Financial Literacy and Subprime Mortgage Delinquency

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April, 2009

What Caused Delinquencies?

Source: The Economist.

Cognitive Ability and Credit Markets

Many market commentators have claimed that borrowers made uninformed decisions:

"Many (. . .) buyers who took out high loan-to-value mortgages with adjustable rates did not have ready access to information about what they were doing (. . .) and so made serious mistakes"
(Robert Shiller in *Wall Street Journal*, October 9th, 2008)

"Take the greed and the financial misrepresentation out of it, and the root of this crisis is massive levels of financial illiteracy"
(John Bryant in *The Economist*, April 3rd, 2008)

The Effect of Limited Financial Literacy

- Limited financial literacy may cause . . .
  - Inappropriate reaction to income / consumption shocks
  - Gullibility when confronted with complicated contracts
  - Impatience, because interest rate seems low in short run
  - Inability to compare and contrast different options

- Recent research in other contexts suggests numerical ability is associated with worse consumption / savings outcomes (Banks and Oldfield, 2007; Lusardi and Mitchell, 2009)
- Very little evidence in the context of mortgage/housing markets

$\rightarrow$ Is numerical ability also associated with mortgage defaults?

Research Question 1

Does numerical ability predict delinquency and default of mortgages?
- Robust controlling for education and other cognitive skills?

- We conducted a survey with borrowers and asked
  - info about mortgage
  - socio-demographics
  - preference parameters
  - cognitive ability
  - numerical ability
  - . . .
- . . . and then match it to data from the registry of deeds and loan performance data

Research Question 2

What is the channel of this effect?

- Do individuals with poor numerical abilities have mortgages with riskier terms?

- We have accurate measurements of the mortgage terms, as well as the total LTV (including other possible mortgages)

Sampling strategy

- Combine LP and registry of deeds data for MA, CT and RI
  - LoanPerformance (LP): FICO at origination, details of mortgage conditions, monthly updates on payments
  - Registry of deeds: full history (incl. other mortgages) of property

- For matched first-lien, subprime mortgages issued in '06 and '07:
  - We cold-called 3,523 homeowners (using USAPeopleSearch.com); 1,043 dead phone numbers
  - We also mailed invitation to 4,996 addresses if we had no phone number
  - Participants were paid $20 for completing the phone survey
- $\rightarrow$ N=339

Checking Sample Selection

No differences between respondents and non-respondents in . . .

- FICO Score
- Fixed-Rate Mortgage
- Interest-Only
- Balloon Payment
- Refinance mortgage
- Loan-to-Value Ratio
- Amount of Mortgage
- Initial interest rate
- Debt-to-Income Ratio
- Full-Doc Status
- Foreclosure after mailing went out

Information from Survey

- Three measures of "financial literacy":
  1. Numerical ability using method of Banks and Oldfield (2007)
  2. Economic literacy questions (Lusardi and Mitchell, 2009)
  3. General cognitive ability using a verbal fluency measure (Dohmen et al, 2007) that correlates highly with IQ

- Preference parameters: Hypothetical questions to calculate discount factors, present-bias, and risk aversion

- Experience with mortgages: Experience and search strategy

- Socio-demographics characteristics: Education, gender, race, age, etc.

- Income

Measuring Numerical Ability

Numerical Ability Questions (Banks and Oldfield, 2007)

1. In a sale, a shop is selling all items at half price. Before the sale, a sofa costs $300. How much will it cost in the sale?

2. If the chance of getting a disease is 10 per cent, how many people out of 1,000 would be expected to get the disease?

3. A second hand car dealer is selling a car for $6,000. This is two-thirds of what it cost new. How much did the car cost new?

4. If 5 people all have the winning numbers in the lottery and the prize is $2 million, how much will each of them get?

5. Let's say you have $200 in a savings account. The account earns ten per cent interest per year. How much will you have in the account at the end of two years?

Banks and Oldfield (2007) suggest division into four groups:

	Group			
	1	2	3	4
This study:	15.6%	53.9%	17.1%	13.3%
Banks and Oldfield (2007):	16.2%	46.6%	26.8%	11.1%

Correlation Between Measures of Cognitive Ability

	Numerical ability group	Verbal IQ measure	Savings scenario	Inflation scenario
Verbal IQ measure	0.356	1		
	(0.000)			
Savings Q corr. (DV)	0.236	0.153	1	
	(0.000)	(0.005)		
Inflation Q corr. (DV)	0.273	0.251	0.093	1
	(0.000)	(0.000)	(0.087)	
Reaction time in	-0.279	-0.303	-0.157	-0.207
NA questions	(0.000)	(0.000)	(0.004)	(0.000)

Notes: $N = 339$. *p*-values in parentheses. A factor analysis performed on these correlations reveals one common factor ($\lambda = 1.17$), while all other eigenvalues are less than 0.005.

Individual characteristics
Means by numerical ability group

|	Financial Literacy Group			
	1	2	3	4
Born in U.S. (DV)	0.74	0.84	0.86	0.91
African-American (DV)	0.32	0.20	0.14	0.07
Hispanic (DV)	0.17	0.06	0.05	0.04
High school or less (DV)	0.49	0.29	0.10	0.04
Income ($ thousands)	51.6	69.4	100.6	127.1
	(9.9)	(33.3)	(63.3)	(98.9)
Credit score (FICO)	625	632	624	650
at origination of loan	(49)	(62)	(59)	(72)

Notes: numbers in parentheses are standard deviations.
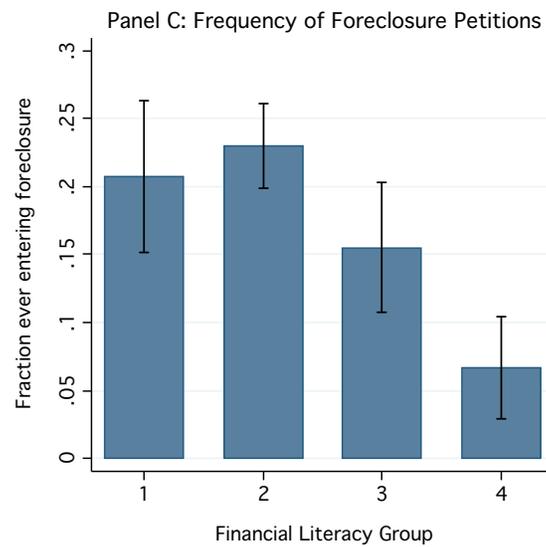
Knowledge About Mortgage Terms
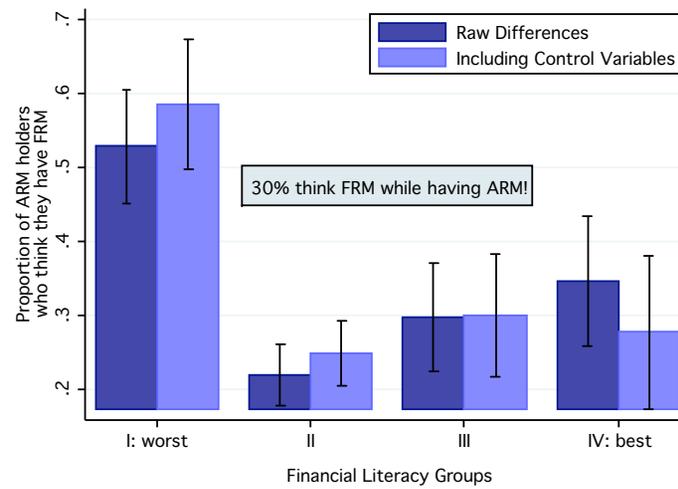
Note: N = 208. Control variables: Socio-demographics.

Raw Correlations: % of Time Delinquent (N=339)

Panel A: Percent of Time Delinquent
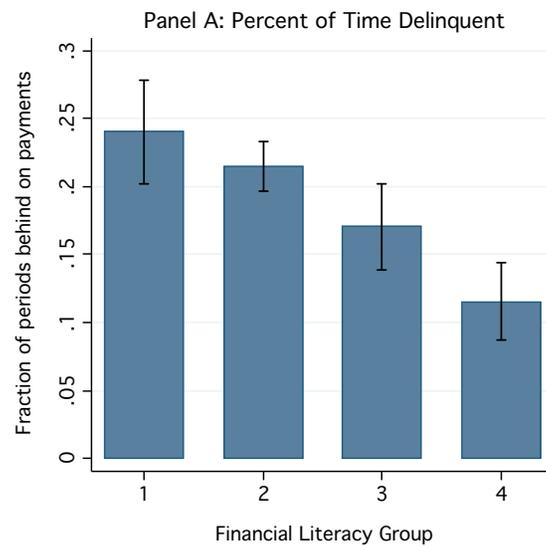
Raw Correlations: Frequency of Foreclosure Petitions

Panel C: Frequency of Foreclosure Petitions

Interpretation

- Strong and significant association between numerical ability and delinquency
  - Robust to including a wide range of control variables
    - Socio-demographics: age, gender, education, race, fluency in English, etc
    - Preferences: risk and time
    - Household financial status: income, unemployment, fluctuation in income, how often unemployed, FICO, borrower is investor, etc
  - R^2 increases from 2 to 25% and coefficient of NA stays the same

$\rightarrow$ What is the channel of this association?

Narrowing Down the Channels

1. Which aspect of cognitive abilities is related to delinquencies?
   General cognitive abilities, economic literacy, or numerical ability?
   - Control for general IQ, economic literacy, and response time
   - → It is numerical ability!

2. Is the effect mediated by the choice of poorer mortgage terms?
   - Control for mortgage details (FRM, LTV, DTI, Low Doc)
   - → Effect of numerical ability on delinquency is not mediated through poor choice of mortgage conditions!

3. Choice of geographic area or mortgage lender?
   - Include ZIP-code fixed effects → Not geographic area
   - Include lender/servicer fixed effects → Not lender/servicer

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Summary

- We combine two data sources
  - Mortgage and payment information from LoanPerformance
  - Individual-level measures of numerical and cognitive ability

- Results:
  - Strong association between numerical ability and delinquency
  - → Foreclosures are two-thirds lower in top-numeracy group compared to bottom numeracy group
  - → Keep in mind that this is a correlation (not causality)

  - Robust to inclusion of a wide set of controls
  - Numerical ability, not general cognitive skills or econ literacy
  - Not driven by mortgage attributes

→ Our results suggest that numerical ability acts through other financial mistakes

Policy Implications

- Results don't indicate that firms steer people into unfavorable contracts, but . . .
  - We survey individuals 2 years after mortgage had been originated
  - Many subprime defaults (about 60 percent) happen before that

- For lending firms:
  - Take numerical ability into account in risk models
  - "Make application harder not easier"
- For public policy:
  - Numerical ability seems to matter
  - Disclosure and regulating mortgage products might not do the whole trick

Thank you!

Response rate

	Cold Calls	Mail-Ins
Responses	259	90
Response Rate		
of working phone numbers	10.4 %	–
of individuals answering phone	46.6 %	96.7 %

Checking sample selection

Cold-Calls: Comparing characteristics between responders (*R*) and non-responders (*NR*).

Variable	Number of Observations NR	R	Means NR	R	Diff NR-R	*p*-value
FICO Score	2346	242	632.298	638.719	-6.421	0.116
Fixed-Rate Mortage (=1)	2346	242	0.410	0.397	0.014	0.678
Interest-Only (=1)	2346	242	0.082	0.095	-0.013	0.479
Balloon Payment (=1)	2346	242	0.203	0.227	-0.024	0.372
Refinance (=1)	2346	242	0.529	0.492	0.037	0.275
Loan-to-Value Ratio	2346	242	78.264	77.706	0.559	0.520
Amount of Mortgage	2346	242	237215	250294	-13079	0.124
Initial interest rate	2346	242	8.003	7.938	0.065	0.408
Debt-to-Income Ratio	2153	227	41.666	41.348	0.318	0.619
Full-Doc Status (=1)	2346	242	0.725	0.723	0.002	0.949
Foreclosure after mailing went out (=1)	2017	217	0.105	0.092	0.013	0.553

Checking sample selection

Mail-Ins: Comparing characteristics between responders (*R*) and non-responders (*NR*).

Variable	Number of Observations		Means		Diff	
	NR	*R*	*NR*	*R*	*NR-R*	*p*-value
FICO Score	4902	90	621.287	612.878	8.409	0.173
Fixed-Rate Mortage (=1)	4902	90	0.161	0.178	-0.017	0.659
Interest-Only (=1)	4902	90	0.079	0.056	0.023	0.421
Balloon Payment (=1)	4902	90	0.303	0.344	-0.042	0.394
Refinance (=1)	4902	90	0.781	0.778	0.003	0.943
Loan-to-Value Ratio	4902	90	81.200	80.530	0.670	0.556
Amount of Mortgage	4902	90	257982	235381	22601	0.080
Initial interest rate	4902	90	8.201	8.000	0.200	0.103
Debt-to-Income Ratio	4537	86	42.226	43.756	-1.530	0.116
Full-Doc Status (=1)	4902	90	0.653	0.600	0.053	0.294
Foreclosure after mailing went out (=1)	3779	76	0.160	0.145	0.015	0.718

Checking sample selection

Table shows no evidence of selection into sample.

Formal test confirms this impression.

- Run regression for each outcome k: $y_i^k = \alpha_k + \gamma_k R_i + \beta_k CC_i + e_i^k$
- Estimate using SUR, allowing e_i^k, e_i^l to be correlated, which may matter for joint test that $\gamma_k = 0$.

▷ χ^2-Test that γ_k are zero in all 10 equations: $p = 0.52$

Measuring economic literacy

Economic Literacy (Lusardi and Mitchell, 2009)

1. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? More than today, exactly the same as today, or less than today? (79% say less)

2. Suppose that in the year 2020, your income has doubled and prices of all goods have doubled too. In 2020, how much will you be able to buy with your income? More than today, exactly the same as today, or less than today? (74% say the same)
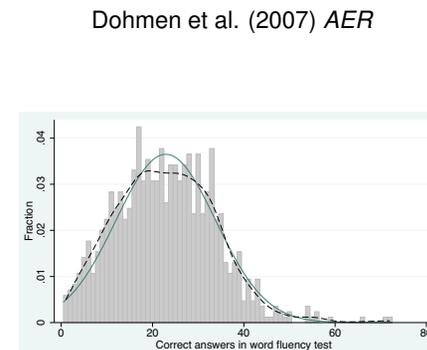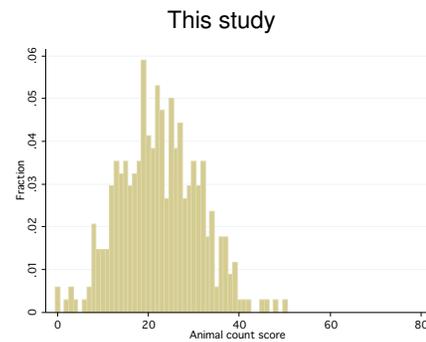
Proxy for basic understanding of economic mechanisms, absence of money illusion.

Measuring General Cognitive Ability

Word Fluency Test (Lang et al., 2005)

"In the next 90 seconds, name as many animals as you can think of. The time starts now."

Test corrleates highly with general measures of IQ (Lang et al, 2005).

Mortgage characteristics
Means by numerical ability group

	Financial Literacy Group			
	1	2	3	4
Fixed-rate loan (DV)	0.36	0.31	0.38	0.38
Initial interest rate	8.2	8.0	7.9	7.8
	(1.1)	(1.1)	(1.1)	(1.2)
Low documentation (DV)	0.40	0.33	0.22	0.22
Cumulative LTV	0.86	0.83	0.85	0.85
	(0.17)	(0.16)	(0.15)	(0.17
Back-end DTI ratio	43.1	42.5	39.9	41.3
	(6.8)	(8.1)	(9.3)	(8.6)
# Previous mortgages	2.1	1.9	1.5	1.3
	(2.6)	(2.2)	(2.2)	(2.0)
First-time Homebuyer (DV)	0.70	0.58	0.50	0.33
Duration of mortgage	28.4	28.6	29.4	28.3
	(4.2)	(4.9)	(5.0)	(4.7)

Notes: numbers in parentheses are standard deviations.

Raw Correlations: Percent of Payments Behind

Panel B: Percent of Payments Behind
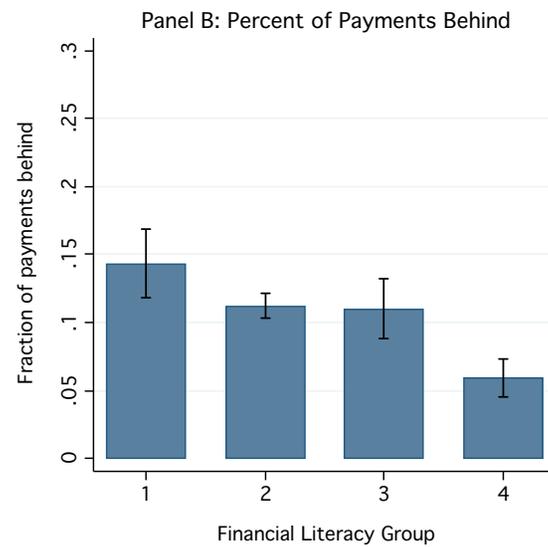
Homeowner Experience Does Not Help Much

	% of Time delinquent	% Payments Missed	Forclosure Initiated
Numerical Ability Index	−0.044***	−0.025***	−0.284**
	(0.016)	(0.009)	(0.126)
Number of Previous Mortgages	0.004	0.006	0.108
	(0.009)	(0.005)	(0.070)
First-time Home Buyer (DV)	0.056*	0.027*	0.526**
	(0.029)	(0.016)	(0.213)
Took Home-Owner Counseling (DV)	−0.011	0.007	0.213
	(0.047)	(0.030)	(0.303)
Shopped around for Mortgages (DV)	0.028	0.019	0.066
	(0.028)	(0.016)	(0.194)
Controls?	Yes	Yes	Yes
R^2	0.251	0.237	
N	336	336	332

Interpretation

- Homeowner experience doesn't substantially improve loan performance and doesn't diminish impact of numerical ability

- Search before obtaining a mortgage has insignificant impact
  $\rightarrow$ reinforces interpretation that individuals miscalculate budget

It's Numerical Ability, Not Other Cognitive Skills

	Fraction of Time in Delinquency		Forclosure Initiated (=1)	
NA Index	−0.045***	−0.046***	−0.252**	−0.241*
	(0.016)	(0.016)	(0.124)	(0.127)
Verbal IQ measure	−0.001	−0.001	−0.027**	−0.027**
	(0.002)	(0.002)	(0.013)	(0.013)
Savings Scenario correct (DV)		−0.000		−0.223
		(0.035)		(0.235)
Inflation scenario correct (DV)		0.010		0.024
		(0.032)		(0.219)
Controls?	Yes	Yes	Yes	Yes
R^2	0.24	0.24		
N	336	336	332	332

Note: OLS and probit regressions. s.e. in parentheses. Control variables include income, race, english fluency, education, age, FICO, risk and time preferences, etc.

Level of significance: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Interpretation

- Effect on being behind on payments is specific to numerical ability, and not associated with general IQ or with economic literacy

- General IQ has a separate impact on foreclosure
  - $\rightarrow$ Plausible that cognitive skills help in averting foreclosure process

Effect Not Mediated by Poor Mortgage Terms

	Fraction of Time in Delinquency		Fraction of Payments Missed		Forclosure Initiated (=1)	
NA	−0.043***	−0.035**	−0.025***	−0.023**	−0.297**	−0.289**
	(0.015)	(0.016)	(0.009)	(0.010)	(0.121)	(0.130)
FRM (=1)	0.018	0.026	0.005	0.009	−0.004	0.010
	(0.028)	(0.029)	(0.016)	(0.017)	(0.199)	(0.216)
Low-Doc	0.028	0.018	0.009	0.002	0.164	0.180
	(0.031)	(0.033)	(0.018)	(0.018)	(0.213)	(0.237)
LTV Ratio		0.084		0.072		2.522***
		(0.095)		(0.053)		(0.893)
DTI Ratio		0.003*		0.001		0.020
		(0.002)		(0.001)		(0.013)
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.251	0.260	0.229	0.235		
N	335	307	335	307	331	305

Note: OLS and probit regressions. s.e. in parentheses. Control variables as above

Level of significance: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Interpretation

- Effect of numerical ability on delinquency is not mediated through poor choice of mortgage conditions.

- Taken together, the results are suggestive of a specific channel:

  ▷ Individuals with poor numerical abilities may be more likely to "mess up" their budget
  ▷ This can lead to higher delinquency and even complete default.