Where's the Smoking Gun? A Study of Underwriting Standards for US Subprime Mortgages

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and

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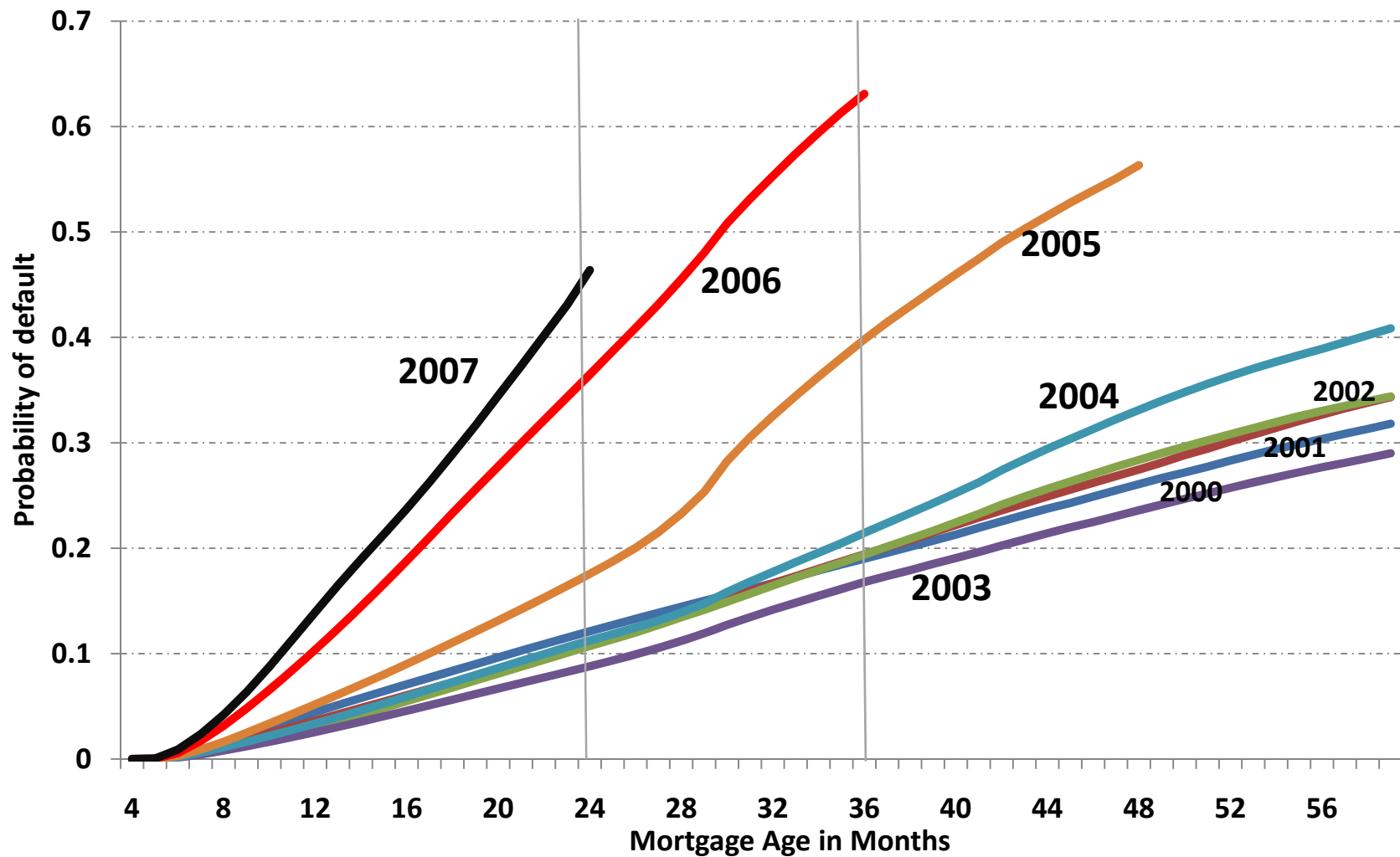Federal Reserve Bank of St. Louis

Bank of Finland/SUERF conference
4–5 June 2009
House of the Estates, Helsinki

Subprime Default Probabilities

Motivation

The **President's Working Group on Financial Markets** (March, 2008):

*"The turmoil in financial markets was triggered by a **dramatic weakening of underwriting standards for U.S. subprime mortgages, beginning in late 2004**, and extending into early 2007." –*

Emphasis in the original

Study of subprime mortgage originations with a view to examining and testing this hypothesis.

Dominant explanation:
Decline in Underwriting Standards

Implications:

1. Subprime mortgages of **earlier vintages had robust underwriting**

2. Something went wrong **after 2004**

3. The change occurred **within subprime originations** (but not the overall mortgage market).

- Underwriting: Summarizing the risk of default ex ante with the purpose or approving or denying the loan application

- Borrower's **observable characteristics at the time of origination of the loan**

Hard Information?

Decline in underwriting shown with hard information (Demyanyk and van Hemert, 2008)

Stein (2002):

firm? In what follows, I argue that the key distinguishing characteristic of small-business lending is that it relies heavily on information that is "soft"— that is, information that cannot be directly verified by anyone other than the agent who produces it. For example, a loan officer who has worked with a small-company president may come to believe that the president is honest and hardworking—in other words, the classic candidate for an unsecured "character loan." Unfortunately, these attributes cannot be unambiguously documented in a report that the loan officer can pass on to his superiors. This situation contrasts sharply with, for example, an application for a home mortgage loan. Here the decision of whether or not to extend credit is likely to be made primarily based on "hard," verifiable information, such as the income shown on the borrower's last several tax returns.[2]

Data and Coverage

We use the data from LoanPerformance

Securitized subprime mortgages only

More than 9 million originations securitized as subprime

Covers almost the entire market for subprime mortgages that have been securitized, especially the later vintages

Summary Trends: 1998-2006

- Increase in the proportion of ARMs

- Increase in the proportion of **Low-doc** loans

- Increase in the proportion of **high LTV** loans

- Increase in average **FICO scores.**

Evidence from Summary Statistics

Despite exposing themselves to more credit risk on some borrower attributes (for example, by **lowering documentation requirements**) …

lenders seem to have attempted to offset this by increasing the average quality of borrowers (**by raising credit score requirements**) to whom such loans were made.
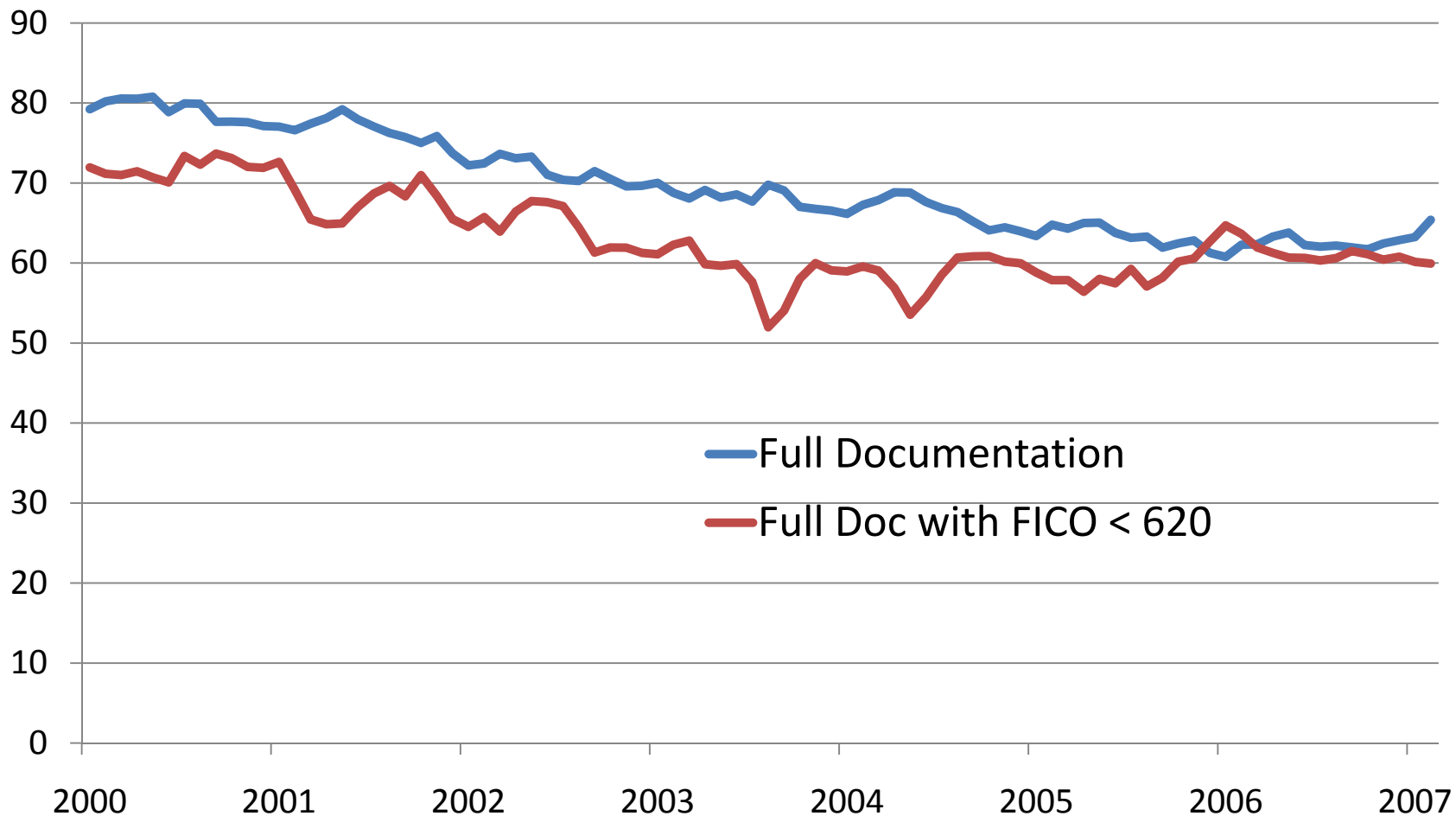
FICO and Low Documentation

Legend:
- Low Documentation
- Low Doc with FICO < 620

FICO and Full Documentation
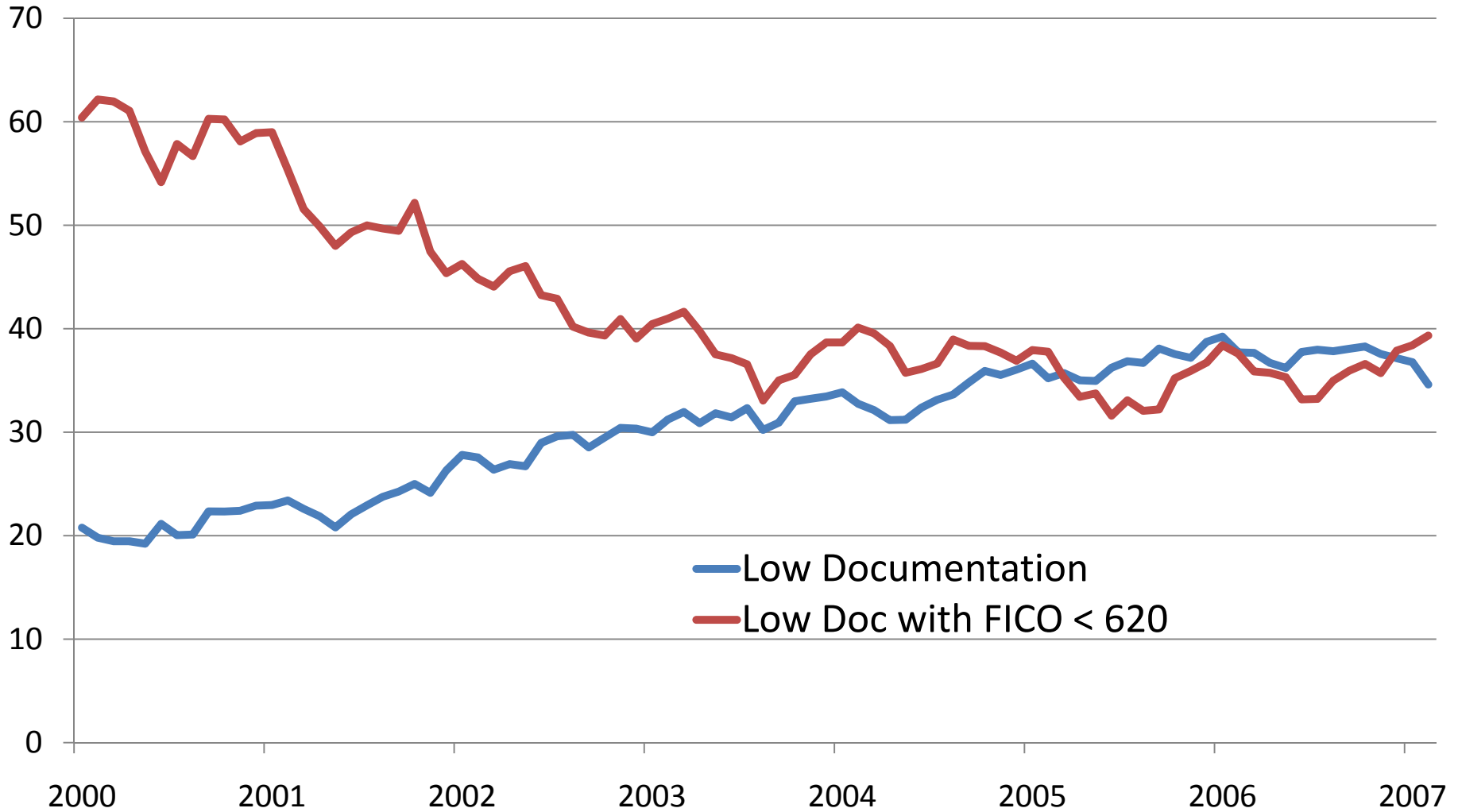
Legend:
- Full Documentation
- Full Doc with FICO < 620

FICO and Default

Why did lenders choose higher FICO Scores?

Ex post, some industry experts have even faulted originators on this account:

> "*… the crucial mistake many lenders made was relying on FICO credit scores to gauge default risk, regardless of the size of the down payment or the type of loan.*"

The woman who called Wall Street's meltdown- <u>Fortune Magazine</u>, Aug. 4, 2008

Results: Determinants of Default

Our estimates show that a **higher FICO score at origination significantly lowers the probability of (*ex post*) default.**

The magnitude of this relationship is **not significantly different across vintages**

Why? Because we account for the endogeneity problem of including loan terms in a default regression

(1) Endogeneity of Mortgage Terms: Theory

Asymmetric Information:

Akerlof (1970), Rothschild and Stiglitz (1976), Brueckner (2000)

Advances in empirical contract theory:

Chiappori and Salanie, (2000); Chiappori et al. (2006)

Under both **adverse selection** and **moral hazard**, one should observe a **positive correlation** conditional on observables between **risk** (ex-post default) and **coverage** (LTV)

Theoretical Framework

Adverse selection: risk is **exogenous** and **unobservable**

Positive correlation: high-risk agents are more likely to opt for the mortgage contract with the lower downpayment but a higher interest rate (Brueckner, 2000)

Moral Hazard: the **reverse causality** would generate the same correlation

Borrowers buying into mortgages with higher LTV for any unspecified or exogenous reasons are likely to exert less effort to repay the loan and therefore become riskier

Endogeneity: Anecdotal Evidence

Mortgage Pricing Sheet, Option One Mortgage Corp.

		LTV			
Grade	Credit Score	65%	70%	75%	80%
	700+	8.65	8.70	8.80	8.90
	660	8.75	8.80	8.90	9.00
AA+	620	9.00	9.05	9.15	9.25
	580	9.55	9.60	9.90	10.05
	540	10.45	10.70	10.90	11.15
	700+	9.35	9.40	9.50	9.60
	660	9.45	9.50	9.60	9.70
AA	620	9.70	9.75	9.85	9.95
	580	10.15	10.20	10.35	10.50
	540	10.70	10.95	11.00	11.25

Positive Correlation: Endogeneity Bias

Determinants of Default: Hazard Ratios

	2000	2001	2002	2003	2004	2005	2006	2007
FICO/100	**0.4495***	**0.4395***	**0.4129***	**0.3666***	**0.3992***	**0.4852***	**0.5502***	**0.5562***
Full- Doc	0.8754***	0.8624***	0.8219***	0.7451***	0.7518***	0.6922***	0.6517***	0.6657***
Owner Occupied	0.8076***	0.8022***	0.8127***	0.7825***	0.7493***	0.7725***	0.7729***	0.7611***
Second Home	0.6302***	0.5463***	0.5738***	0.6072***	0.5989***	0.7045***	0.6922***	0.6896***
Refinance (Cash Out)	0.7625***	0.6605***	0.6414***	0.5419***	0.5164***	0.5015***	0.5558***	0.5738***
Refinance (No Cash Out)	0.919***	0.7927***	0.7477***	0.5829***	0.5341***	0.539***	0.5975***	0.5831***
LR test H0: $\beta = 0$ (p-value)	22077 (0.00)	27461 (0.00)	44013 (0.00)	83203 (0.00)	123586 (0.00)	155671 (0.00)	157703 (0.00)	23435 (0.00)

Determinants of Default: Hazard Ratios with **Closing Rate Spread**

	2000	2001	2002	2003	2004	2005	2006	2007
FICO /100	**0.5262***	**0.5529***	**0.5415***	**0.4889***	**0.514***	**0.6343***	**0.7105***	**0.826***
Full- Doc	0.902***	0.8837***	0.8666***	0.806***	0.8348***	0.8023***	0.7541***	0.8162***
Closing Rate Spread	**1.2269***	**1.2175***	**1.2453***	**1.2341***	**1.2261***	**1.2481***	**1.1923***	**1.3413***
Owner Occupied	0.8739***	0.8702***	0.8889***	0.8721***	0.8447***	0.9252***	0.8958***	0.9336***
Second Home	0.5987***	0.5743***	0.6394***	0.6409***	0.6642***	0.77***	0.7479***	0.7637***
Refinance (Cash Out)	0.7821***	0.7221***	0.7047***	0.5934***	0.554***	0.5464***	0.6134***	0.6855***
Refinance (No Cash Out)	0.9664***	0.8657***	0.8286***	0.6428***	0.5852***	0.6023***	0.6635***	0.7166***
LR test $H_0: \beta = 0$ (p-value)	34398 (0.00)	42843 (0.00)	68978 (0.00)	121636 (0.00)	185109 (0.00)	245904 (0.00)	257072 (0.00)	45442 (0.00)

(2) Credit risk is multidimensional

Lenders compensate for the increase in the *ex ante* risk of one borrower attribute by raising the requirement standards along another dimension

Need to "aggregate" each borrower characteristic to build a summary measure that fulfils a variety of desirable conditions

Solution to this **aggregation problem** has proved elusive

Counterfactual Analysis

Getting around the aggregation problem:

How would ex post default rates change if a mortgage originated to a "representative borrower" in 2005 were to be given a loan in 2001?

Counterfactual Analysis: Survival Plots
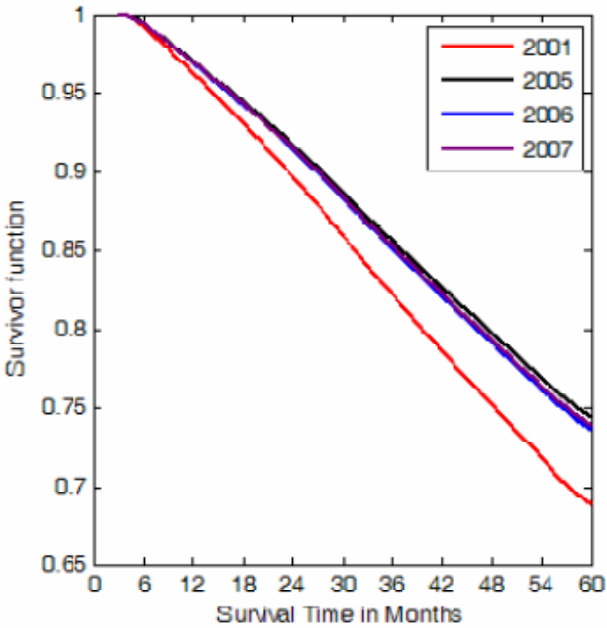
2001
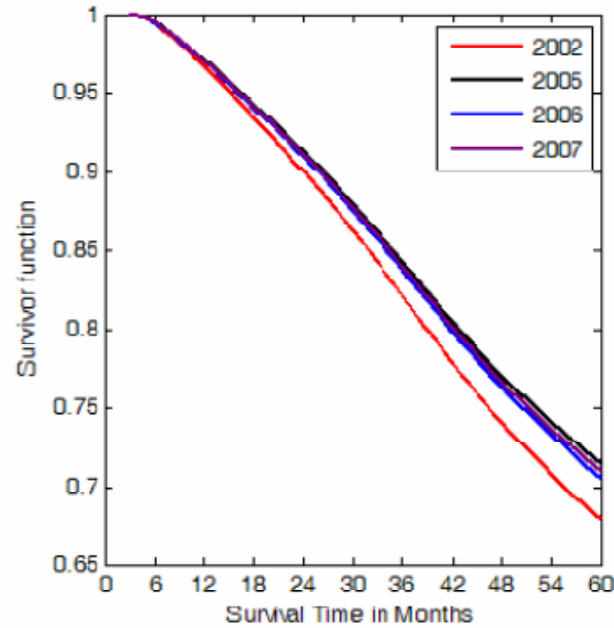
2002
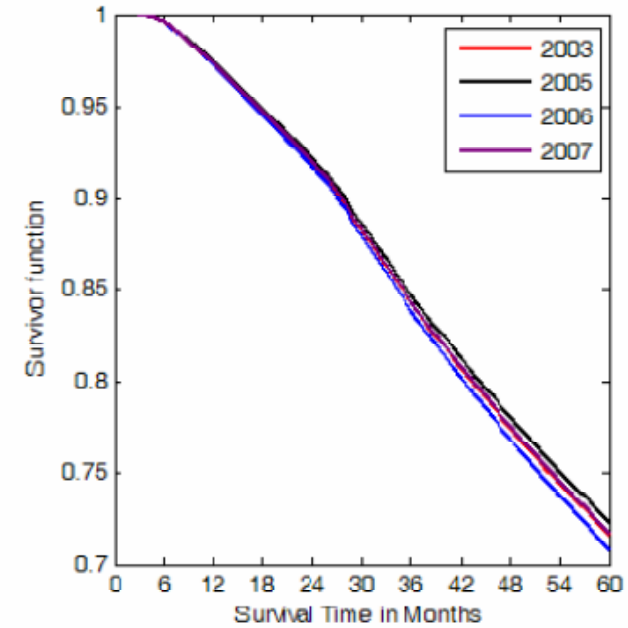
2003

Counterfactual Analysis:
including mortgage terms
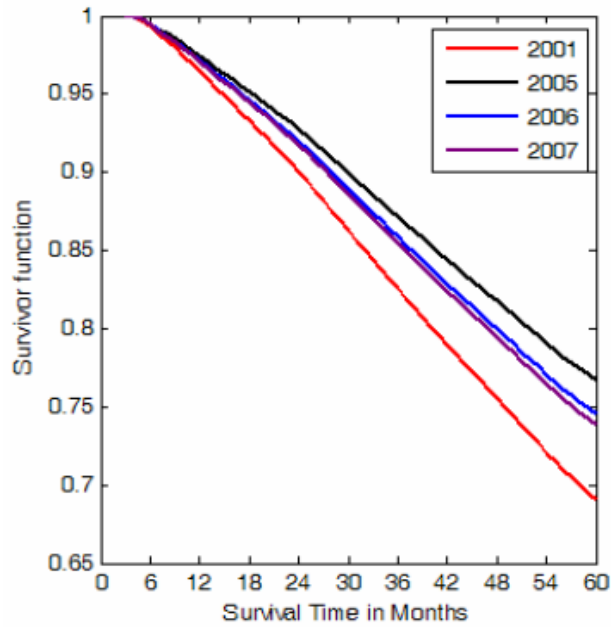
2001
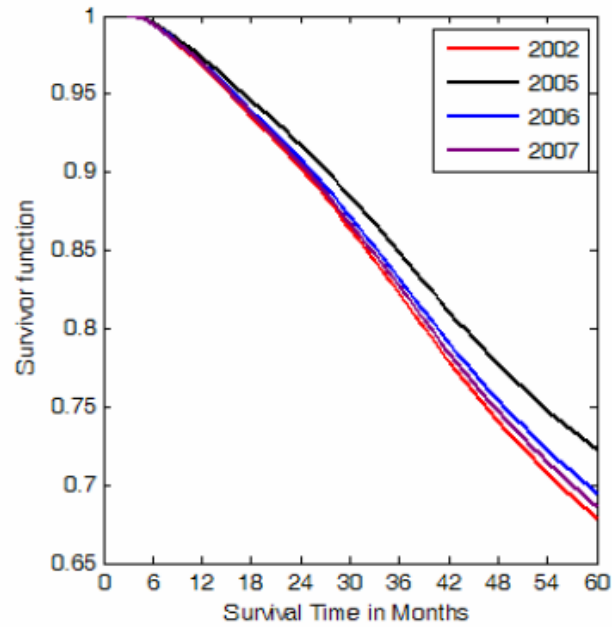
2002
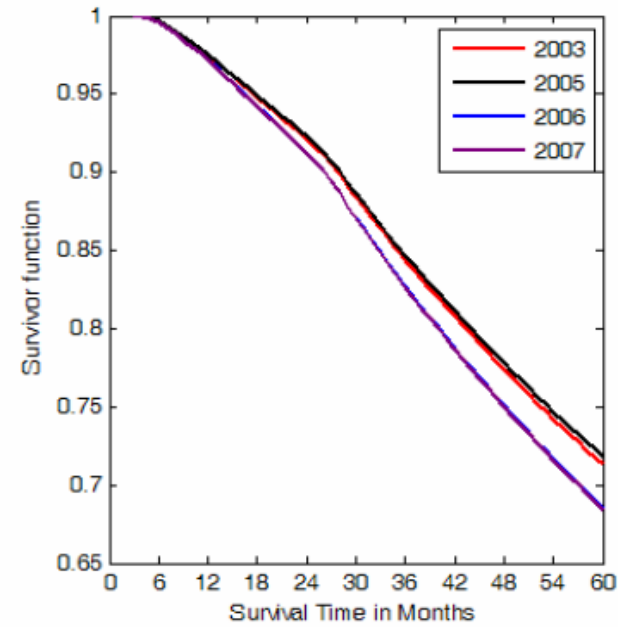
2003

Conclusion on Counterfactual

A representative borrower in 2006 (likewise for 2005 and 2007) had originated mortgages in 2001 and 2002, she would have **performed significantly better than** representative borrowers of vintages 2001 and 2002 respectively

We **fail to reject the null hypothesis for 2003 vintages**: No statistically significant differences in the loan performances between the representative borrowers of 2005 or 2007 vintages and that of the 2003 vintage

So, what's behind the high early default rates on subprime mortgages?

Subprime Default Probabilities
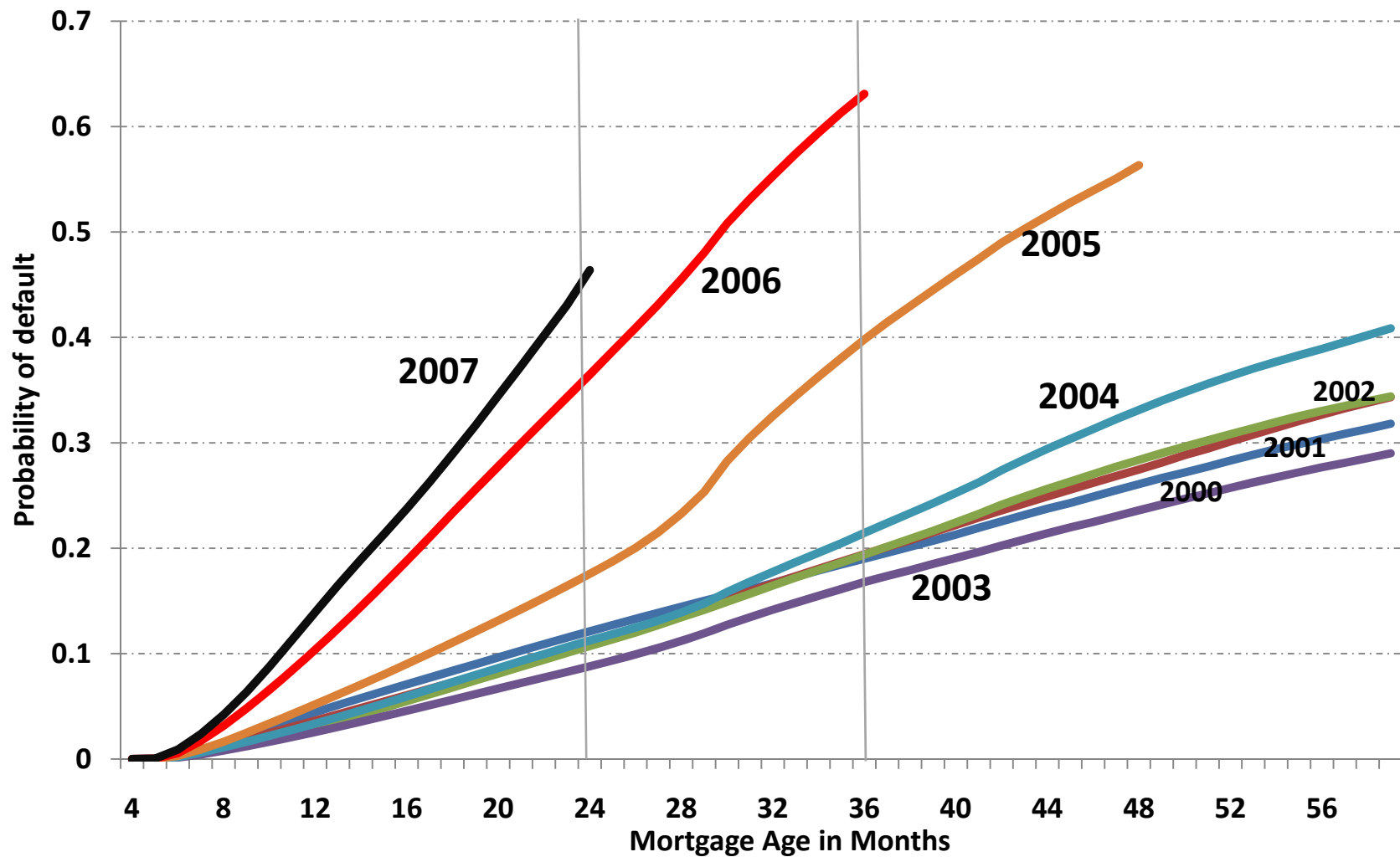
Post Delinquency

Evidence of the use of prepayments as an exit option following a delinquency

A sharp drop in **prepayments** on post-2004 vintages accompanied by a sharp rise in **foreclosures** (and default)

Post-delinquency Behavior of Owner Occupied (up to two ears after origination)
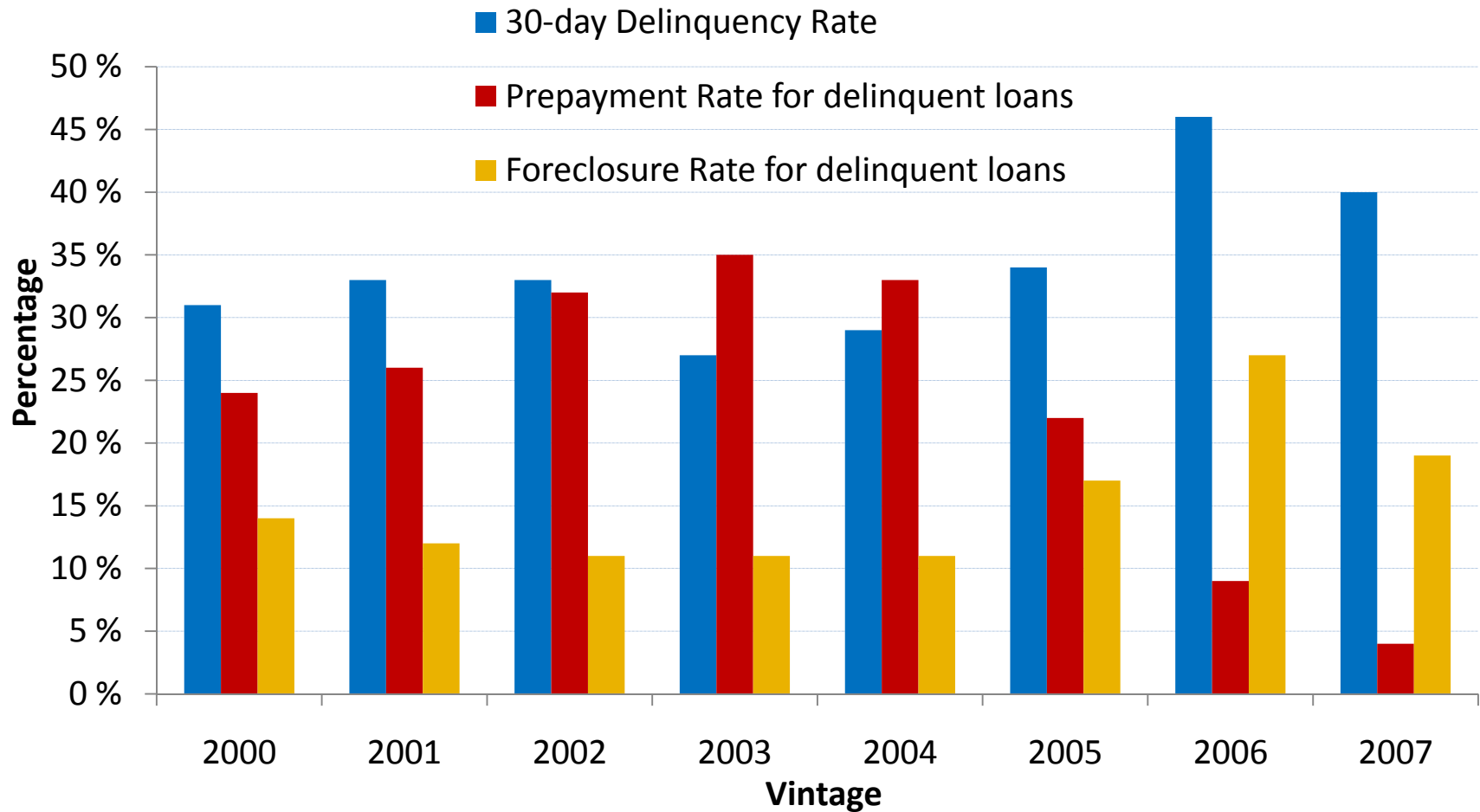
Post-delinquency Behavior of Owner Occupied (up to two years after origination)
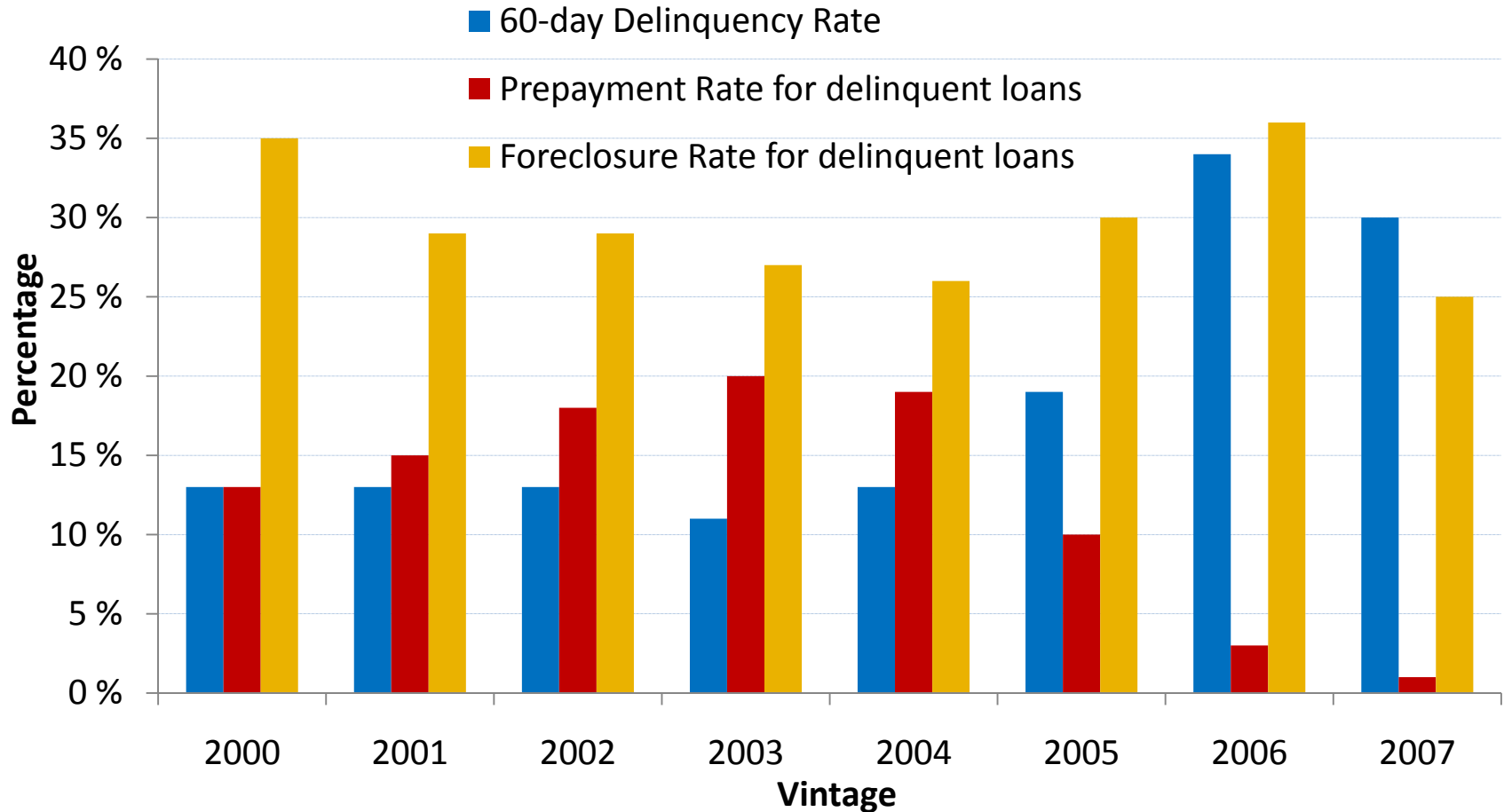
Pre- Delinquency

Evidence of the use of prepayments as an exit option even before registering a delinquency

A sharp drop in **prepayments** on post-2004 vintages accompanied by a sharp rise in **delinquencies**

Pre-delinquency Behavior by Product Type
(up to loan age of 18 months)

Fixed

Legend:
- 30 day delinquiencies
- Paid Off Before Hitting 30 day delinquiencies
- Total of Two
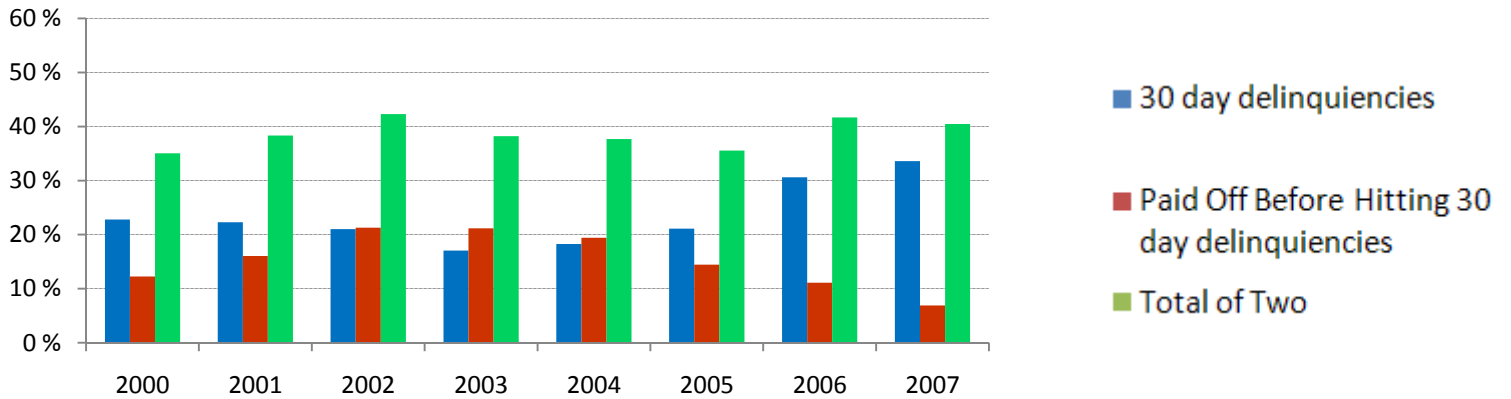
ARM2
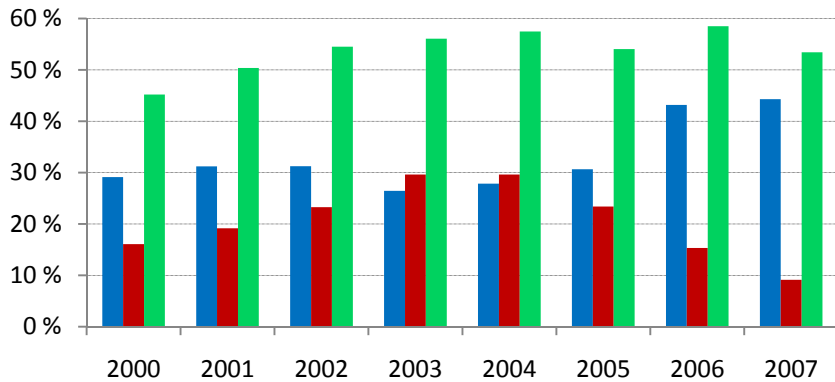
ARM3
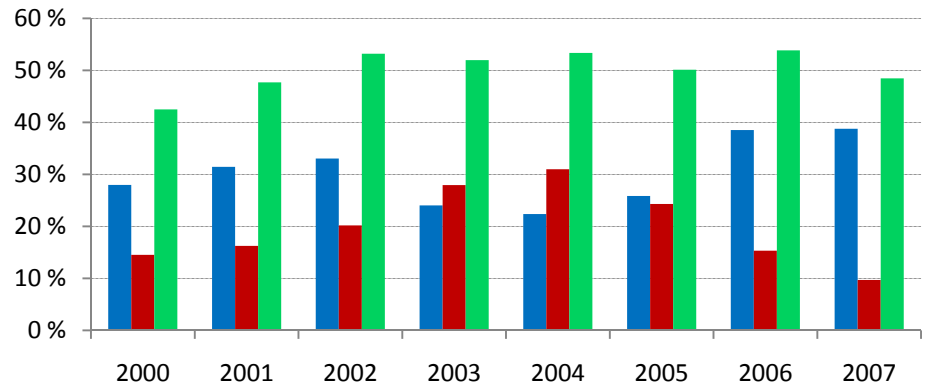
Pre-delinquency Behavior by Occupancy
(up to loan age of 18 months)

Owner Occupied

Legend:
- ■ 30 day delinquiencies
- ■ Paid Off Before Hitting 30 day delinquiencies
- ■ Total of Two
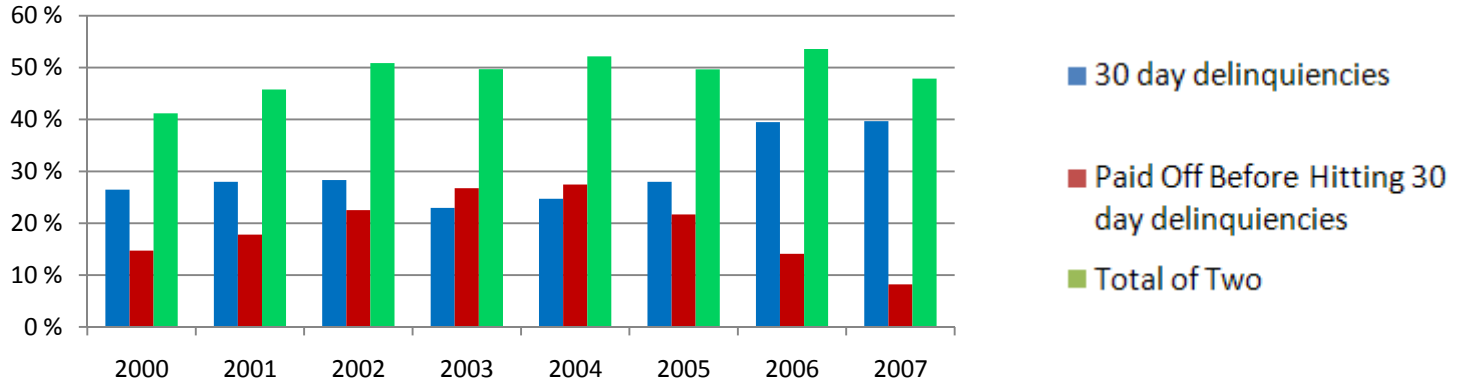
Second Home
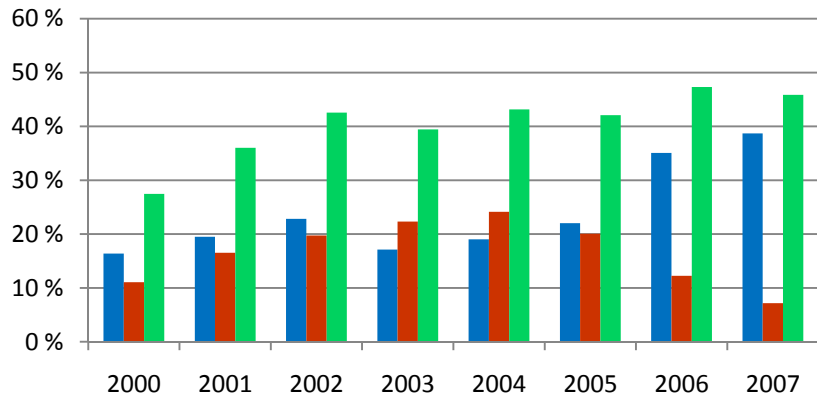
Non-Owner (Investor)
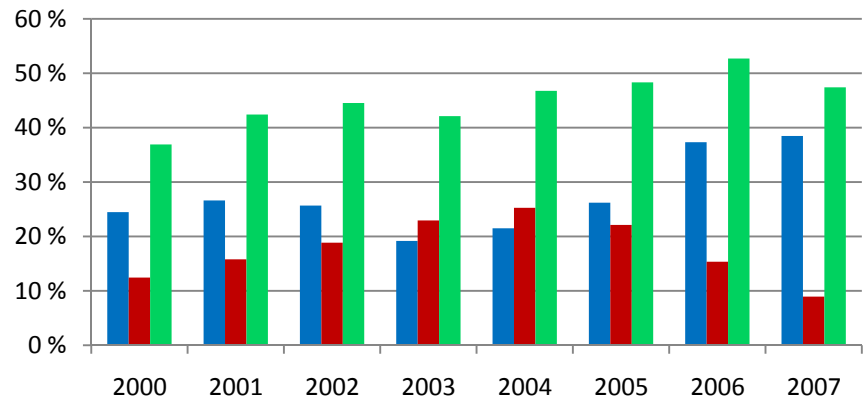
Pre-delinquency Behavior by Purpose
(up to loan age of 18 months)
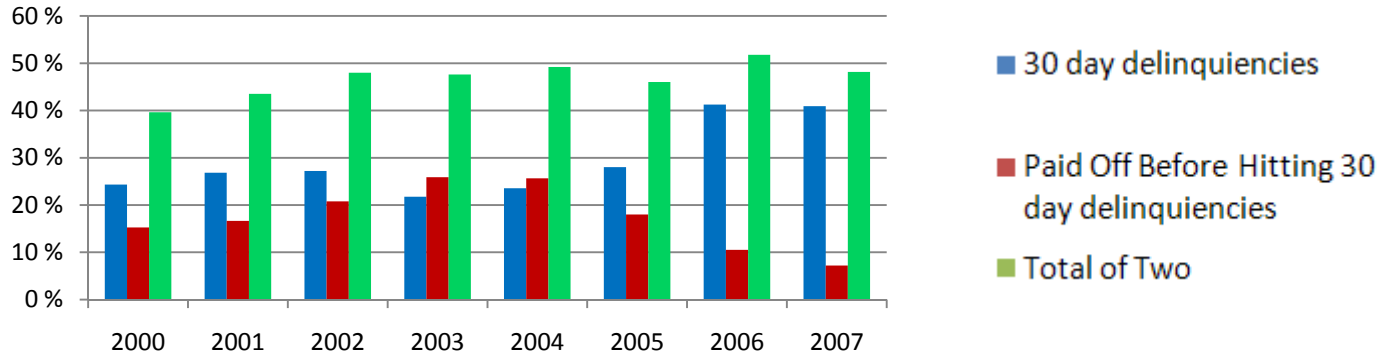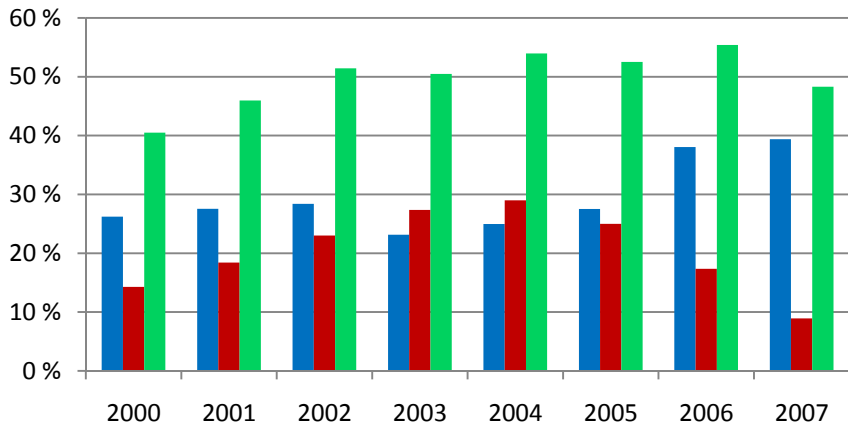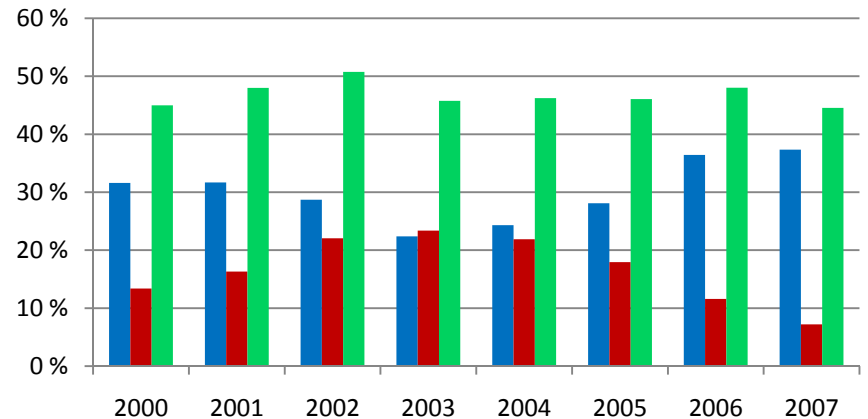
High Prepayment Rates on Earlier Vintages

Subprime mortgage contracts were designed as "**bridge-finance**" providing temporary credit accommodation

Companion paper, Bhardwaj and Sengupta (2008) point to the **high early prepayment rate** in subprime mortgages

Prepayments were largely sustained by the boom in house prices in the United States from 1995 to 2006.
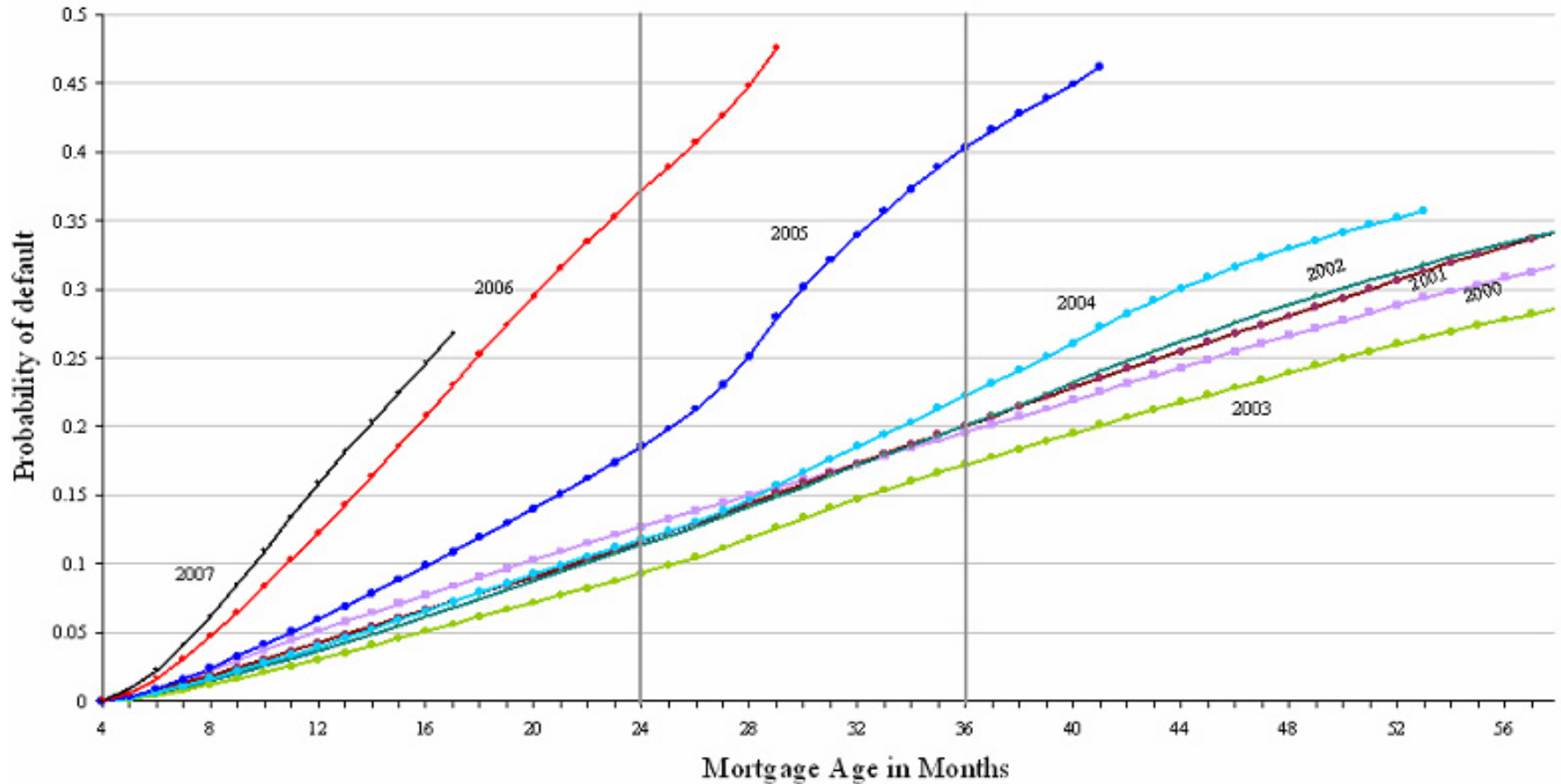
Conclusion

Sparse evidence of a dramatic weakening of lending standards within the subprime market.

Deterioration in underwriting post-2004 cannot be the explanation for collapse of subprime mortgage market

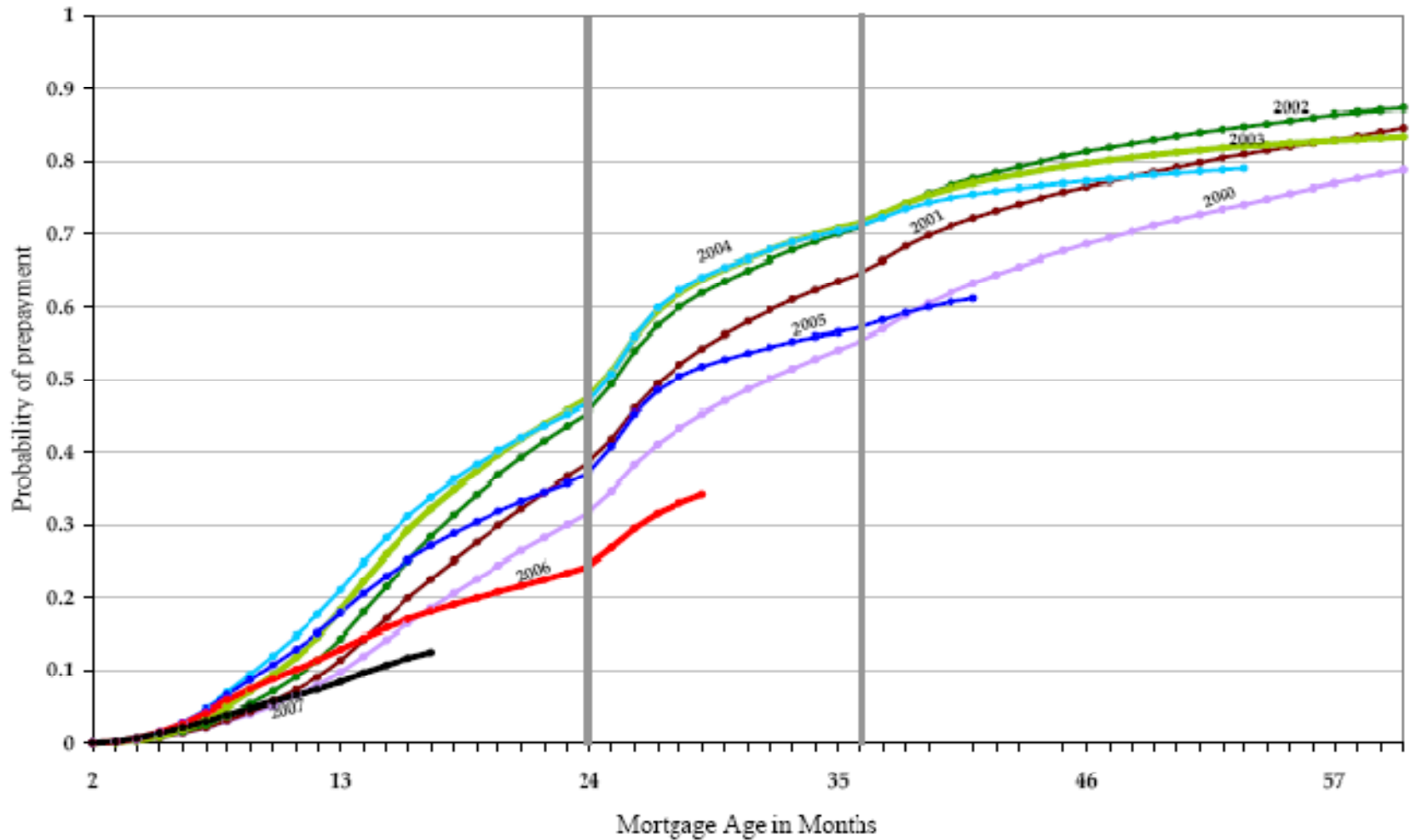One cannot rule out that underwriting standards for subprime loans were poor to begin with.
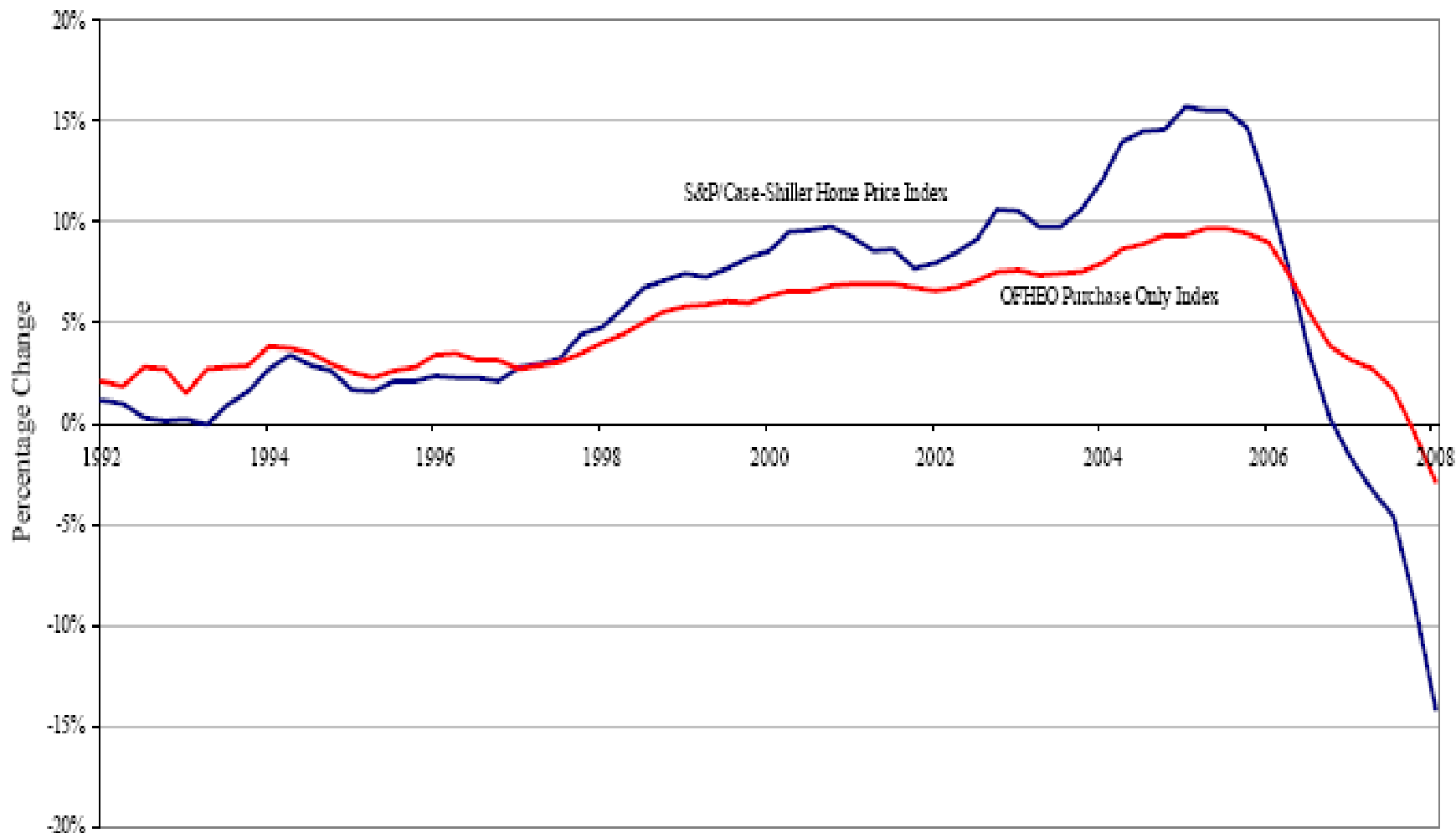
Default Probabilities
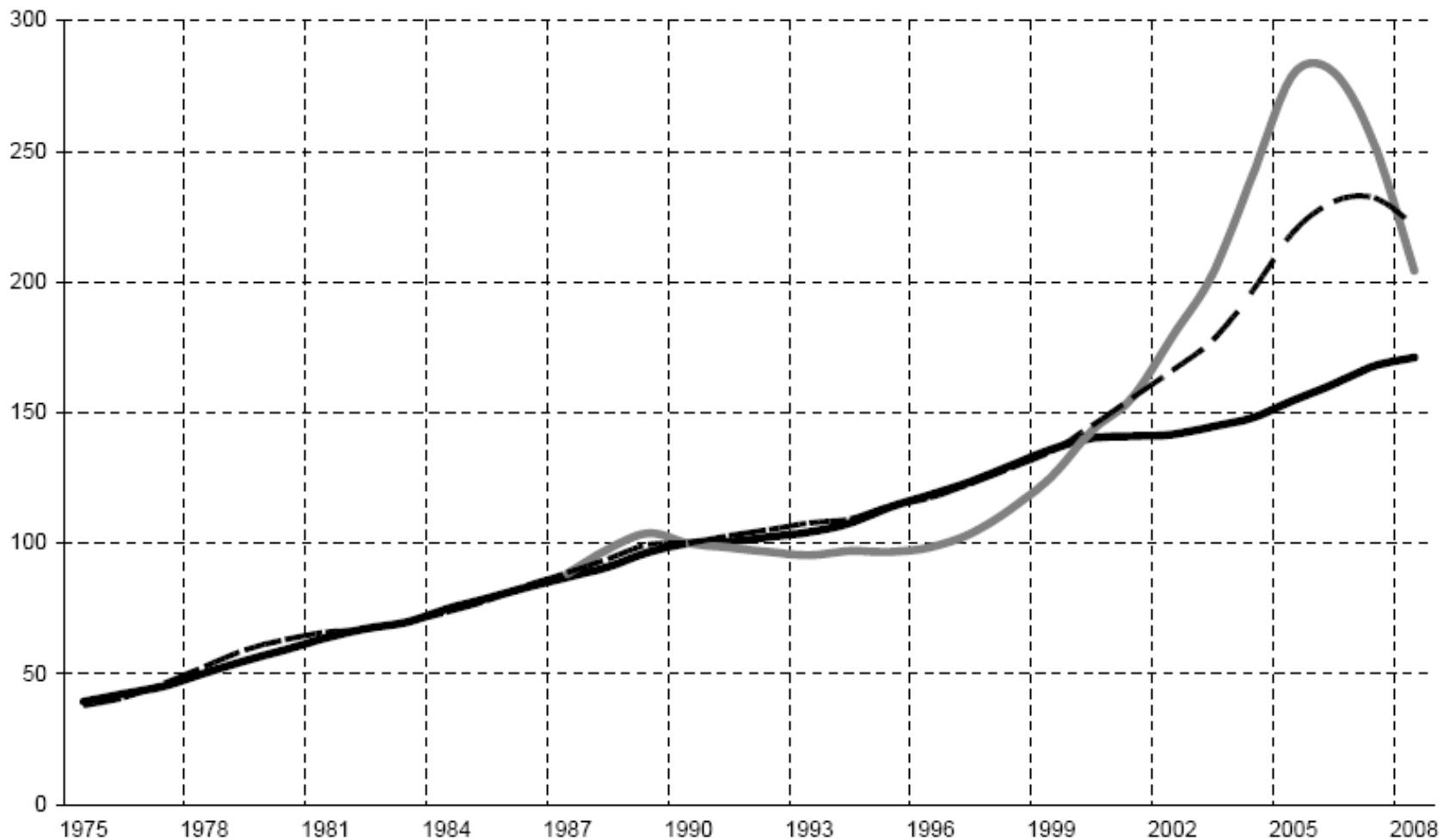
Prepayment Probabilities

Growth rate of House Prices

Sustainable?