Complex Mortgages

Gene Amromin, Federal Reserve Bank of Chicago
Jennifer Huang, Cheung Kong Graduate School of Business
Clemens Sialm, University of Texas-Austin and NBER
Edward Zhong, University of Wisconsin

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Complex mortgages and the housing crisis

"The availability of these alternative mortgage products [interest-only ARMs, negative amortization ARMs, pay-option ARMs] proved to be quite important and, as many have recognized, is likely a key explanation of the housing bubble."

Ben S. Bernanke

AEA Meetings, January 3rd, 2010

Motivation

- Over the last decade the residential mortgage market has experienced a significant increase in product complexity (followed by reversion to 'vanilla' products)

- Much of the product innovation focused on products with <u>deferred amortization schedules</u>

  - "Complex" b/c they add an extra element of uncertainty; lower monthly servicing costs at the expense of higher leverage

- Mortgage securitization and the extension of credit to subprime borrowers have received a lot of attention; the contract design of mortgages remains largely unexplored

Composition of mortgages over time
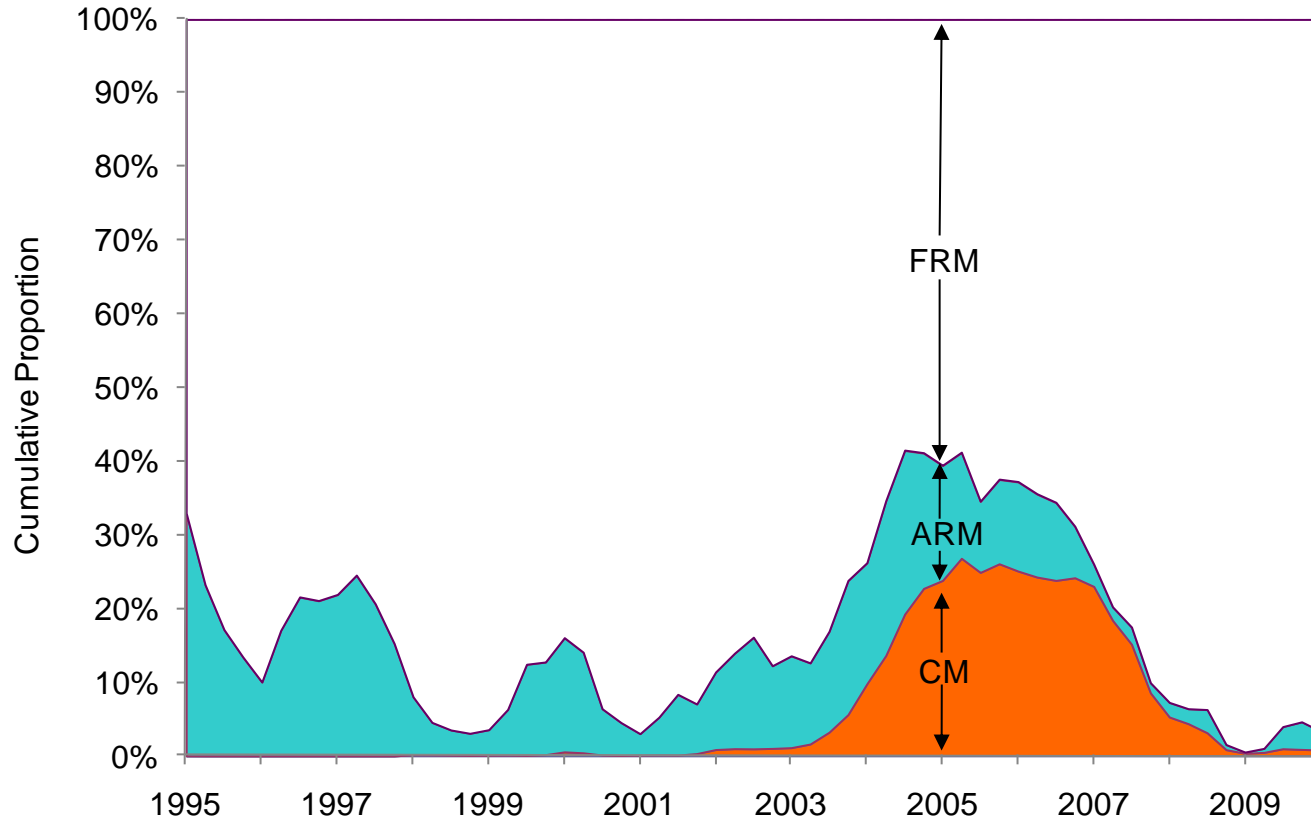
- A welfare-improving innovation (e.g. hat)?
- … or something that may be difficult to digest later on?

Le Petit Prince
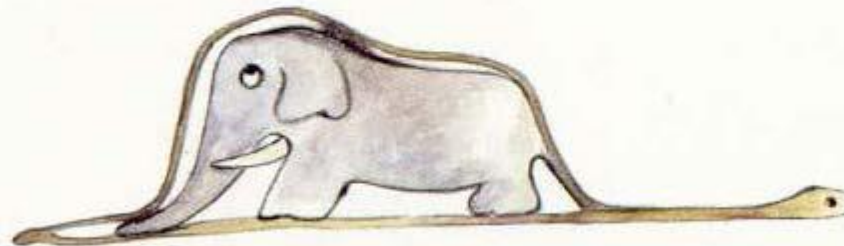
Rationales for complex mortgages

- **CMs as non-transparent contracts**
  - obfuscate the true borrowing costs and fool unsophisticated borrowers into suboptimal contracts
  - Carlin (2009); Carlin and Manso (2009)

- **CMs as optimal contracts**
  - for borrowers and lenders that expect higher growth rate or higher volatility in house prices and incomes
  - for borrowers who maximize the value of their default option
  - Barlevy and Fisher (2010), Piskorski and Tchistyi (2010), Corbae and Quintin (2010), Cocco (2013), Garmaise (2013)

Main questions

- **Who took out such contracts?**
  - Households with high (stated) incomes and prime credit scores
  - To purchase more expensive homes relative to income

- **Where? Which theory is consistent with this?**
  - Areas with higher proportion of young households, higher house price appreciation, and higher population growth
  - In non-recourse states, investment properties, incomplete docs

- **What followed?**
  - Higher default rates: payment resets and greater leverage
  - Unobservable borrower characteristics appear to play a role too
    - CM borrowers more sensitive to the value of the default option
    - Less sensitive to income and credit scores
    - More likely to stop payments abruptly

What are these mortgages?

- Fixed-rate mortgages (FRM): fixed interest rate, principal amortized over a pre-specified term (usually 30 years)

- Adjustable-rate mortgages (ARM): interest rate resets at pre-specified frequency; also amortize principal

- Complex mortgages (CM) are (mostly) ARMs: the principal does not amortize over a pre-specified horizon or is allowed to increase

  - Interest only (IO): fixed interest over n years, then ARM that amortizes over 30-n

  - OptionARM (NegAm): Required minimum payment < IO payment

    - Minimum payment can only increase by 7.5% a year unless…
    - … a loan reverts to an amortizing ARM if one of two conditions is met:
      - after n months elapse (n is usually 60)
      - LTV ratio breaches the pre-specified limit (110 to 125)

An illustration of CM

Panel A: Annual Mortgage Payment
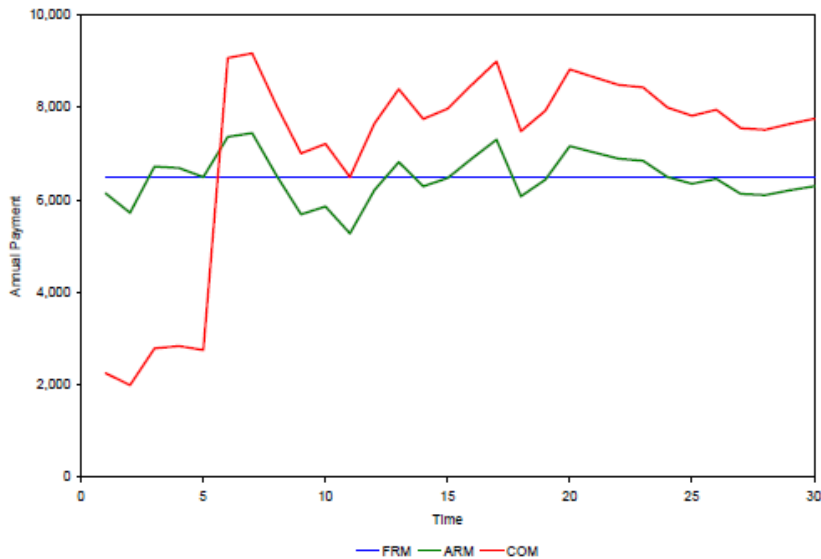
Panel B: Remaining Loan Balance
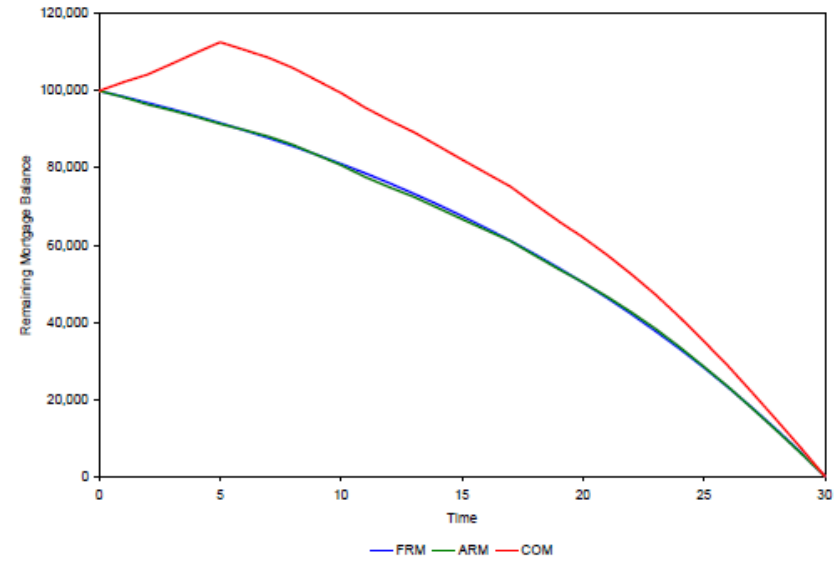
- CM payments are much more likely to jump because of amortization kick-in
- CM lead to greater leverage ratios for any path of housing prices

$100,000 balance, 30-year amortization; FRM rate fixed at 5%, initial ARM rate at 4.5%, spread to T-bill is 150bp, floor of 2% and cap of 7%. Simulated Treasury rate follows an AR(1) estimated for 1927-2009. Option ARM pays 50% of the interest payment over the first 5 years, becomes an ARM with a 25-year amortization schedule thereafter

Data

- Representative sample of U.S. mortgage loans originated between 2003 and 2007 from LPS Analytics

- Income data from HMDA

- Quarterly MSA-level HPI data from the Federal Housing Finance Agency (FHFA)

- Quarterly county level unemployment rate data from the BLS

- Annual county-level population data from the BEA

- Local demographic characteristics from the 2000 U.S. Census

Summary statistics by mortgage type

	All Mortgages			Complex Mortgages	
	FRM	ARM	CM	IO	NEGAM
Number of Observations	6,744,639	1,242,097	1,733,516	1,356,330	377,186
Loan Level Variables at Origination:					
Loan Amount	180,938	223,838	334,277	328,600	354,691
House Value	268,087	310,377	473,833	465,045	505,433
Income	88,329	100,218	133,481	131,066	142,168
Income with Full Documentation	86,049	95,967	117,904	117,195	121,320
FICO	710.14	681.69	713.18	714.89	707.04
FICO Below 620 (in %)	9.85	23.18	5.97	6.65	3.54
First Lien Loan to Value (LTV)	73.62	76.74	73.29	73.53	72.44
Value to Income (VTI)	3.50	3.54	4.16	4.15	4.23
Initial Interest Rate (in %)	6.15	6.15	5.03	5.92	1.86
Refinance (in %)	41.38	35.42	44.91	39.71	63.61
Condo (in %)	11.37	16.70	18.63	19.57	15.25
Investment Property (in %)	9.05	9.76	11.50	11.63	11.03
Low Documentation (in %)	11.13	11.96	24.94	19.99	42.72
Government Securitized (in %)	79.04	40.28	25.56	31.06	5.81
Private Securitized (in %)	15.05	42.10	53.15	51.94	57.48
With Prepayment Penalty (in %)	5.76	26.62	32.77	19.31	81.19
Above Conforming Limit (in %)	5.22	14.00	33.42	31.67	39.71

Mortgage choice

	State Fixed Effects		Lender Fixed Effects	
	ARM	CM	ARM	CM
Log(Inc)	0.214**	0.442**	0.248**	0.459**
	(0.009)	(0.013)	(0.013)	(0.015)
FICO	−0.520**	−0.035**	−0.455**	0.042**
	(0.011)	(0.008)	(0.010)	(0.009)
LTV	0.207**	0.350**	0.312**	0.433**
	(0.019)	(0.032)	(0.016)	(0.028)
VTI	0.155**	0.279**	0.233**	0.385**
	(0.013)	(0.016)	(0.023)	(0.027)
Low Doc	0.143**	0.815**	0.178**	0.528**
	(0.037)	(0.045)	(0.033)	(0.039)
Above Limit	0.697**	1.129**	0.580**	1.132**
	(0.039)	(0.037)	(0.048)	(0.067)
Condo	0.389**	0.415**	0.490**	0.501**
	(0.030)	(0.024)	(0.047)	(0.041)
Investment	0.328**	0.167**	0.318**	0.343**
	(0.018)	(0.028)	(0.019)	(0.029)
Refinance	−0.302**	0.094*	−0.203**	0.044
	(0.019)	(0.039)	(0.019)	(0.047)
College	0.117**	0.052**	0.125**	0.083**
	(0.009)	(0.012)	(0.012)	(0.020)
Young	0.087**	0.062**	0.081**	0.086**
	(0.010)	(0.008)	(0.014)	(0.015)
Price Change	0.151**	0.278**	0.016	0.300**
	(0.029)	(0.031)	(0.026)	(0.034)
Pop Growth	0.026	0.068**	0.030	0.131**
	(0.017)	(0.024)	(0.025)	(0.038)
Log(BEA Inc)	0.140**	0.234**	0.087**	0.139**
	(0.020)	(0.030)	(0.027)	(0.039)
Non-Recourse			0.250**	0.502**
			(0.047)	(0.077)
Year Dummies	Yes		Yes	
State Dummies	Yes		No	
Lender Dummies	No		Yes	
Observations	8,915,275		7,538,406	

- multinomial logit model: CM v. FRM v. ARM

- Not poor & naïve

- Help with affordability

- More optimistic

- Self-selected (less averse to strategic defaults?)

Mortgage choice: robustness

- These results are robust to limiting the sample to …

  - loans with full documentation, portfolio loans

  - Investment properties, subprime borrowers

  - Purchase transactions, non-California loans

- Stronger for contracts that are "more" complex, i.e. for NegAm loans as compared to IOs

Contract choice and delinquency: hazard rate
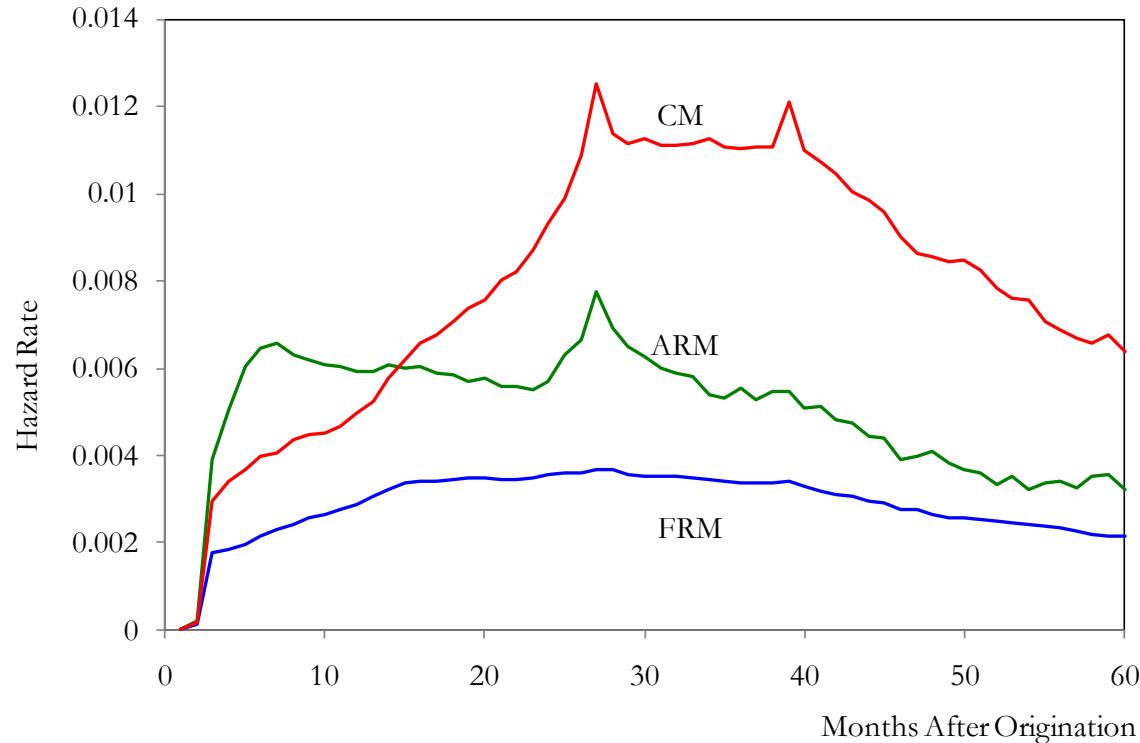
- Share becoming 60+dpd in month t conditional on being performing in $t-1$

- From about 15 months on, CM hazard rates are uniformly the highest

- Funny peaks following 2 and 3 year anniversaries

Contract choice and delinquency: regressions

- Cox proportional hazard model of first time default (60+dpd), allow baseline hazard to vary by state and year of origination

- Why might we expect CMs to default more?
  - additional payment shocks
  - higher LTV
  - possible self-selection: attract households that may be more risk-seeking, subject to greater background risk, more willing to default

- Include time-varying loan and macro characteristics
  - Change in required payments, change in house value and loan amount, MSA-level unemployment and income growth

- 2003-2007 McHMDA originations, performance observed through 2009

Hazard regression results

VARIABLES	MSA-Level Covariates	
CM	0.698**	
	(0.012)	
IO		0.659**
		(0.013)
NEGAM		0.938**
		(0.020)
Payment resets	0.031**	0.025**
	(0.002)	(0.002)
House Price Growth	-0.406**	-0.406**
	(0.020)	(0.020)
Loan Balance Growth	0.016	-0.002
	(0.012)	(0.012)
Income growth	-0.150**	-0.152**
	(0.024)	(0.024)
Unemployment	0.020	0.020
	(0.013)	(0.012)
ARM	0.456**	0.460**
	(0.010)	(0.010)
Log (income)	-0.058**	-0.062**
	(0.010)	(0.010)
FICO	-0.662**	-0.664**
	(0.012)	(0.012)

- Payment resets are associated with higher delinquency hazard rates
- … as are decreases in house prices or incomes

- Yet, CMs have higher delinquency rates with all of these controls in place
- The impact of having a CM on delinquency status is similar to that of a 1 std decrease in FICO score
- About twice as high as for a similar FRM borrower ($e^{0.698}$=2)

What could explain higher CM delinquencies?

CM	0.697**
	(0.013)
CM x LTV	0.108**
	(0.020)
CM x Log(income)	0.083**
	(0.009)
CM x FICO	0.078**
	(0.012)
ARM	0.452**
	(0.010)
Log (income)	-0.078**
	(0.010)
FICO	-0.679**
	(0.010)
LTV	0.472**
	(0.010)
State-year baselines	Yes
Other controls	Yes
N	23,151,288

- Suggestive evidence that CM borrowers differ in their risk taking and willingness to default. How can we test this?
- Interact CM with measures of gains from default and sophistication

- Defaults by CM borrowers are more sensitive to gain from default

- The default gap between CM and FRM borrowers is <u>largest</u> for the more affluent and more creditworthy households
  - i.e. more sophisticated CM borrowers are the ones to default more

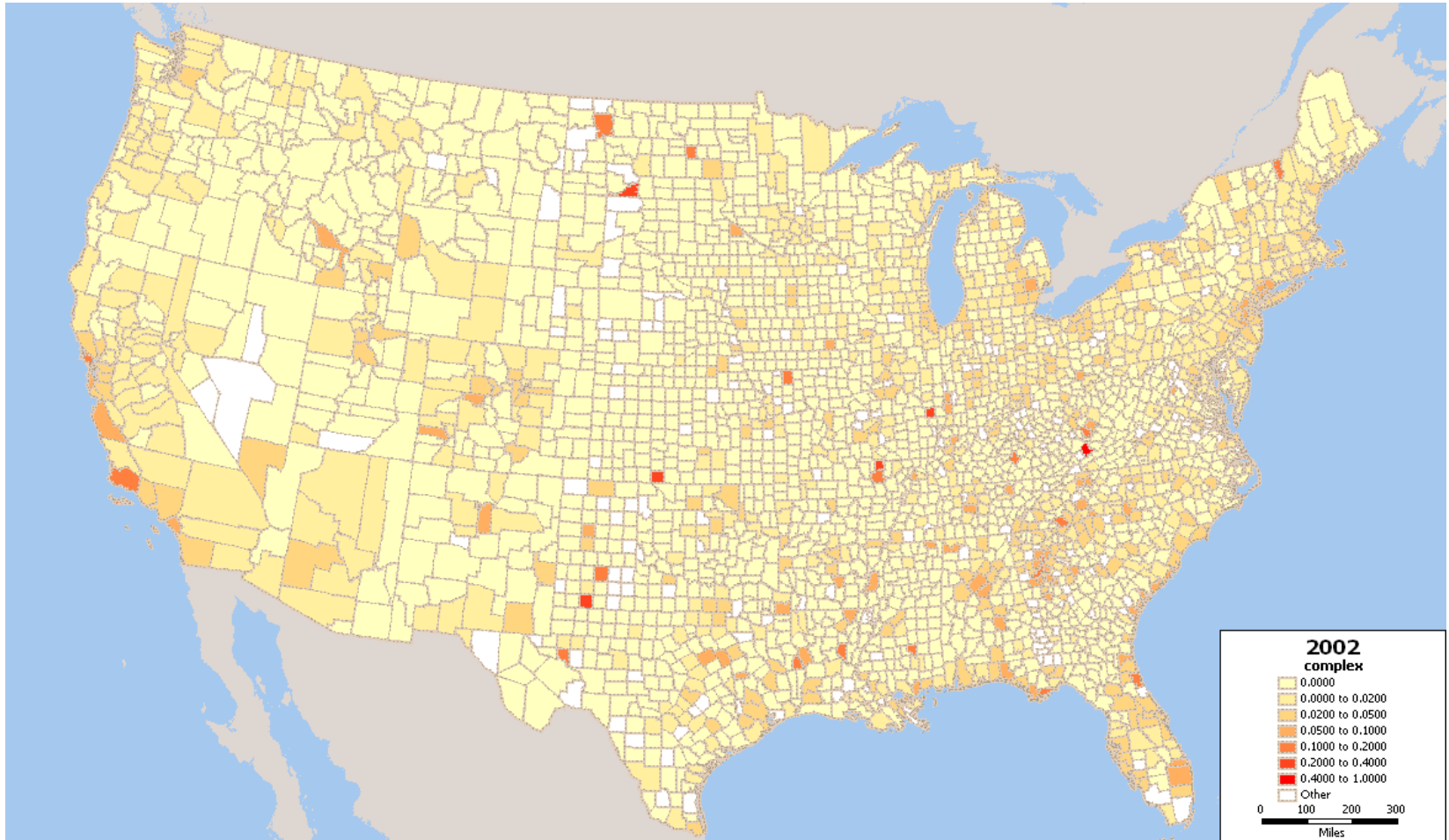# Payment patterns following initial delinquency

	No additional payments given delinquency
CM	0.629**
	(0.019)
ARM	0.435**
	(0.013)
Log (income)	0.197**
	(0.017)
FICO	0.375**
	(0.006)
LTV	0.281**
	(0.011)
VTI	0.120**
	(0.018)
Low doc	0.054**
	(0.013)
Jumbo	0.025
	(0.036)
Condo	0.287**
	(0.042)
Investor	0.511**
	(0.030)
Refinance	0.014
	(0.013)
Observations	1,525,404

- Initial delinquency less likely to be strategic for households who try to get back on track

- CM borrowers are more likely to not make any additional payments after first becoming 60+ days past due
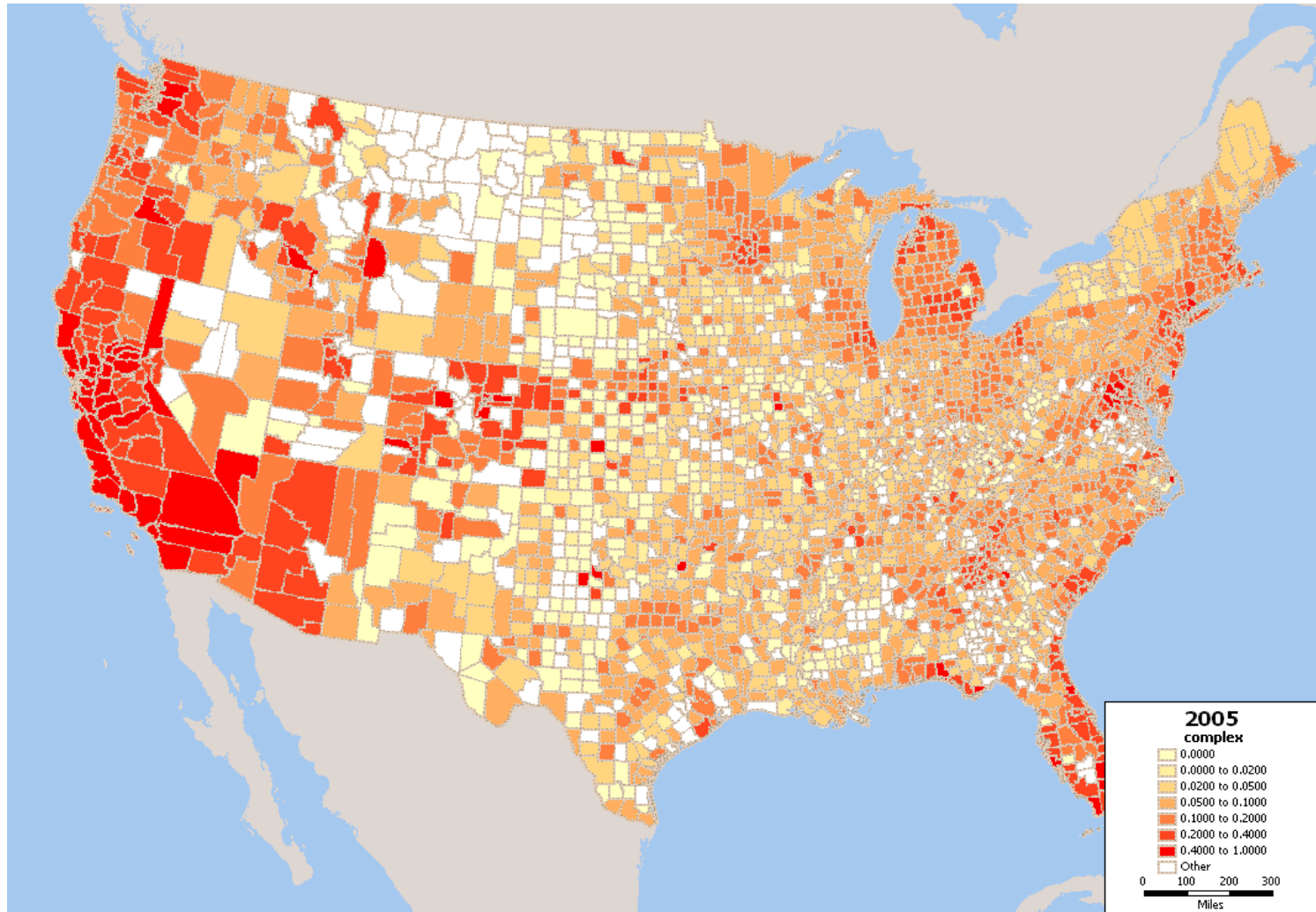
Summary and conclusions

- Complex mortgages are chosen by creditworthy households seeking to purchase more expensive homes relative to their incomes

- There is little evidence consistent with the notion that CM borrowers are naïve households bamboozled by unscrupulous lenders

- CM borrowers experience substantially higher ex post default rates after controlling for a number of borrower, loan, and macro factors

- These rates cannot be explained by payment resets or higher LTVs associated with non-amortizing loans

- Highest sensitivity to gains from default, higher default gap for more sophisticated CM borrowers, and higher propensity to default abruptly are consistent with CMs attracting borrowers who are more strategic in the default decisions

Geographic distribution of CM: 2002

Geographic distribution of CM: 2005

Geographic distribution of CM: 2008

2008
complex
0.0000
0.0000 to 0.0200
0.0200 to 0.0500
0.0500 to 0.1000
0.1000 to 0.2000
0.2000 to 0.4000
0.4000 to 1.0000
Other

0 100 200 300
Miles