The Distributive Impacts of Financial Development: Evidence from Mortgage Markets during U.S. Bank Branch Deregulation. Author: Ishani Tewari

ONLINE APPENDIX

TABLE A1: SUMMARY STATISTICS

	N	Mean	SD	Median
Homeownership	1885651	0.66	0.47	
Total number of mortgage loans	2708774	9	18	3
Total dollar amount of lending (2007$ 100s)	2708774	1485	4172	428
Average family income	2708774	71303	37663	62570
Number of Full-Time Employees	215107	131	1193	27
Total assets	221070	312546	3772309	45902
Capital/asset ratio	218719	0.09	0.06	0.08
Loan-to-value ratio	4400000	77.32	17.49	80.00
House price	4400000	251859	170268	207624
Interest rate	4400000	7.53	1.45	7.38

TABLE A2: BASELINE REGRESSION EXCLUDING LARGE STATES

	(1)	(2)	(3)	(4)	(5)
State dropped	TX	FL	IL	MI	NY
Years since branching	0.002**	0.002**	0.002**	0.002**	0.002**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
State and year FE	no	no	yes	yes	yes
Observations	733782	741778	748512	752308	753753

Note: As in table 3, the regression is a LPM where the dependent variable is probability of homeownership: whether or not the household rents (=0) or owns (=1) from the CPS 1976-2007. In each column, I exclude observations from the state noted in the column header. Standard errors which appear in brackets, are adjusted for state clustering. *,** and *** indicate significance at the 10,5, and 1 percent levels respectively. CPS sampling weights are used.

TABLE A3: HAZARD MODEL

	(1)	(2)	(3)	(4)
Homeownership level	0.172			
	[1.739]			
Homeownership growth		-2.658		
		[1.998]		
Loan level			-6.58E-07	
			[4.24e-06]	
Loan growth				0.0491
				[0.0651]
Observations	324	287	220	188

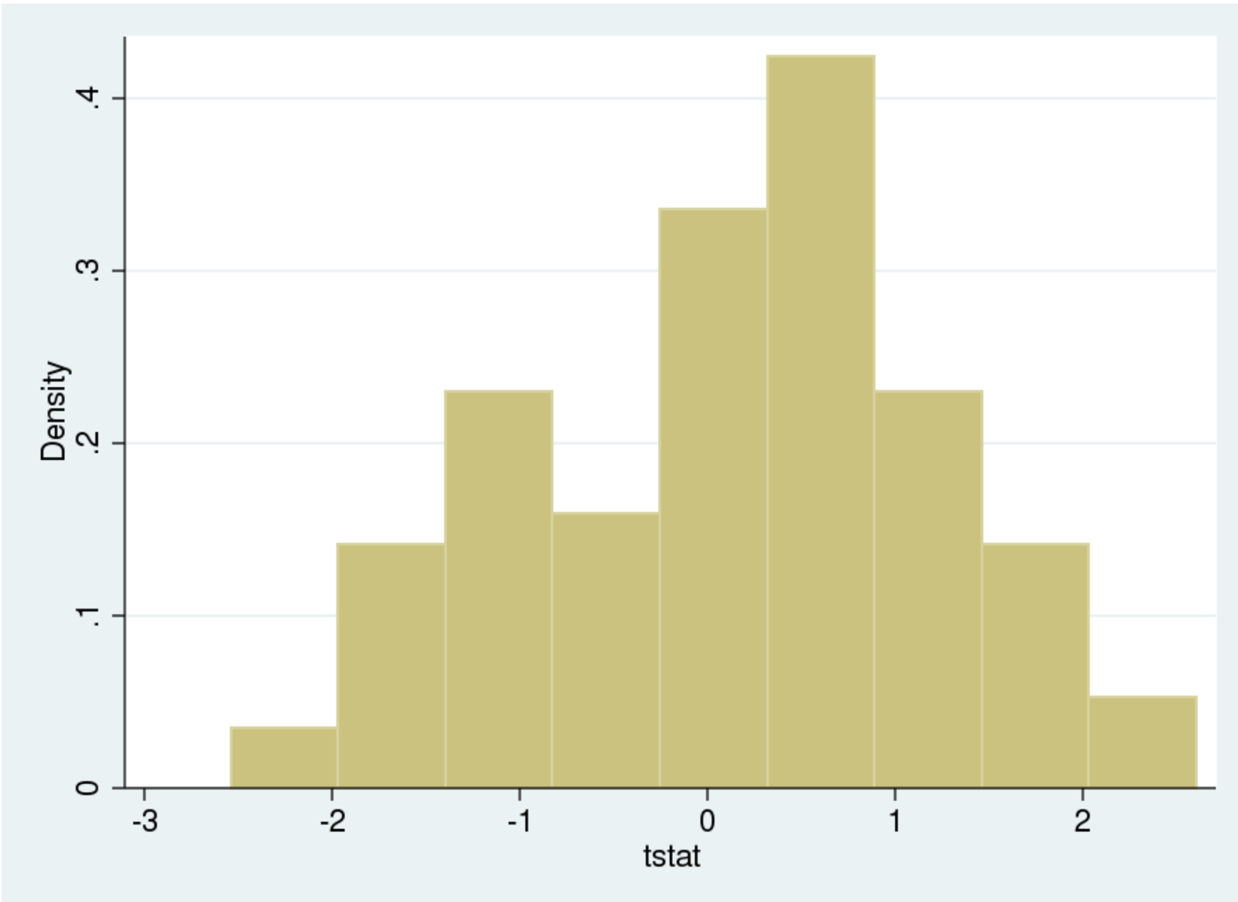
Note: The model is a Weibul hazard model where the dependent variable is the log expected time to bank branch deregulation. The hazard of deregulation is a likelihood that a state deregulates at time t, given that the state has not yet deregulated. Each coefficient measures the percentage change in the hazard of deregulation as a result of a marginal change in either the level of homeownership and mortgage lending or change of homeownership and lending. Standard errors are adjusted for state-level clustering and appear in parentheses. All specifications control for political economy variables that affect the timing of bank branch deregulation (Kroszner and Strahan, 1999). These variables are: (1) small bank share of all banking assets, (2) capital ratio of small banks relative to large, (3) relative size of insurance in states where banks may sell insurance, (4) an indicator which takes upon a value of one if banks may sell insurance, (5) relative size of insurance in states where banks may not sell insurance, (6) small firm share, (7) share of state government controlled by Democrats, (8) an indicator which takes upon a value of one if a state is controlled by one party, (9) average yield on bank loans minus Fed funds rate, (10) an indicator which takes upon a value of one if state has unit banking law, and (11) an indicator which takes upon a value of one if state changes bank insurance powers. Sample period is 1976 to 1994. I use observations for ten years before a state's deregulation year. States drop from the sample once they deregulate. Standard errors appear in brackets.

TABLE A4: EFFECT OF BRANCHING DEREGULATION ON HOMEOWNERSHIP—PROBIT ESTIMATES

	(1)	(2)	(3)	(4)	(5)
Yrs since branching	0.00269***	0.00266***	0.00144*	0.00203**	0.00218**
	[0.000947]	[0.000942]	[0.000874]	[0.000896]	[0.000900]
Gini		-0.0582	0.0515	0.0418	0.0435
		[0.0926]	[0.0963]	[0.0970]	[0.0953]
HH income (Ks)			0.00359***	0.00359***	0.00361***
			[9.04e-05]	[9.04e-05]	[9.39e-05]
Marry			0.259***	0.259***	0.259***
			[0.00590]	[0.00590]	[0.00597]
Age			0.00965***	0.00965***	0.00970***
			[0.000358]	[0.000357]	[0.000354]
High school			0.0223***	0.0222***	0.0216***
			[0.00653]	[0.00653]	[0.00650]
State and year FE	yes	yes	yes	yes	yes
State income controls	no	no	no	yes	yes
Bank struct controls	no	no	no	no	yes
Observations	798103	796734	794917	794917	764956

Notes: In all columns, the regression is a marginal probit where the dependent variable is probability of homeownership whether or not the household rents (=0) or owns (=1) from the CPS 1976-2007. Col. 3 controls for household characteristics namely, total household income (2007$), age, marital status and education. col. 4 controls for state-level gross domestic product, personal income and disposable income per capita, col. 5 controls for lags of bank structure variables-- HHI, the number of banks that control over half of the state deposits, the share of deposits controlled by small banks and the number of counties that the average bank operates in (these variables are only available through 2000). Standard errors, which appear in brackets, are adjusted for state clustering.. *,** and *** indicate significance at the 10,5, and 1 percent levels respectively. CPS sampling weights are used

FIGURE A1: ROBUSTNESS-- DISTRIBUTION OF T-STATISTICS FROM PLACEBO REGRESSIONS



Notes: The figure plots the distribution of the t-statistic of the coefficient estimate of β from the baseline homeownership regression run 100 times with the year of branching deregulation randomized among the states. The mean is .128 and the max is 2.60. The "true" t-statistic (from Table 2) is 2.81. The regression is: $Y_{ist} = \beta D_{st} + \sigma_s + \gamma_t + \varepsilon_{ist}$ where Y_{ist} is the household's homeownership status, The D_{st} is the branching deregulation year for each state. σ_s, γ_t are state and time fixed effects respectively.

Appendix

A1:Theoretical framework

The following model provides predictions for the relationship between improvements in a bank's ability to screen and a borrower's downpayment requirement and consequent access to mortgage credit. The basic premise of the analysis is that, in the presence of asymmetric information, mortgage applicant's choice of leverage is a signal of his unobservable risk type. In the spirit of Rothschild and Stiglitz (1976), there is a unique separating equilibrium in which safer borrowers get a smaller loan than they would under full information. For some borrowers, this may prevent them from getting a mortgage at all. The analysis parallels that of Harrison, Noordewier and Yavas (2004).

Environment

In the first period, a risk-neutral borrower chooses a mortgage contract (L, i) offered by a competitive, risk-neutral lender where L is the loan amount and i is the interest rate to purchase a house with price P. $P \geq L$ so the borrower must borrow to finance the purchase (second or "piggy-back" mortgages are not available). In the second period, the borrower's total repayment amount is $R = (1 + i)L$. In the analysis to follow, I characterize a mortgage contract (L, R).

Each borrower has a first-period income y_0 which the lender can observe and initial wealth W which can be used to finance the downpayment or the portion of the purchase price not financed by the loan. If $L < P - W$, then the borrower cannot afford the downpayment and does not take out a loan. The second-period income, y, is stochastic with a probability density function $f(y)$ cumulative density function $F(y)$ on the interval $[0, y_0]$, i.e. ,the second-period income can either stay the same or fall. There are two type of borrowers, high or safe types and low or risky types, who are defined by the probability, p_j where $j = H, L$ that their income will fall in the second-period; $p_H < p_L$ i.e. the low type's income is more likely to fall in the future. When there is private information, the bank is not able to distinguish between the high and low types.

The borrower pays the debt with his uncertain second-period income. In the case of default, he incurs a cost $C > 0$ which may be interpreted as reputation damage, transaction costs or problems with future credit. The repayment amount will always exceed the value of the house $R > P$. So I rule out cases where house price appreciation is so high that the borrower can sell it to pay off the debt, i.e. the borrower must rely on his future income to repay. For simplicity, I assume that the house value does not fluctuate. In order to ensure that there is no strategic or ruthless default, I assume that the value of the asset and costs of default exceed the repayment amount, $P + C > R$. When will the borrower choose to default? If the second period income, y falls below the repayment amount net of the house value $y < R - P$ then the borrower defaults. There is no default if income remains y_0.

Borrower's Utility

Using the concepts defined in the preceding section, I define the borrower $j's$ expected utility over the contract (L, R):

$$U_j(L,R) = W + L - P + \delta p_j \int_0^{R-P} (y - C) f(y) \partial y + \delta p_j \int_{R-P}^{y_0} (y + P - R) f(y) \partial y + \delta(1 - p_j)(y_0 + P - R) \tag{1}$$

In the first period, the borrower spends $P - L$ out of his initial wealth to purchase the house. The next three terms represent his discounted utility in different states of the world. As stated before the second-period stochastic income can fluctuate from 0 to y_0 with probability p_j. If it drops below $R - P$, then he defaults and incurs C. If it is above $R - P$, the borrower sells the house, makes the repayment and enjoys whatever is left over. With probability $1 - p_j$, his income does not change in which case he is also able to make the repayment. δ is the discount factor (also for the lender).

Lender's Zero Profit Condition

The lender's profit from extending a contract to borrower j is:

$$\Pi(L_j, R_j) = -L + \delta p_j \int_0^{R-P} Pf(y)\partial y + \delta p_j \int_{R-P}^{y_0} Rf(y)\partial y + \delta(1-p_j)R \tag{2}$$

In the first period, he lends L. Mirroring the borrower's utility from the previous section, the lender will get the asset value P if the borrower's income drops too low and he defaults. Otherwise, the bank will be repaid R.

Indifference and Zero Profit Curves

In order to study the equilibrium, I turn to the properties of the indifference curves and zero profit curve derived from (1) and (2).

The slopes of borrower's indifference curve is given by the marginal rate of substitution between L, B. Differentiating (1) with respect to L, B:

$$MRS_U = \frac{U_l}{-U_B} = \frac{1}{\delta[p_j(C+P-R)f(R-P) + p_j(1-F(R-P)) + 1 - p_j} \tag{3}$$

Similarly, in the lender's case:

$$MRS_\Pi = \frac{\Pi_l}{-\Pi_B} = \frac{1}{\delta[p_jPf(R-P) - p_jRf(R-P) + p_j(1-F(R-P)) + (1-p_j)]} \tag{4}$$

To simplify, I assume F follows a uniform distribution so $f(x) = 1$ and $F(x) = x$ for all x. Also assume $y_0 = 1$.

The salient features of the indifference and zero profit curves are i) Indifference curves are upward sloping $\Longleftrightarrow MRS_U > 0$ since the borrower's utility is decreasing in the repayment amount $U_R < 0$; ii) Lower curves have higher utility levels $\Longleftrightarrow U_R < 0$; iii) Zero profit curves are upward sloping $\Longleftrightarrow MRS_\Pi > 0$ if $R - P < 1/2p_j$; iv) Both sets of curves are convex $\Longleftrightarrow \frac{\partial MRS_U}{\partial R} > 0$ and $\frac{\partial MRS_\Pi}{\partial R} > 0$; **v)** The zero profit curve for the low type is above the high type's $\Longleftrightarrow \frac{\partial R^0}{\partial p_j} < 0$ for any given L and $\frac{\partial L^0}{\partial p_j} < 0$ for any given R where R^0, L^0 are zero profit repayment and loan amounts and **vi)** Zero profit curves are more convex than indifference curves so that tangency/equilibrium exists $\Longleftrightarrow$zero profit flatter than indifference curve when $R < R^{\tan gency}$ $(MRS_U = MRS_\Pi)$ and steeper when $R > R^{\tan gency}$ for a given p_j

A separating equilibrium depends on the relative slope of the two types. The relationship between the slope of the indifference curve and risk profile is given by:

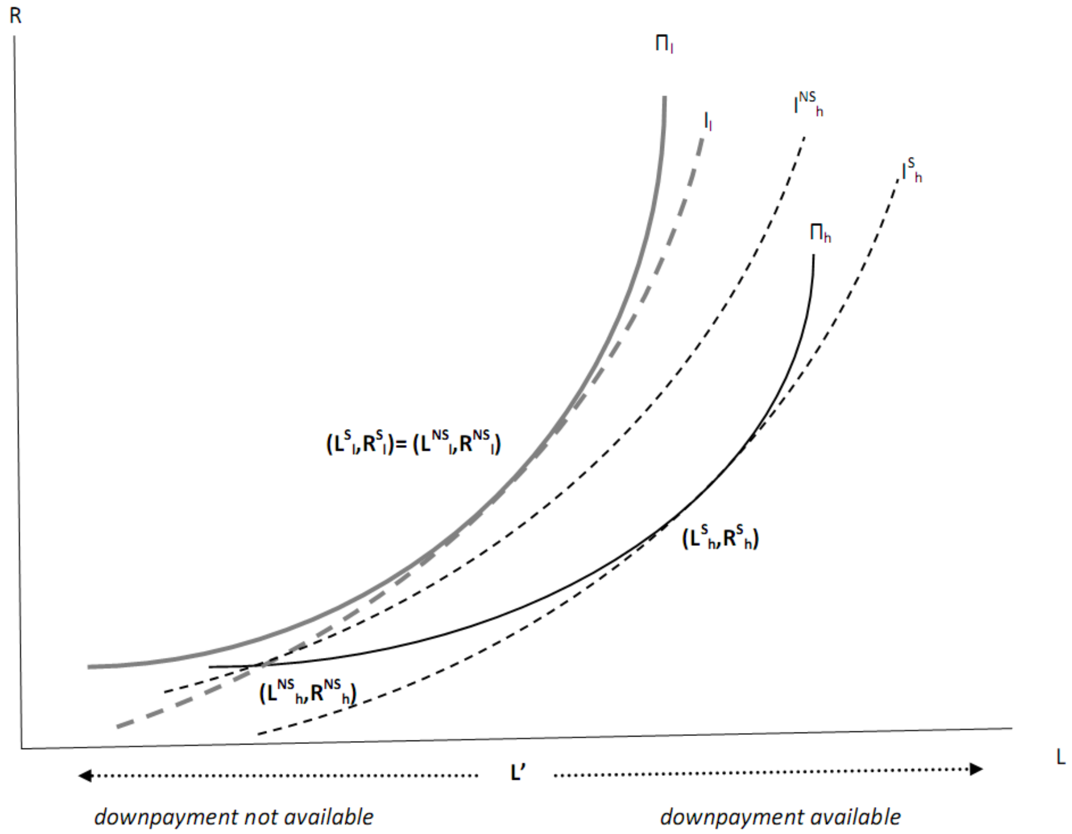
$$\frac{\partial MRS_U}{\partial p_j} = \frac{-(C+P-R)f(R-P) + F(R-P)}{\delta[p_j(C+P-R)f(R-P) + p_j(1-F(R-P)+1-p_j]^2} \tag{5}$$

Under the previous assumptions of uniform distribution, the numerator is $-C-2P+2R$. So $\frac{\partial MRS_U}{\partial p_j} > 0$ if $C < 2(R-P)$ and the high type's indifference curve is always flatter than the low type's. This leads to the following proposition:

Proposition 1 *If $C < 2(R-P)$, then $L_l > L_h$ and $R_l > R_h$*

That is, in the presence of private information of borrower type, the high/safe type will signal his creditworthiness by taking a smaller loan with a smaller loan balance than his riskier counterpart. I illustrate the indifference zero profit curves in the figure below.

Figure 1a: Separating equilibrium with $C < 2(R-P)$, high type gets smaller loan under private information



The key thing to note in the figure is how the optimal contracts change when there is perfect information and in the absence of it. When the lender can identify the high and low types using a screening technology, he offers contracts (L_j^S, R_j^S) and when he cannot a contract (L_j^{NS}, R_j^{NS}) emerges where borrowers signal their type using LTV. As the figure shows, the low type always receives the same contract whereas in the case of no-screening, the high type is credit rationed in the sense that he gets a loan smaller than his first-best level. As stated before, if the high types initial wealth is such that $L < P - W$, then he cannot afford the downpayment and does not take out a loan. In the figure above, I show the case where $\overline{L}$ represents the minimum loan amount that borrower needs given his wealth i.e. where his wealth covers the down payment requirement. In this case, when the lender acquires a screening technology, the high types contract changes from (L_h^{NS}, R_h^{NS}) to (L_h^S, R_h^S). In the equilibrium with screening, the high type no longer has to signal his creditworthiness getting a larger loan and crossing the threshold $\overline{L}$ so that the downpayment and thus, house is affordable.

Intuition: The limited liability feature of the mortgage contract provides intuition for the above results. The borrower's utility function implies that a larger loan is associated with greater consumption in the first period but lowers consumption while increasing default probability in the second future. In the case of default, the most the borrower can lose is the house and incur some default cost C. Once default occurs, the marginal loss to the borrower becomes zero. In the presence of sufficiently small default cost, larger loans are more attractive to low types than to high types because the former are more likely to experience an income drop and thus, benefit disproportionately from the contract's limited liability.

Although not explicitly analyzed, the interest rate provides further intuition. The interest rate is $1 + i = R/L$, the slope of the line from the origin to a point on the (L, R) plane. This slope is steeper, meaning a higher price, for the low type's contract relative to the price on the high type's contract. This difference in interest rate is another way separation occurs. The safe borrower is deterred from taking a larger loan because it would entail a higher price not only because it is a larger loan but also the lender assigns him the riskier borrower's interest rate, which is higher. The risky borrower finds the larger loan more attractive because even though he has a higher price, since his probability of defaulting is higher, there is a lower likelihood he will have to repay.

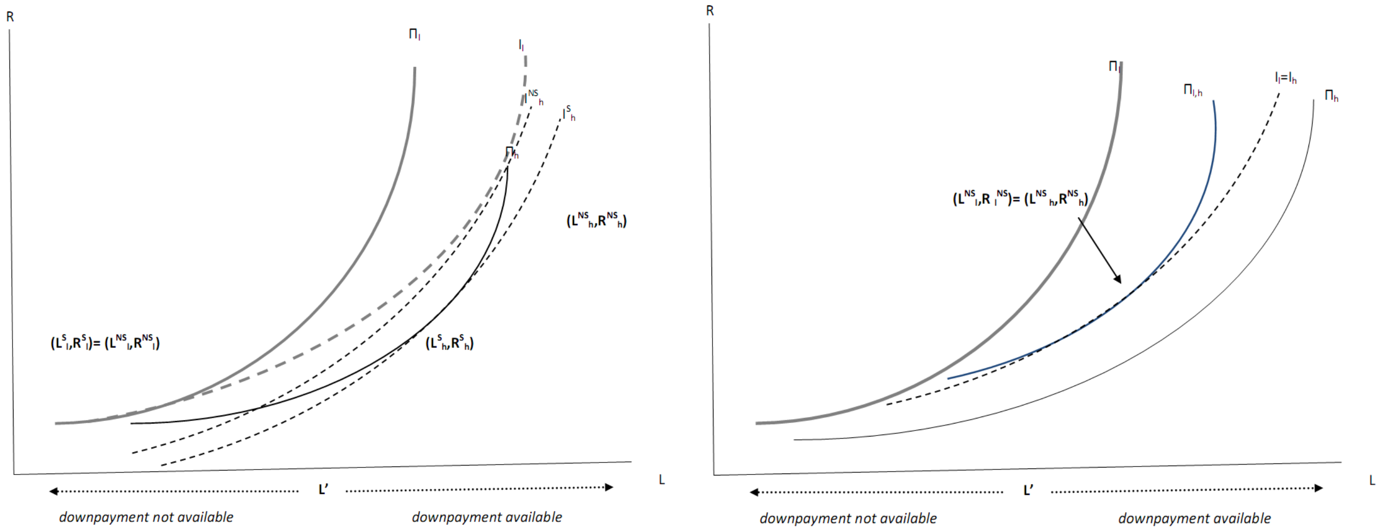
Proposition 2 *If $C > 2(R - P)$, then $L_l < L_h$ and $R_l < R_h$*

In the case above, $\frac{\partial MRS_U}{\partial pj} < 0$ so the high types indifference curve at any point in the (L, R) plane is steeper than the low types. The resulting separating equilibrium has *opposite* properties than the previous one. That is, risky borrowers obtain smaller loans and balances that safe borrowers. This case is depicted in the left-hand side panel of Figure 2. Finally, there is one more special case.

Proposition 3 *If* $C = 2(R - P)$*, then* $L_l = L_h$ *and* $R_l = R_h$

In this case, the indifference curves of the two borrowers have the same slopes at any point and so, do not intersect. There is no separating equilibrium because every contract that the lender offers to the high type is coveted by the low type since the zero-profit contract for the high type is below that of the low type (and lower indifference curves have higher utility). The unique equilibrium in this case is pooling and is show in the right-hand side panel in the figure below.

Figure 1b: Separating equilibrium with $C > 2(R-P)$ and pooling equilibrium



The separating equilibrium in Proposition 1, i.e. with $C < 2(R-P)$ or default costs not "too" high is the one most likely to hold.[1] Since C may include some intangible aspects such as damage to credit ratings or psychological costs in addition to monetary penalties or fees, it is difficult to quantify. However, most studies document that by the time their home is foreclosed on, borrowers have negative equity in the home and the effective monetary penalties are small relative to the debt. The provision of "deficiency judgement" exists in some states whereby lenders are allowed to go after borrower's other assets if the proceeds of the foreclosure sale do not pay off the existing mortgage plus costs. However, as Pence (2006) points out lenders rarely exercise deficiency judgements since it is rarely profitable because most borrowers in foreclosure have very few resources anyway. Also, in many cases, states only allow collection of deficiency judgement after the lender has already gone through a lengthy judicial foreclosure procedure and many banks do not find another costly legal procedure attractive at that stage. Thus overall, a borrower's costs of default are likely to be low in U.S. mortgage markets.

[1] The results in Proposition 1 are on the lines of Brueckner (2000). They also resemble the separating equilibrium of Rothschild and Stiglitz (1976) where safe drivers buy smaller insurance coverage than risky drivers and safe drivers end up with smaller coverage than they would under perfect information. Rothschild and Stiglitz (1976) does not feature default costs but rather the type of equilibrium is driven by the mix of high-risk and low-risk consumers.

The predictions for interest rate are ambiguous. More lending on the intensive margin per borrower will result in higher interest rates since the convexity of the zero profit curve indicates that the interest rate of any given borrower type increases with loan amount. However, more lending to high types on the extensive margin changes the pool of borrowers, with an increase in the proportion of those who qualify for lower interest rates given their better credit risk. So, the effect on loan price remains ambiguous. Furthermore, in actual mortgage lending, interest rates (across all types of borrowers) do not increase smoothly with LTV. The interest rate is primarily dependent on the creditworthiness, maturity and fixed/adjustable nature of the mortgage. The portion of the price that depends on LTV usually only increases when the LTV exceeds 80%. Mortgage borrowers with LTV ratios less than 80% typically do not receive significantly lower interest rates. The reason is that banks are usually confident that with these low LTVs, they will be able to recover all or nearly all of the loan balance if the borrower defaults (McDonald and Thornton 2008). When the LTV exceeds 80%, the lender requires the borrower to buy private mortgage insurance (PMI) from a third-party. Thus, increasing LTV overall should only reflect in increases in PMI and only when the LTV crosses the 80% threshold. The PMI feature of mortgage markets fits in well with the original approach of Rothschild and Stiglitz (1976) which was originally in the context of insurance markets. Just as in their model, the safe customers (healthier individuals or safer drivers) differentiate themselves from riskier ones by obtaining smaller insurance coverage than than they would if there was full information.