

“Cherry Picking” in Subprime Mortgage Securitization:

Which Nonprime Mortgage Loans Were Sold by Depository Institutions Prior to the Crisis of 2007?

Paul Calem

Board of Governors of the Federal Reserve System

Jonathan Liles

Freddie Mac

and

Christopher Henderson

Federal Reserve Bank of Philadelphia

The views expressed are those of the authors and do not represent official views of Freddie Mac, the Federal Reserve Bank of Philadelphia, or the Federal Reserve System

Introduction

- The financial crisis of 2007 curtailed most non-agency mortgage securitization activity
- The paper reinforces the view, increasingly prevalent in the literature, that misperception and mispricing of risk by the securitization market was a primary cause of the subprime lending boom and subsequent market collapse

Introduction

- We consider how a bank's decision to securitize a loan varies in relation to the loan's credit risk
 - Depository institutions may utilize securitization to “cherry pick”—to transfer risks along dimensions that investors tend to disregard or where their risk assessments are overly optimistic

- The bank decision to sell or retain mortgages provides a unique perspective from which to analyze the performance of the subprime mortgage ABS market
 - Depositories had a small share of the subprime market, but often retained loans on balance sheet (non-depositories generally relied on an originate-for-sale business model)

Research Objectives

- Explore the decision of depository institutions to sell or retain “high-cost” (subprime) mortgages during 2005 and 2006, in relation to measures of credit risk
 - Use HMDA data merged with ZIP code level data from *LoanPerformance*
- Distinguish between risk dimensions viewed as indicative of cherry picking, and the dimension of mutually observed and priced risk as represented by APR spread
- Also investigate likelihood of sale in relation to the future rate of serious delinquency among subprime loans in the ZIP code where the property is located.

Main Findings

- Likelihood of sale increases with risk along dimensions viewed as indicative of cherry picking
- In contrast, along the dimension of mutually observed and priced risk as represented by APR spread, likelihood of sale decreases with risk
- Likelihood of sale is positively related to the future rate of serious delinquency among subprime loans in the ZIP code where the property is located

Relevant Prior Literature

- Deterioration of underwriting standards and house-price depreciation as leading causes of the market collapse
 - Smith 2007; Coleman, LaCour-Little, and Vandell (2008); Demyanyk and van Hemert (2009); Gerardi, Shapiro, and Willen (2008); Hahn and Passell (2008); Sherlund (2008); Haughwout, Peach, and Tracy (2008)

- Role of securitization and associated agency problems
 - Ben-David (2007); Wray (2007) Ashcraft and Schuermann (2008); Golding, Green, and McManus (2008), Hull (2009); White (2009)

- “Hard” vs. “soft” information
 - Rajan, Seru, and Vig (2009); Keys, et al. (2010a, 2010b)

Relevant Prior Literature

- Amplification of errors via structured finance
 - Coval, Jurek, and Stafford (2009a, b)
 - Nakamura (2010a)

- Subprime mortgage securitization in relation to subsequent credit performance
 - Elul (2009); Mian and Sufi (2009)

Views on Securitization and Credit Risk

- Regulatory capital arbitrage
 - Securitization is favored for lower-risk assets; banks tend to retain opaque, higher-risk loans, because of incentives arising from regulatory capital requirements; e.g., Ambrose, LaCour-Little, and Sanders (2005); Calem and Follain (2007)
- Specialized risk management
 - Banks tend to securitize lower risk and retain higher-risk loans because of advantages in managing relationships with riskier borrowers; e.g., Hill (1996); Dewatripont and Tirole (1994, Chapter 10)

Views on Securitization and Credit Risk

- Macroeconomic uncertainty
 - Macroeconomic uncertainty might limit the incentive to securitize; conversely, greater macroeconomic stability, or perceived stability (such as might have occurred during the housing boom) could encourage securitization of riskier loans
 - Argument based on cost asymmetry—cost of ex-post, realized “excess” securitization exceeds the cost of securitizing “too little”

Views on Securitization and Credit Risk

- Cherry-Picking
 - A bank that “cherry picks” transfers risk via loan sale or securitization, along risk dimensions that the buyer or investors tend to disregard or where their risk assessments tend to be imprecise or overly optimistic
 - Cherry picking reverses the relationship between loan sales and credit risk implied by the previous arguments
 - Cherry picking may not be in a bank’s longer term interest if there are potential reputational consequences
 - The risk dimensions associated with cherry picking behavior may correspond to factors not considered by the market, such as elevated probability of default or loss given default associated with particular neighborhoods
 - Alternatively, they may correspond to factors such as borrower payment capacity which the bank can assess more accurately than investors

Views on Securitization and Credit Risk

- Lemons markets
 - In the traditional lemons market (Akerlof 1970), sellers (lenders) have more information than buyers (security investors), and each are aware of the information asymmetry
 - The information asymmetry in a lemons market may encourage the sale of lower quality goods (securitization of riskier loans), and one possible outcome is market collapse
 - Other outcomes are possible, however, depending on the structure of the market and the strategies that are feasible
 - In the context of loan securitization markets, contracts may evolve that give lenders incentives to pool risks, as in Passmore and Sparks (1996), or to separate risks, as in DeMarzo and Duffie (1999)
 - In the separating case, higher-risk loans may be selected for securitization and the lower-risk loans retained, or the opposite outcome could prevail

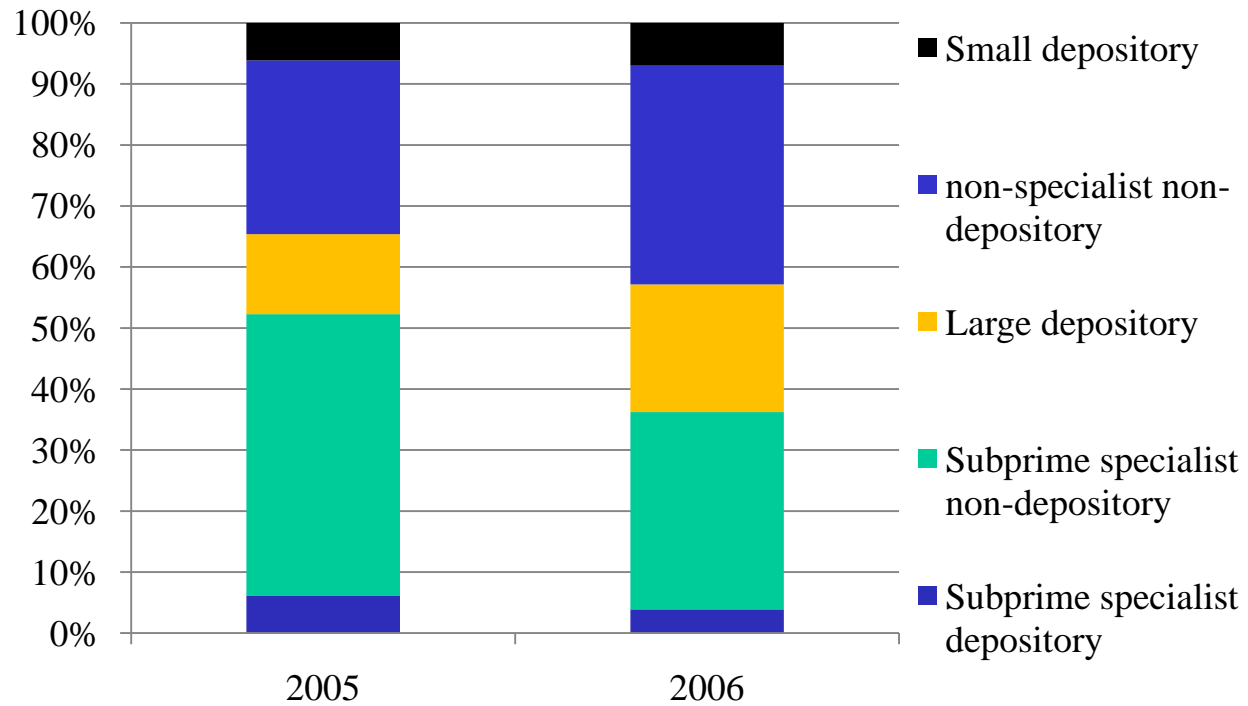
Data Description

- We analyze the disposition (retention vs. sale) of subprime first-lien home purchase loans originated during 2005 and 2006, using loan-level HMDA data
 - Subprime loans are defined to be loans that are “high cost” (have a HMDA-reported APR spread) *or* are originated by a HUD-identified subprime specialist
- The population is limited to loans originated by depository institutions (commercial banks, thrifts, and credit unions)
 - Loans sold to an affiliated institution or to another depository institution are excluded

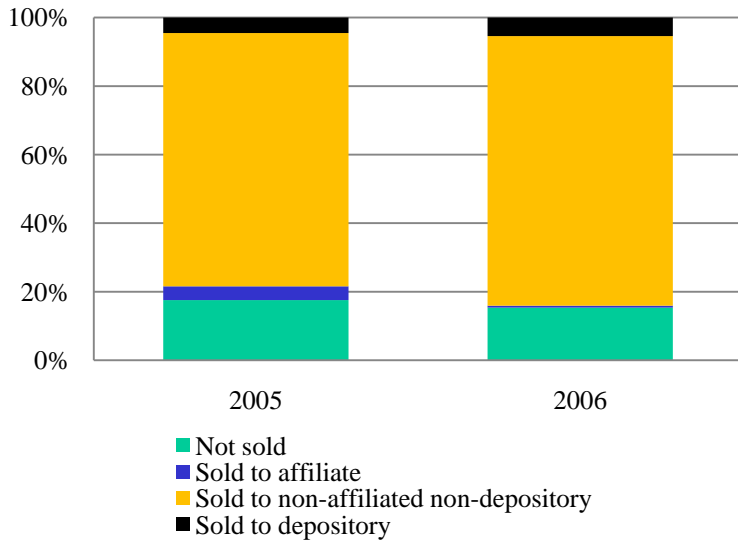
Data Description

- The data are merged at the tract-level with housing and mortgage market variables
 - Aggregate tract-level characteristics from HMDA, such as percent of loans that are high cost
 - Aggregate ZIP code level subprime market characteristics from LoanPerformance, such as percent of loans that are high LTV, and future (Oct. 2008) subprime delinquency rate
 - Data are from the LoanPerformance Servicing (not Securities) database
 - Local area (MSA) house price appreciation (OFHEO index) and change in housing starts (from economy.com)
 - The number of owner-occupied units in the Census tract, from the 2000 U.S. Census

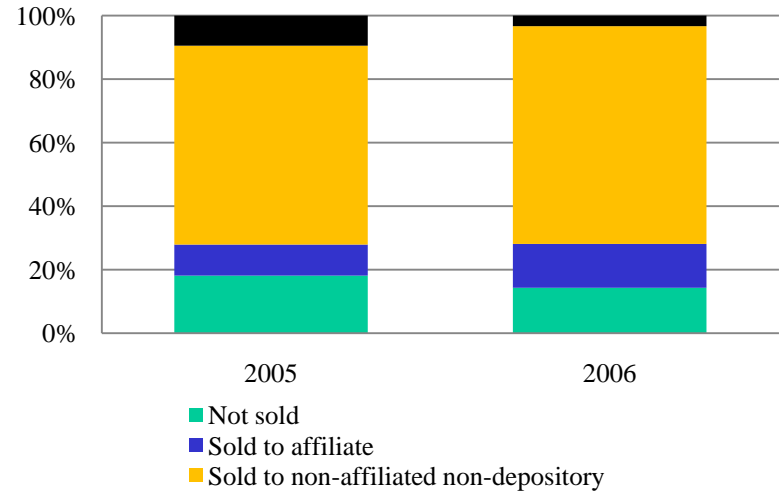
Distribution of high-cost loans by type of institution



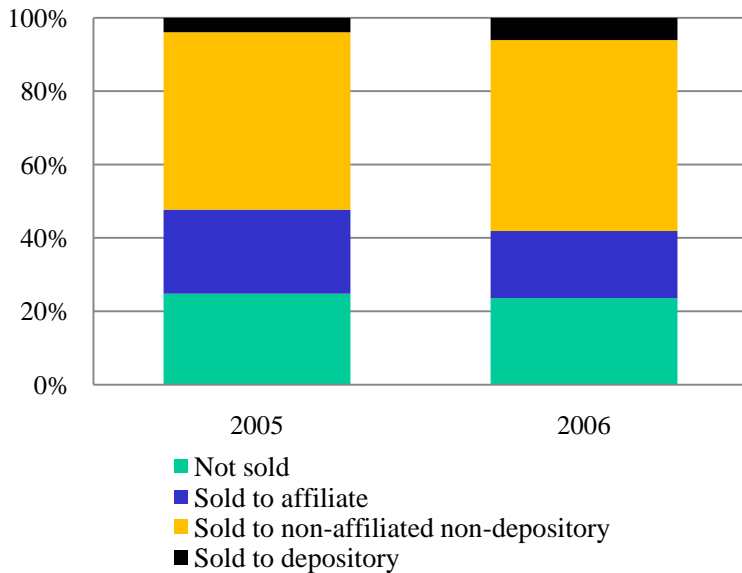
Panel a: Subprime specialist insitutions



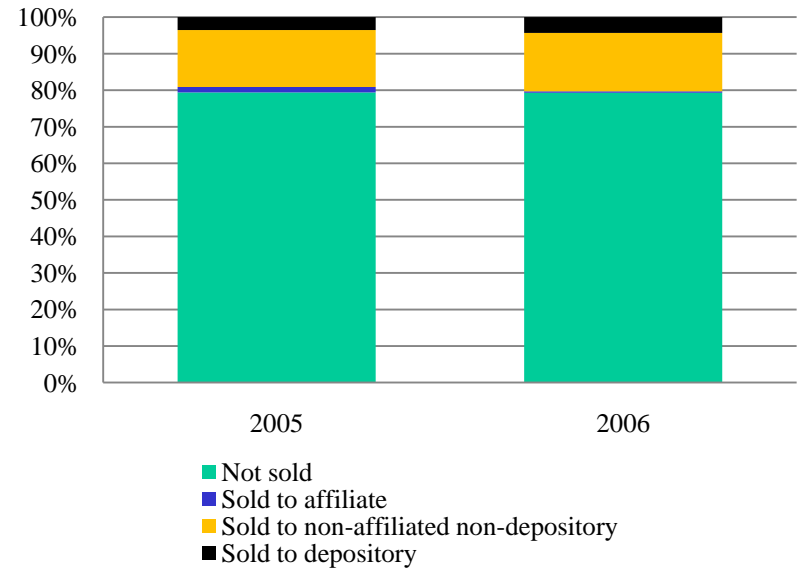
Panel b: Nonspecialist nondepository institutions



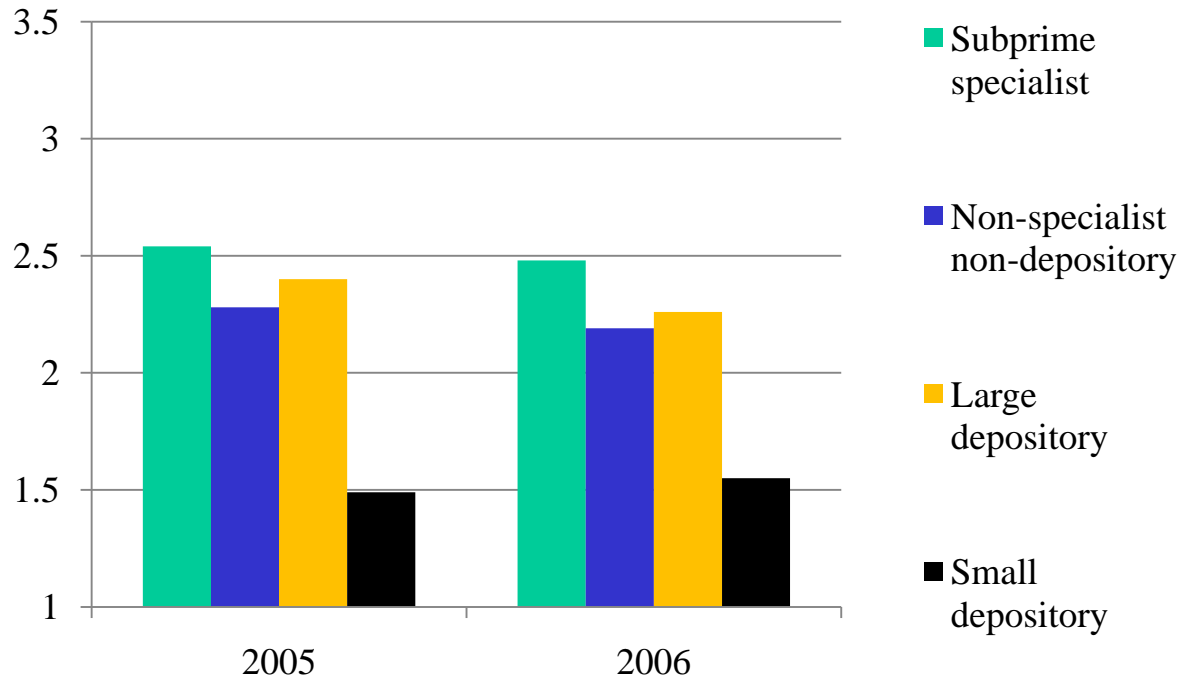
Panel c: Nonspecialist large depository institutions



Panel d: Nonspecialist small depository institutions



Average ratio of loan amount to income by type of institution



Empirical Analysis

- We analyze the disposition of subprime loans in 2005 and 2006 in relation to:
 - APR spread, which reflects the markets assessment of credit risk based on generally observed risk characteristics
 - Particular risk dimensions viewed as likely to be associated with “cherry picking” behavior, as indicated by a positive association between likelihood of sale and credit risk
 - Variables associated with transactions costs, and other control variables

Empirical Analysis

- We estimate separate equations for large and small institutions (greater or less than \$10 billion in assets).
 - We include institution-specific fixed effects in the equation for large institutions and a vector of institution-specific characteristics in the equation for small institutions
- We exclude those large institutions that retained all of their loans or sold all of their loans

Empirical Analysis

- Model 1: Several neighborhood risk variables included as potentially associated with cherry picking
 - Percent of loans in Census tract that are subprime
 - Percent of Census tract's subprime loans that are originated by subprime specialists
 - Housing market depth (log number of tract owner occupied units)

- Model 2: Single neighborhood variable: the future (January 2008) default rate in the Census tract (in place of neighborhood risk factors)

Empirical Analysis

- *Our premise is that depository institutions, primarily because of ties to local markets but also possibly because of greater diligence or better aligned incentives, had been more mindful of risk along these dimensions than subprime mortgage-backed security investors and rating agencies*
- In both Models 1 and 2, we include two additional variables that we associate with cherry picking:
 - An indicator for whether the institution has a branch in the county where the property is located
 - The ratio of loan amount to borrower income

Data and Empirical Approach

- Risk-related control variables
 - Model 1
 - Percent of Census tract's subprime loans that are junior lien
 - Percent that are high LTV ($LTV \geq 90$)
 - Percent that are low FICO ($FICO < 620$)
 - Models 1 and 2
 - Loan for non-owner occupied residence
 - Local area house price appreciation and change in housing starts

Data and Empirical Approach

- Additional control variables include:
 - Loan size
 - Primary regulator
 - Type of depository institution
 - Thrift institution identifier
 - HUD-identified subprime specialist
 - Credit union
 - Metropolitan area dummy variable
 - Institution size (log of total assets)

Caveats

- We are unable to control at the loan level for loan and borrower characteristics related to credit risk or loan pricing but not reported in HMDA data
 - These include interest rate type or loan product category, borrower FICO score, and LTV or (for loans with piggyback seconds) combined LTV
- We cannot observe whether banks offered greater credit enhancements on riskier loans
- We address only the loan sale or securitization decision of the banking side of the organization
 - Many of the same subprime loans in ABS recycled back to the investment portfolios of these organizations

Empirical Results

Panel A: Depository institutions with assets less than \$10 billion

Dependent Variable: Subprime loan was sold (1,0)

Variable	2005		2006	
	Odds Ratio	Chi Square	Odds Ratio	Chi Square
	Fraction of tract loans that are high cost	2.70	96.3*	3.60
Lender is subprime specialist; loan not high cost	8.35	35.1*	43.58	47.6*
APR spread in [3.0, 3.25)	1.74	49.8*	2.40	187.3*
APR spread in (3.25,5.25]	1.34	21.0*	1.70	73.8*
APR spread in (5.25,7.0]	1.25	8.1*	1.81	73.7*
Loan for nonprimary residence	0.79	48.6*	0.71	144.2*
Ratio of loan amount to borrower income	1.17	147.9*	1.08	40.1*
Log of census tract owner-occupied units	0.71	219.3*	0.78	150.3*
Loan amount < \$55,000	0.44	192.7*	0.41	307.4*
Loan amount in [\$55,000, \$155,000)	1.10	3.5	1.06	2.1
Loan amount in [\$155,000, 255,000)	1.21	13.2*	1.12	7.6*
Property in an MSA	1.09	5.5**	1.12	12.3*
Indicator for loan originated in county where bank has a branch	0.72	90.5*	0.63	178.8*
Log of institution total assets	1.25	576.4*	1.12	191.2*
Fraction of tract's high cost home purchase loans that are 2nd lien	18.32	485.3*	32.43	866.5*
Subprime specialist share of subprime loans in tract	4.87	194.2*	2.57	73.8*

Panel B: Depository institutions with assets greater than \$10 billion

Dependent Variable: Subprime loan was sold (1,0)

Description	2005		2006	
	Odds Ratio	Chi Square	Odds Ratio	Chi Square
Fraction of loans in census tract that are high cost	2.42	132.6*	1.84	101.1*
APR spread in [3.0, 3.25)	7.42	480.9*	2.11	267.1*
APR spread in [3.25, 5.25)	5.58	373.9*	1.59	121.2*
APR spread in [5.25, 7.0)	3.22	166.3*	1.54	102.3*
Loan indicator for nonprimary residence	1.44	150.9*	1.32	157.0*
Ratio (loan-level) created by dividing loan amount by income	1.18	209.2*	1.09	95.2*
Natural log of census tract owner-occupied units	0.94	13.4*	0.97	5.6**
Loan size (0, 55K]	2.48	331.3*	1.96	324.6*
Loan size (55, 155K]	2.78	745.6*	2.31	1098.8*
Loan size (155, 255K]	1.92	327.1*	1.69	533.8*
Metro area loan indicator	1.11	13.2*	1.19	53.4*
Indicator for county where bank has a branch	0.98	0.6	1.02	1.5
Percent of 2nd liens in census tract	1.02	0.0	1.78	51.5*
Percent of HUD subprime specialists in the census tract	1.47	17.2*	1.57	35.5*

Panel A: Depository institutions with assets less than \$10 billion

Dependent Variable: Subprime loan was sold (1,0)

Description	2005		2006	
	Odds Ratio	Chi Square	Odds Ratio	Chi Square
	Indicator for loan originated in county where bank has a branch	0.72	90.0*	0.65
Lender is subprime specialist; loan not high cost	8.75	38.8*	30.9	40.5*
APR spread in [3.0, 3.25)	1.72	49.3*	1.85	100.8*
APR spread in (3.25,5.25]	1.42	23.0*	1.32	21.8*
APR spread in (5.25,7.0]	1.33	13.1*	1.51	37.6*
Log of institution total assets	1.28	735.6*	1.13	248.9*
Loan for nonprimary residence	0.87	18.4*	0.78	77.8*
Ratio of loan amount to borrower income	1.20	217.2*	1.10	63.8*
Loan amount < \$55,000	0.37	334.4*	0.34	555.4*
Loan amount in [\$55,000, \$155,000)	1.02	0.2	0.94	3.2
Loan amount in [\$155,000, 255,000)	1.18	11.4*	1.06	0.6
Property in an MSA	1.49	146.3*	1.50	180.0*
Annual rate of change in local area HPI in year	2.53	36.5*	13.67	79.5*
Annual rate of change in local area housing starts in year	0.34	181.7*	0.78	10.5*
Subprime 90+ delinquency rate in census tract as of Jan. 2008	3.21	35.4*	1.99	13.7*
Insufficient data for measuring tract delinquency rate	0.73	7.8*	0.82	2.8

Panel B: Depository institutions with assets greater than \$10 billion

Dependent Variable: Subprime loan was sold (1,0)

Description	2005		2006	
	Odds Ratio	Chi Square	Odds Ratio	Chi Square
Bank has a branch in county were loan was originated	0.99	0.19	1.02	1.4
APR spread in [3.0, 3.25)	7.03	458.5*	2.08	264.2*
APR spread in [3.25, 5.25)	5.37	359.5*	1.58	120.6*
APR spread in [5.25, 7.0)	3.15	161.1*	1.55	106.3*
Loan indicator for nonprimary residence	1.48	175.4*	1.34	172.2*
Ratio (loan-level) created by dividing loan amount by income	1.19	227.7*	1.11	121.6*
Loan size (0, 55K]	3.31	699.3*	2.05	471.3*
Loan size (55, 155K]	3.36	1201.4*	2.37	1493.2*
Loan size (155, 255K]	2.09	430.9*	1.70	573.3*
Metro area loan indicator	1.15	23.1*	1.28	107.7*
Annual house-price rate of change for given year	0.27	128.6*	0.49	13.1*
Annual housing starts rate of change for the metropolitan area in given year	0.90	2.6	1.19	10.4*
Subprime 90+ days delinquent in census tract as of Jan. 2008	1.73	12.2*	1.70	18.0*
Insufficient data for measuring delinquency rate	0.88	1.6	0.85	2.9

Empirical Results

- Likelihood of sale decreases with APR spread (consistent across samples and years)
 - This relationship conforms to the view that banks tend to retain loans that market participants in general regard to be higher risk

- In contrast, along the risk dimensions posited to be associated with cherry picking, depository institutions retain higher-quality loans and sell the lower-quality loans.
 - Loan-to-income ratio
 - All three neighborhood risk measures in Model 1
 - Future neighborhood subprime delinquency rate in Model 2

Empirical Results

- Results for out-of-market origination are mixed.
 - Small banks: likelihood of sale greater for out-of-market originations
 - No relationship evident for large banks

Other Empirical Results

- Relationship to loan size, occupancy status, local area housing market conditions differs between large and small banks
- Loans outside metro areas less likely to be sold

Robustness

- Model 1 and 2 results are robust to:
 - o Including observations with missing income (setting the loan-to-income ratio=0 and using a dummy variable)
 - o Excluding loans sold to other depository institutions
 - o Excluding potentially endogenous tract % second lien
 - o Dropping November/December originations

Robustness

- Model 1 results are robust to:
 - Inclusion of ZIP-code level measures of subprime market product mix
 - Using the full HMDA sample, excluding the measures of subprime market composition from LoanPerformance data

Conclusions

- We find that the likelihood of sale increases with risk along dimensions observable to banks but not likely observed or considered by investors.
 - Likelihood of sale increases along various dimensions of neighborhood risk
 - Likelihood of sale increases with ratio of loan amount to borrower income
 - A higher neighborhood delinquency rate *ex-post* is associated with increased likelihood of sale

- This evidence is suggestive of cherry picking behavior
 - However, we cannot rule out “lemons market” explanations