

Internet Appendix For “Collateral Misreporting in the RMBS Market”

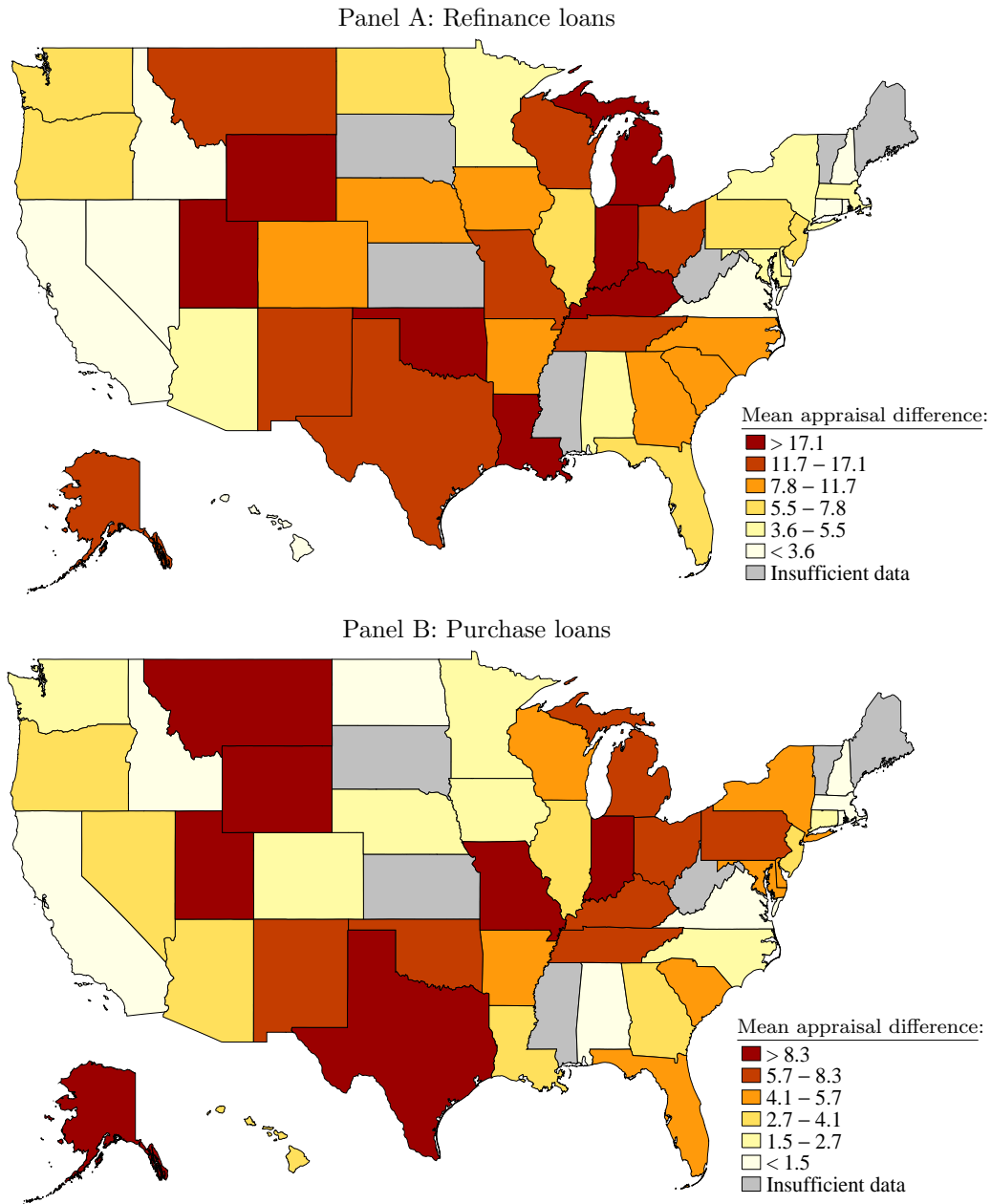
A. New Century-ABSNet matching description

We merge funded first-lien loans associated with single-unit properties in New Century data with those loans in ABSNet whose originator is either New Century Mortgage Corporation or its subsidiary, Home123 Corporation. We keep loans for which the lien position or the number of units in the underlying property are missing. This results in initial samples of 952,289 loans in the New Century data and 577,899 loans in ABSNet. We first match the loans based on their zip code, first payment date, interest rate type (fixed- or adjustable-rate mortgage), and purpose of transaction (purchase or refinance). Second, we require the New Century’s status date to be within 30 days from the loan origination date in ABSNet, and loan amounts and credit scores to be within a \$1,000 and 10 points, respectively. Third, we only consider the remaining loan pairs a match when it is unique. This procedure results in 363,623 unique matches, which represents 38.2% on the initial New Century data sample. Restricting the sample based on the criteria described in Section 1.1 results in a sample of 70,325 matched loans, which are described in Table IA.5.

To confirm the accuracy of our matching procedure, we repeat the matching exercise with all loans in ABSNet regardless of their originator. Using this methodology, we match 468,676 pairs of loans. Of the 363,623 pairs that we obtained through the original matching, 363,434 (99.95%) coincide with those obtained through the less restrictive matching procedure, which provides reassurance about the accuracy of the database merge.

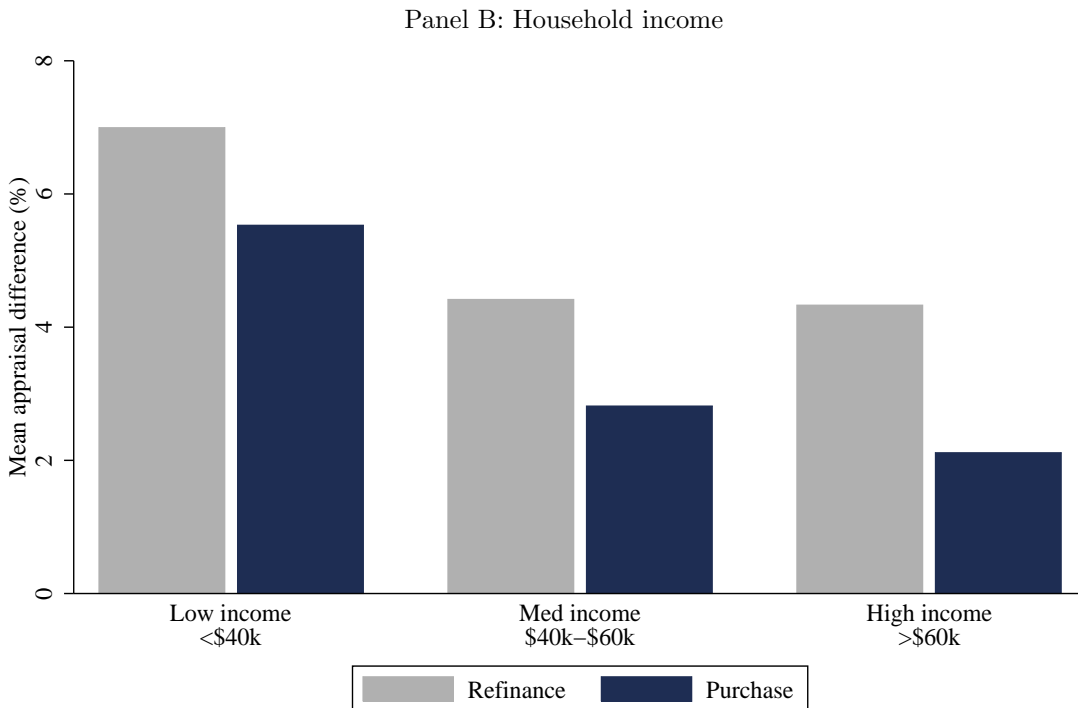
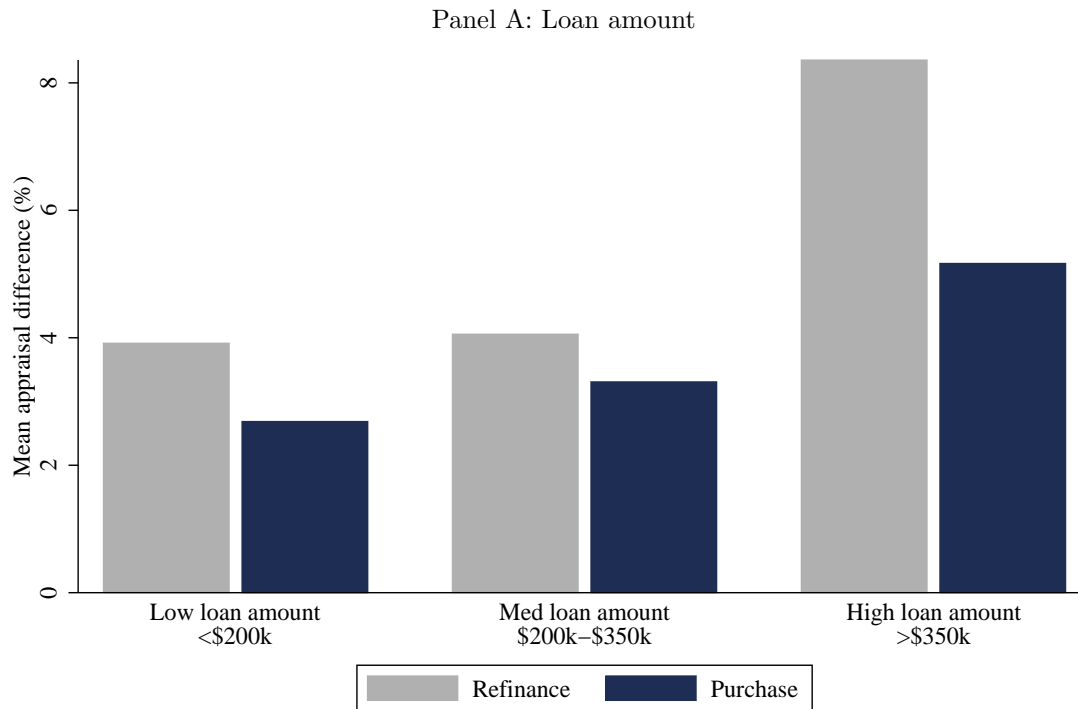
B. Supplemental figures and tables

Figure IA.1. Geographic distribution of appraisal differences



This figure plots average appraisal differences for refinance loans and purchase loans by state. Appraisal difference is defined as the difference between appraised value and AVM value, divided by the average of both values. States with less than one hundred observations are omitted.

Figure IA.2. Additional cross-sectional description of appraisal differences



This figure plots the average appraisal difference by loan amount, zip code-level income in 2001 (from the SOI IRS database), and zip code-level population density (from the 2000 Decennial Census). Appraisal difference is the difference between appraised value and AVM value, divided by the average of both values.

Figure IA.2 (continued). Additional cross-sectional description of appraisal difference

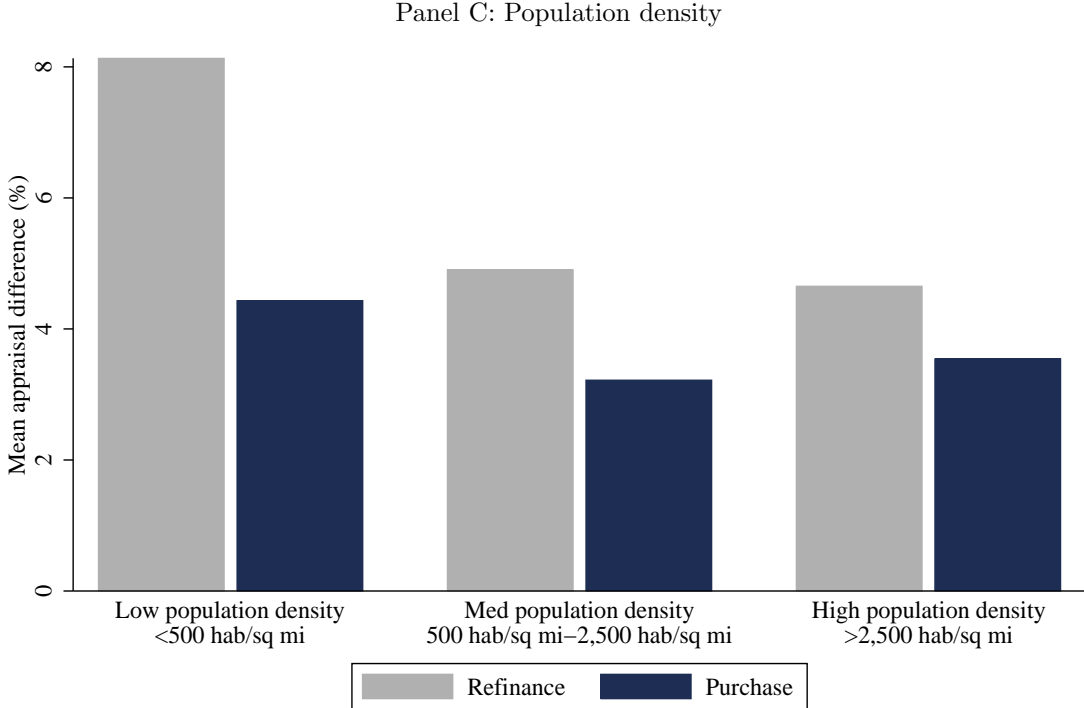
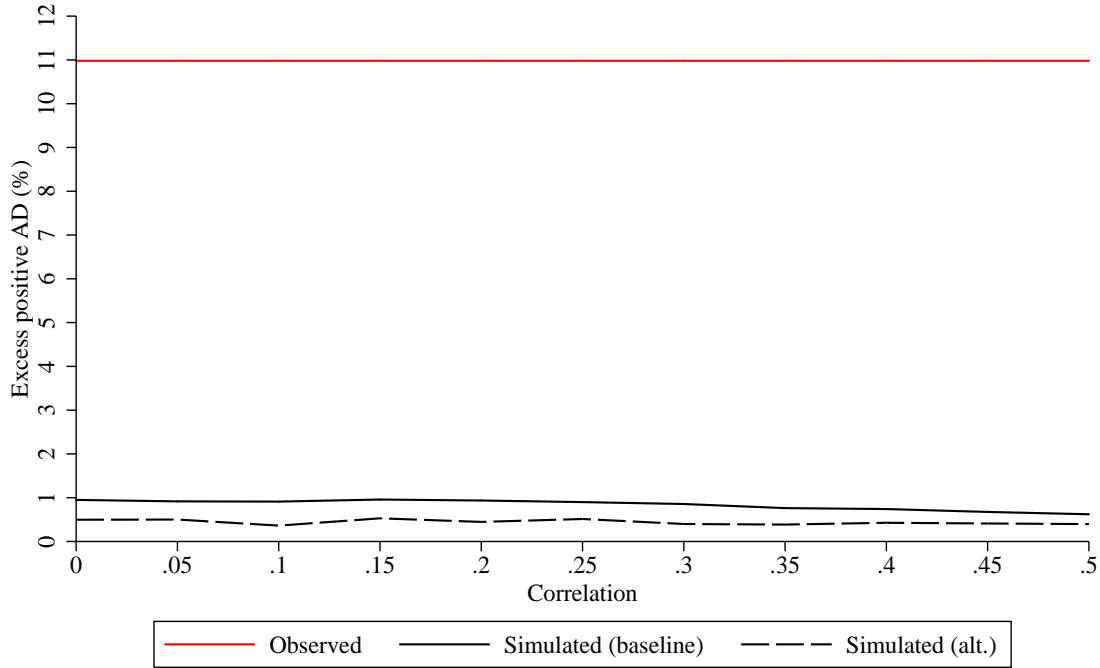
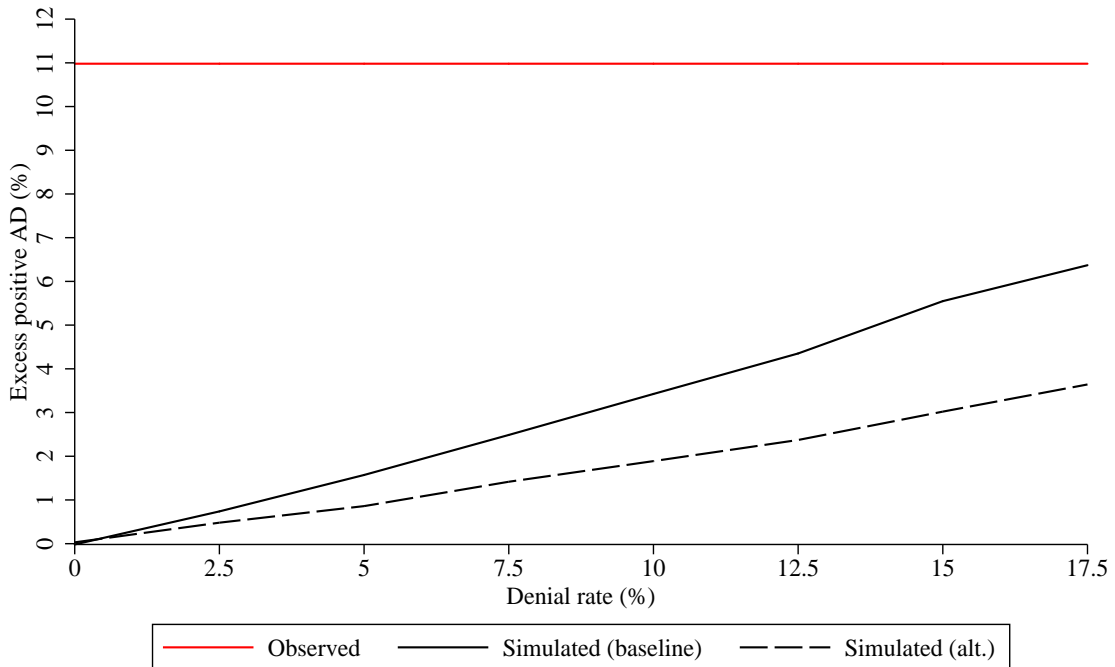


Figure IA.3. Simulation sensitivity analysis for refinance loans

Panel A: Sensitivity with respect to error correlations



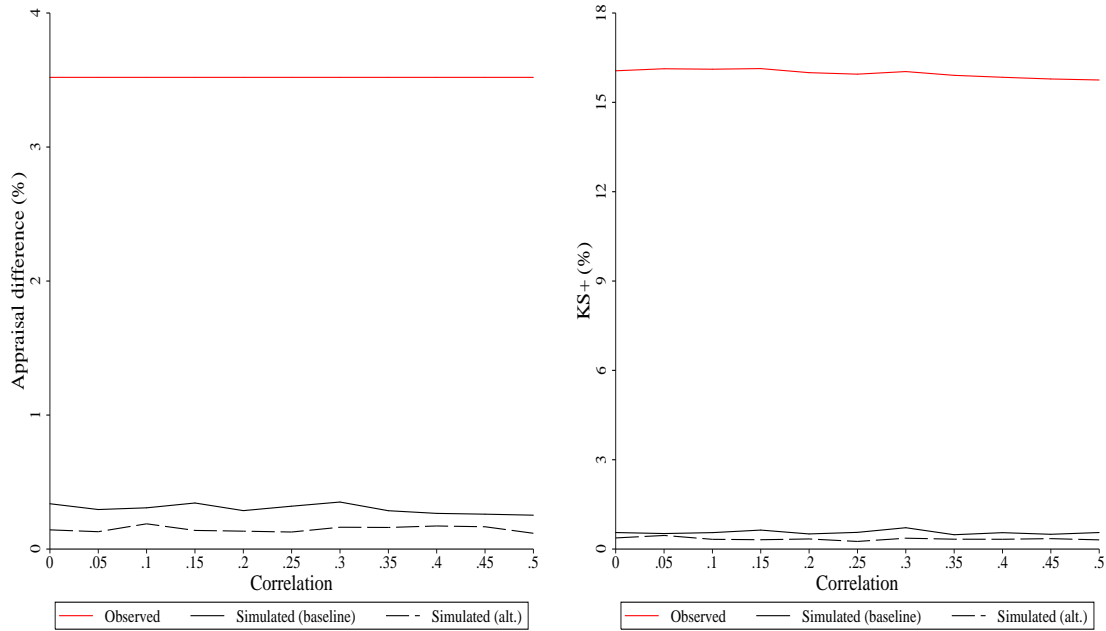
Panel B: Sensitivity with respect to denial rates



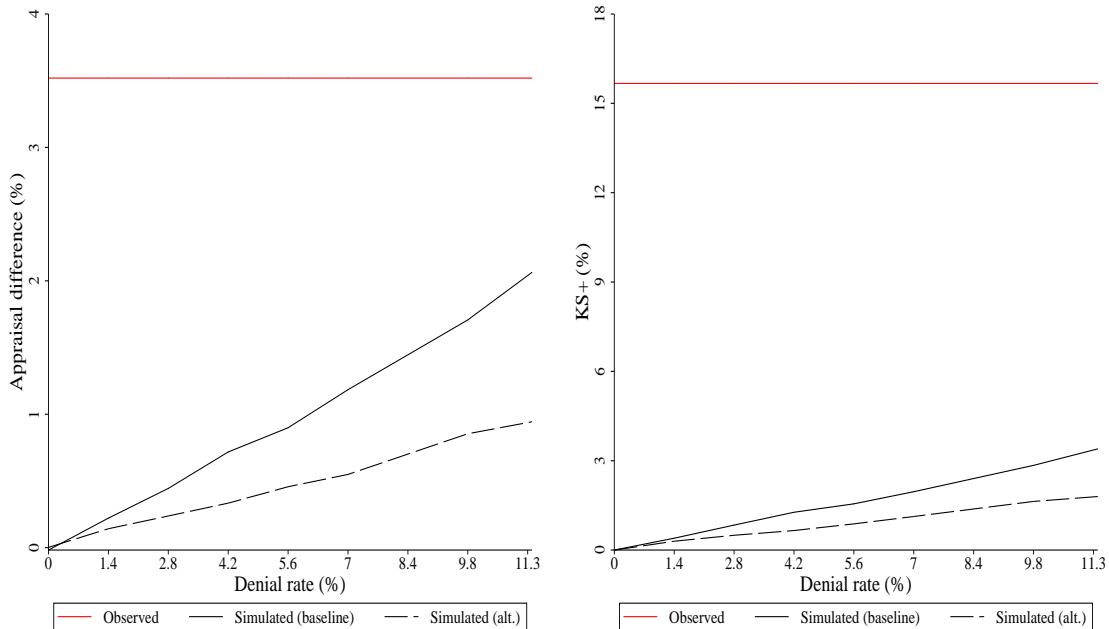
This figure plots refinance simulation results for excess positive AD under different assumptions regarding error correlations and denial rates. In the alternative simulations, we change the threshold for 100% origination probability from $A \geq V$ to $A \geq 1.25V$ while keeping the same linear structure for loan completion probability when appraisals are below the 1.25 V threshold. Excess positive appraisal difference measures the amount of appraisals that are higher than the AVM in excess of 50%.

Figure IA.4. Simulation sensitivity analysis for purchase loans

Panel A: Sensitivity with respect to error correlations

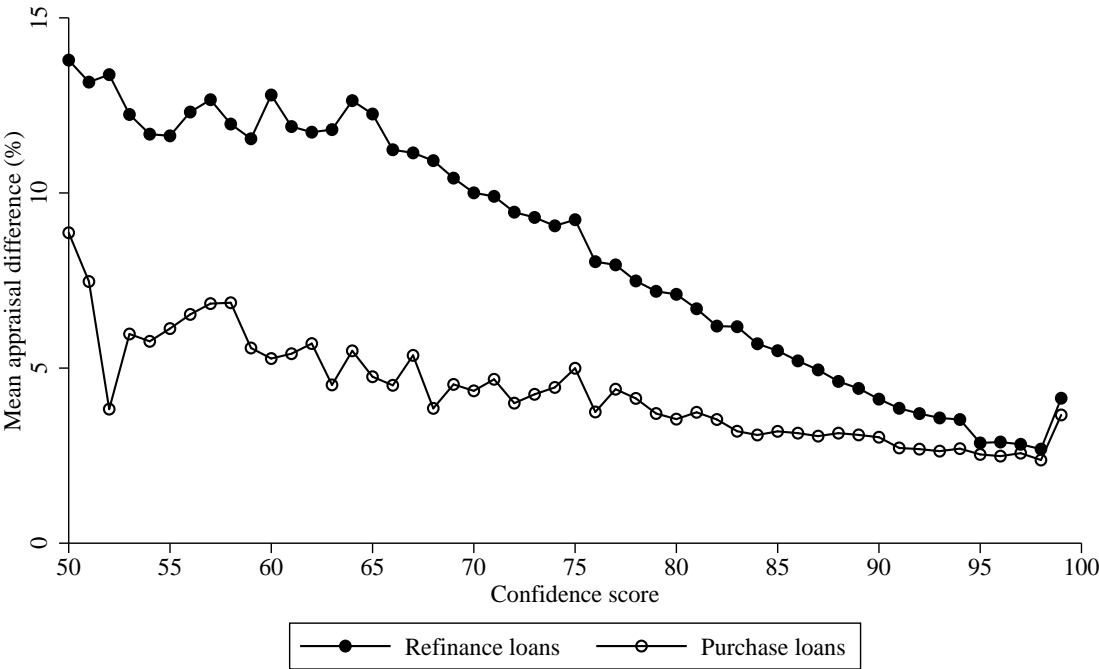


Panel B: Sensitivity with respect to denial rates



This figure plots purchase simulation results under different assumptions regarding error correlations and denial rates. In the alternative simulations, we change the threshold for 100% origination probability from $A \geq V$ to $A \geq 1.25V$ while keeping the same linear structure for loan completion probability when appraisals are below the $1.25V$ threshold. Appraisal difference is defined as the difference between appraised value and AVM value, divided by the average of both values. KS^+ measures maximum difference from the bias-free simulated distributions. Because KS^+ is computed relative to the bias-free simulation, observed KS^+ changes slightly across the correlation scenarios in Panel A.

Figure IA.5. Appraisal difference by confidence score



This figure plots the mean appraisal difference for refinance loans and purchase loans by AVM confidence score. Appraisal difference is the difference between appraised value and AVM value, divided by the average of both values.

Table IA.1. Appraisal bias and delinquency (CLTV ratios)

Panel A: Refinance loans				
	(1)	(2)	(3)	(4)
Mean delinquency	30.2	30.2	30.2	30.2
CLTV (%)	0.547*** (32.45)		0.491*** (28.46)	0.554*** (32.74)
Adjusted CLTV (%)		0.190*** (13.50)	0.058*** (16.94)	
Appraisal difference (%)				0.055*** (16.56)
Controls	yes	yes	yes	yes
CBSA \times Quarter FE	yes	yes	yes	yes
<i>N</i>	3,662,156	3,662,156	3,662,156	3,662,156
<i>R</i> ²	0.27	0.26	0.27	0.27
Panel B: Purchase loans				
	(1)	(2)	(3)	(4)
Mean delinquency	37.3	37.3	37.3	37.3
CLTV (%)	0.504*** (27.55)		0.398*** (22.50)	0.517*** (28.78)
Adjusted CLTV (%)		0.174*** (17.06)	0.108*** (17.86)	
Appraisal difference (%)				0.143*** (21.61)
Controls	yes	yes	yes	yes
CBSA \times Quarter FE	yes	yes	yes	yes
<i>N</i>	2,272,782	2,272,782	2,272,782	2,272,782
<i>R</i> ²	0.29	0.29	0.30	0.30

This table reports results from OLS regressions where the dependent variable is a dummy variable that takes the value of one if the loan became more than 90 days delinquent at any point in time between origination and September 2012, and zero otherwise. The explanatory variables of interest are reported and adjusted CLTV ratios, and the loan's appraisal difference. Reported CLTV ratios are from ABSNet data. Adjusted CLTV ratios are calculated by dividing original combined loan amount by AVM valuation. Control variables include indicators for full-doc loans, the presence of a prepayment penalty, owner occupied properties, complex loans, adjustable-rate loans, as well as credit score, loan amount, and interest rate at origination. Reported *t*-statistics in parentheses are heteroscedasticity-robust and clustered by CBSA. ****p* < 0.01, ***p* < 0.05, **p* < 0.1.

Table IA.2. Baseline simulation calibration parameters and appraisal bias moments

Panel A: Refinance loans			
	Data	Bias free simulation	Selection bias simulation
<i>Calibration parameters</i>			
σ_A	-	19.10	19.30
σ_{AVM}	-	19.10	19.30
β	-	0	0.33
<i>Appraisal bias moments</i>			
σ_{AD}	24.26	24.28	24.35
d	2.50	0	2.54
Mean AD	5.36	-0.04	0.57
AD>0-0.5	10.98	-0.05	0.79
KS ⁺	15.59	-	0.87
Mean (A-AVM)/AVM	9.28	3.07	3.74
(A-AVM)/AVM>0.20	21.28	21.96	22.70
(A-AVM)/AVM<-0.20	8.02	17.37	16.77
Panel B: Purchase loans			
	Data	Bias free simulation	Selection bias simulation
<i>Calibration parameters</i>			
σ_A	-	20.30	20.30
σ_{AVM}	-	20.30	20.30
β	-	0	0.21
<i>Appraisal bias moments</i>			
σ_{AD}	21.27	21.39	21.29
d	1.70	0.00	1.70
Mean AD	3.62	0.01	0.27
AD>0-0.5	7.56	0.08	0.47
KS ⁺	15.67	-	0.74
Mean (A-AVM)/AVM	6.69	2.41	2.65
(A-AVM)/AVM>0.20	14.95	18.80	19.06
(A-AVM)/AVM<-0.20	6.41	14.06	13.72

This table reports the parameter values and appraisal bias moments from the baseline simulations. Appraisal and AVM values are modeled as bivariate normal random variables with means of zero, equal error standard deviations, and correlations of 0.25 and 0.5 respectively for refinance and purchase loans. We calibrate error standard deviations for Appraisal and AVM such that the simulated appraisal difference (AD) standard deviations for refinance and purchase loans match their empirical counterparts. To model selection, we assume that loan completion probability is one if an appraisal is above the property's true value and is otherwise $\max(0, 1 - \beta(V - \max(0, A))/V)$, where V represents the property's true value and can be normalized to one. The parameter β is calibrated such that the simulation generates targeted denial rates of 2.5% for refinance loans and 1.7% for purchase loans, which are based on observed HMDA collateral denial rates. Excess positive appraisal difference measures the amount of appraisals that are higher than the AVM in excess of 50% and KS^+ measures the maximum differences from the bias-free simulated distributions.

Table IA.3. Simulation sensitivity analysis

Panel A: $A \geq V$ threshold for 100% loan completion probability

		Refinances			Purchases			
		Mean AD	Excess positive AD	KS ⁺	Mean AD	Excess positive AD	KS ⁺	
$\rho = 0$	d = 0	-0.01	0.03	0	d = 0	0.01	-0.01	0
	d = 2.5	0.57	0.89	0.89	d = 1.7	0.34	0.62	0.64
	d = 7.5	1.93	2.87	2.85	d = 4.9	1.04	1.83	1.86
	d = 12.5	3.50	5.08	5.05	d = 8.1	1.88	3.19	3.23
	d = 17.5	5.31	7.47	7.53	d = 11.3	2.72	4.56	4.58
$\rho = 0.25$	d = 0	-0.04	-0.05	0	d = 0	0.01	0.03	0
	d = 2.5	0.57	0.79	0.87	d = 1.7	0.32	0.53	0.52
	d = 7.5	1.67	2.48	2.54	d = 4.9	0.93	1.58	1.55
	d = 12.5	3.09	4.39	4.47	d = 8.1	1.62	2.71	2.71
	d = 17.5	4.67	6.47	6.58	d = 11.3	2.40	3.98	3.96
$\rho = 0.5$	d = 0	-0.06	-0.12	0	d = 0	0.01	0.08	0
	d = 2.5	0.44	0.60	0.74	d = 1.7	0.27	0.47	0.74
	d = 7.5	1.42	2.00	2.14	d = 4.9	0.78	1.29	2.14
	d = 12.5	2.62	3.57	3.70	d = 8.1	1.36	2.21	3.70
	d = 17.5	3.94	5.27	5.51	d = 11.3	2.03	3.17	5.51

Panel B: $A \geq 1.25V$ threshold for 100% loan completion probability

		Refinances			Purchases			
		Mean AD	Excess positive AD	KS ⁺	Mean AD	Excess positive AD	KS ⁺	
$\rho = 0$	d = 0	0.02	0.05	0	d = 0	-0.04	-0.07	0
	d = 2.5	0.26	0.47	0.46	d = 1.7	0.12	0.18	0.42
	d = 7.5	0.88	1.50	1.50	d = 4.9	0.44	0.84	0.95
	d = 12.5	1.60	2.67	2.66	d = 8.1	0.80	1.47	1.59
	d = 17.5	2.38	3.91	3.90	d = 11.3	1.11	2.07	2.16
$\rho = 0.25$	d = 0	0.00	0.01	0	d = 0	-0.02	-0.04	0
	d = 2.5	0.26	0.43	0.49	d = 1.7	0.15	0.28	0.40
	d = 7.5	0.80	1.31	1.34	d = 4.9	0.41	0.77	0.83
	d = 12.5	1.47	2.40	2.41	d = 8.1	0.77	1.47	1.51
	d = 17.5	2.28	3.69	3.68	d = 11.3	1.08	2.02	2.07
$\rho = 0.5$	d = 0	0.02	0.00	0	d = 0	0.04	0.06	0
	d = 2.5	0.29	0.52	0.53	d = 1.7	0.14	0.27	0.53
	d = 7.5	0.79	1.23	1.24	d = 4.9	0.36	0.69	1.24
	d = 12.5	1.30	2.10	2.10	d = 8.1	0.67	1.24	2.10
	d = 17.5	2.12	3.40	3.40	d = 11.3	0.98	1.77	3.40

This table reports sensitivity analysis for the correlation, denial rate, and appraisal thresholds assumptions discussed in Section 3.1. In total, we consider 15 permutations under both baseline and alternative appraisal thresholds. Appraisal and AVM values are modelled as bivariate normal random variables with means of zero and equal error standard deviations. We calibrate error standard deviations for Appraisal and AVM such that the simulated appraisal difference (AD) standard deviations for refinance and purchase loans match their empirical counterparts. To model selection, we assume that loan completion probability is one if an appraisal is above the property’s true value and is otherwise $\max(0, 1 - \beta(V - \max(0, A))/V)$, where V represents the property’s true value and can be normalized to one. The parameter β is calibrated such that the simulation generates a targeted denial rate. Excess positive appraisal difference measures the amount of appraisals that are higher than the AVM in excess of 50% and KS^+ measures the maximum differences from the bias-free simulated distributions.

Table IA.4. New Century unfunded loan application summary statistics

Variables	Refinance loans N = 976,737		Purchase loans N = 300,223	
	Mean	SD	Mean	SD
<i>Appraisal bias measures</i>				
Appraisal-price difference (%)	-	-	2.0	20.4
Appraisal-price difference ≥ 0 (d,%)	-	-	98.0	-
<i>Loan/borrower characteristics</i>				
Loan amount (\$000)	172.8	124.8	201.5	143.4
LTV (%)	77.3	14.57	85.6	9.8
ARM (d,%)	65.5	-	78.5	-
Prepayment penalty (d,%)	71	-	72.1	-
Owner occupied (d,%)	95.8	-	79.7	-
Interest rate (%)	7.5	2.1	7.6	2.0

This table reports summary statistics for the sample of unfunded loan applications from New Century internal records. The sample consists of first-lien loan applications submitted between 2001 and 2007 for purchase or refinancing with original loan balances between \$30k and \$1 million. Loans with original LTV ratios over 103% or with CLTV ratios below 25%, as well as loans reported as being for homes of over one unit are excluded. FHA and VA loans are also dropped. Appraisal-price difference is the difference between appraisal and the property's purchase price divided by the purchase price.

Table IA.5. New Century-ABSNet merged data summary statistics

Variables	All loans <i>N</i> = 70,325		Refinance loans <i>N</i> = 53,330		Purchase loans <i>N</i> = 16,995	
	Mean	SD	Mean	SD	Mean	SD
<i>Appraisal bias measures</i>						
Appraisal difference (AD) (%)	4.63	22.3	4.85	22.5	3.96	21.7
AD>0 (d,%)	60.7	-	62.0	-	56.7	-
<i>Loan/borrower characteristics</i>						
Purchase loan (d,%)	24.2	-	-	-	-	-
Loan amount (\$000s)	223.3	130.8	217.7	125.9	240.8	143.6
FICO score	608.8	59	598.5	56.3	641.3	56.6
LTV (%)	78.8	11.9	77.5	12.8	82.5	7.2
ARM (d,%)	74.5	-	70.5	-	87	-
Full documentation (d,%)	58.7	-	63.3	-	44.1	-
Prepayment penalty (d,%)	58	-	56.3	-	63.5	-
Owner occupied (d,%)	92.7	-	94.4	-	87.6	-
Complex (d,%)	0.003	-	0.000	-	0.012	-
Interest rate (%)	7.8	1.2	7.8	1.2	7.9	1.2
<i>Loan performance</i>						
Delinquent 90+ before Sep. 2012 (d,%)	48.9	-	44.6	-	62.5	-

This table reports summary statistics for the sample of New Century-ABSnet matched loans. We match the loans in the two datasets based on their zip code, loan size, first payment date, purpose, type of interest rate (fixed or floating), and credit score, and we require matches to be unique. A more detailed description is available in Internet Appendix A