelter services) but because it can have a positive externality by making its owner more caring citizen about his or her community.[6] In that sense, the borrowing constraints in the residential mortgage lending sector have welfare implications for financial consumers given that those restrictions essentially define a threshold as to whom can be served by credit suppliers in the sector. In this study, we empirically investigate the combined role of two borrowing constraints in housing tenure decisions and show that lending restrictions exhibit negative effects on the propensity to own, which tends to increase for younger and less wealthy borrower cohorts. In addition, despite the fact that the residential mortgage lending sector of the country experienced substantial growth during our study period (2006 to 2014), the effects of the wealth constraints are shown to increase over time, indicating that the mortgage market does not seem to expand to more marginal borrower groups. Using these findings, we argue that the direction for public policy in this sector should be a more elaborate policy design to strike an appropriate balance between two competing policy objectives - financial and real estate market stability and inclusion of marginal consumer cohorts in the financial service sector.

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[6] See Green et al. (2012) and Yun and Evangelou (2016) for this argument along with the literature in this vein.

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