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

Geetesh Bhardwaj
The Vanguard Group

Rajdeep Sengupta
Federal Reserve Bank of St. Louis

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Motivation and Related Literature

- **Evidence of Weak Underwriting standards**

  -Increasingly high proportion of Low Doc and High LTV Loans

  Foote et al. (2008); Demyanyk and van Hemert (2008)

- **Originate to Distribute hypothesis**

  -Securitization and Cheap Credit

  -Weak Underwriting standards

  - Keys et al. (2009)
  - Gorton (2008); Elul (2009); Bubb and Kaufman (2009)

Dominant explanation: Decline in Underwriting Standards

- 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)

- Implications:
  1. Something went wrong **within the subprime market** after 2004
  2. Subprime mortgages of earlier vintages had relatively robust underwriting

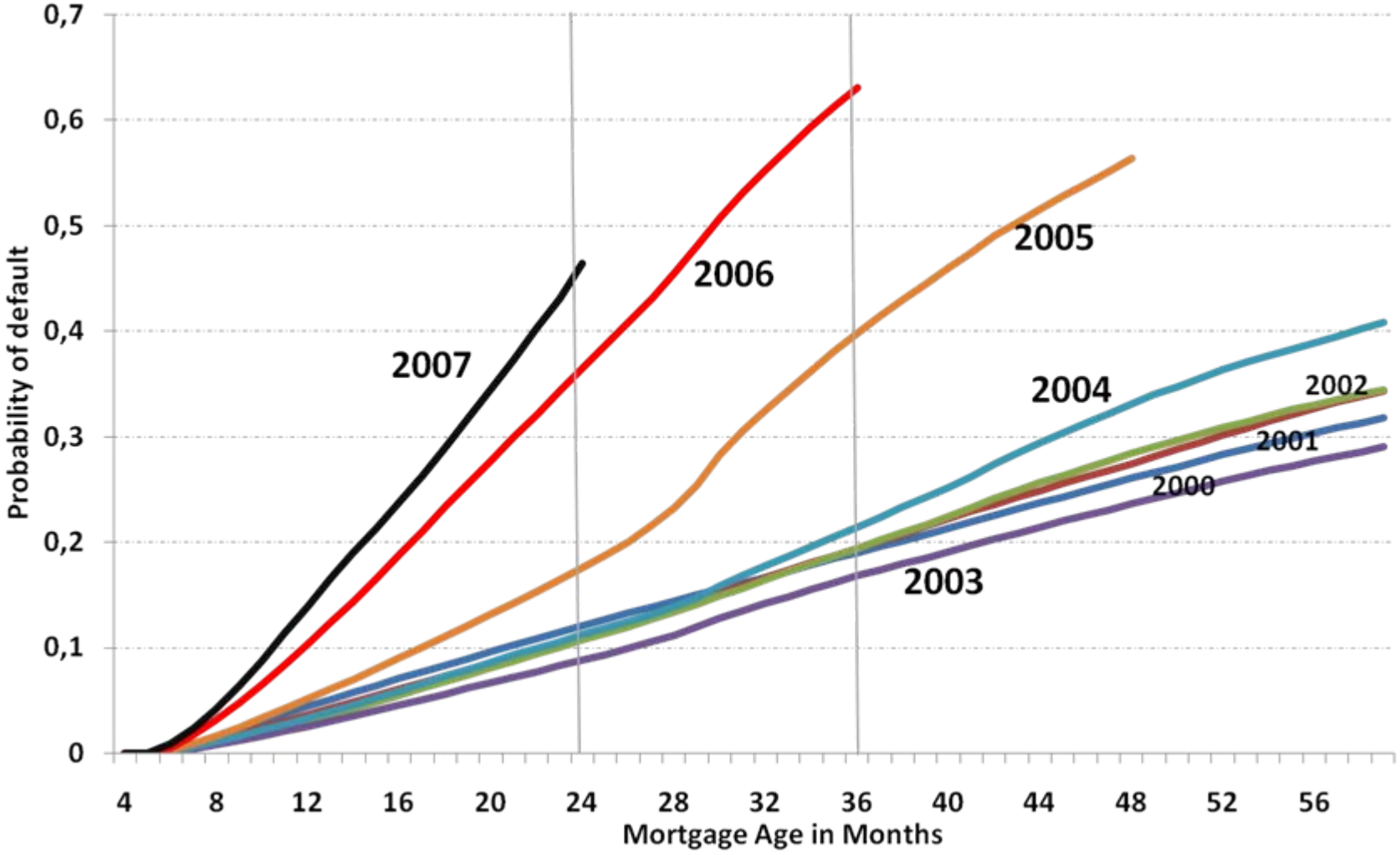
Hard Information?

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

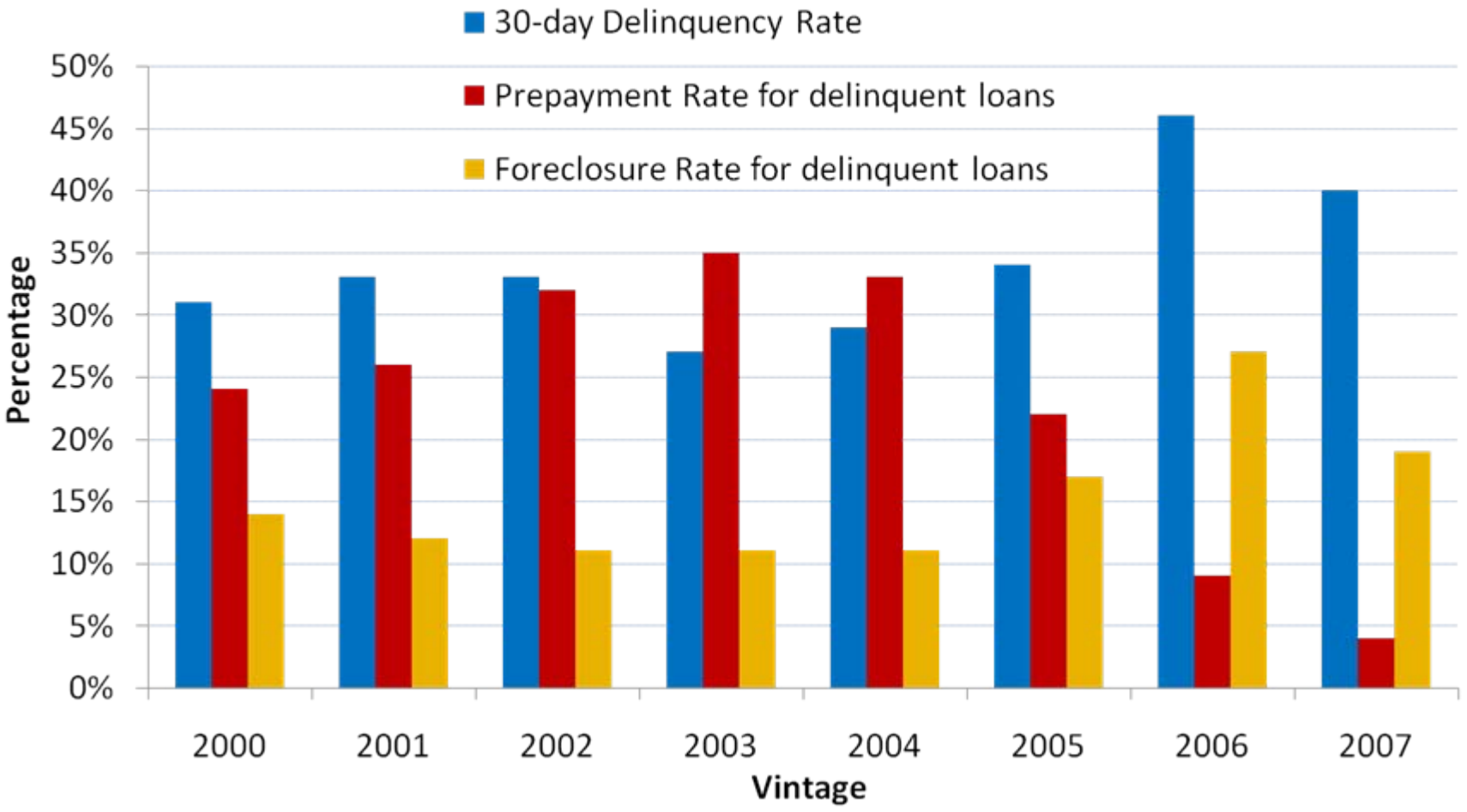
- Stein (2002):

> 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]

Subprime Default Probabilities



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



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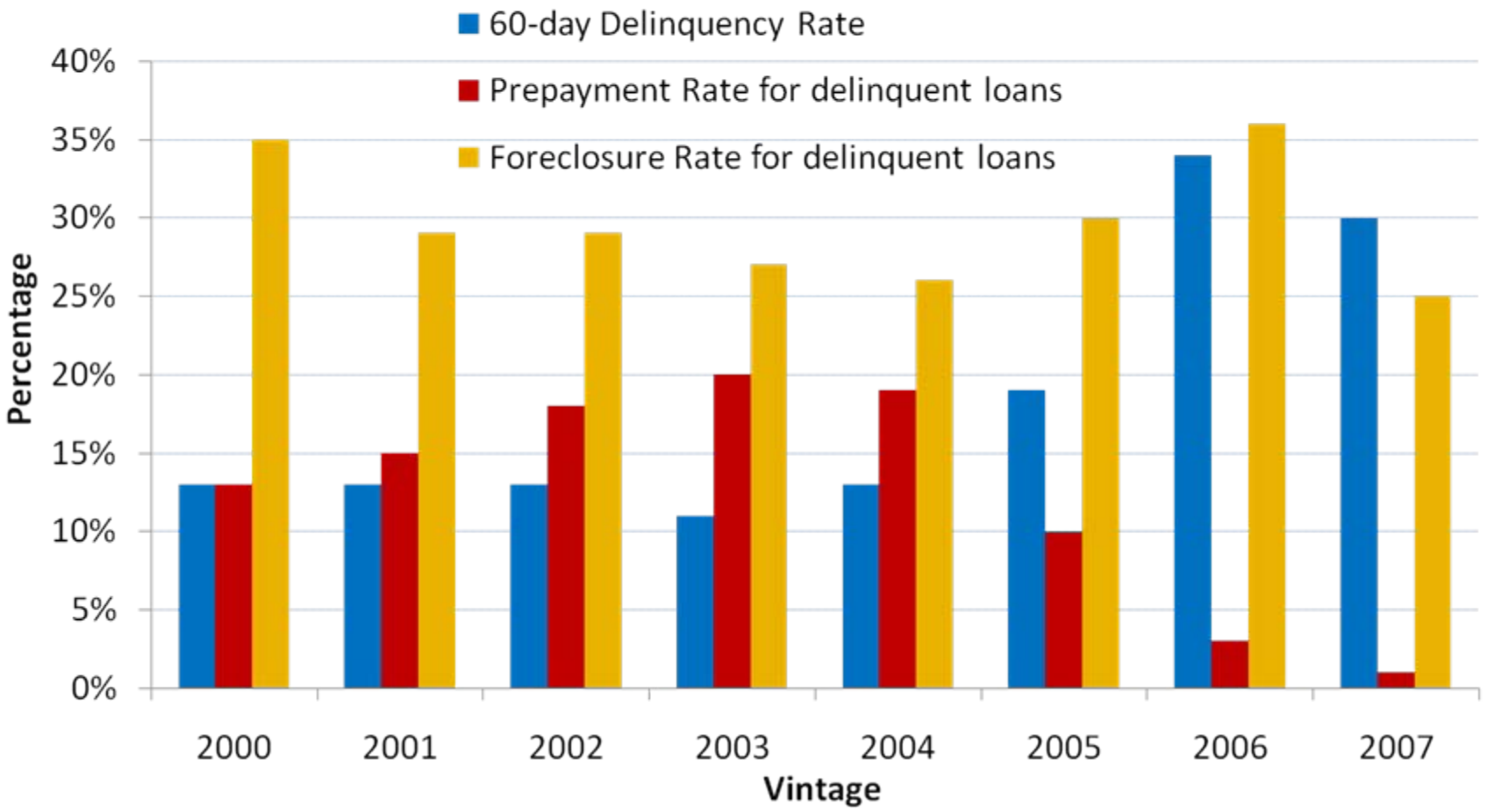
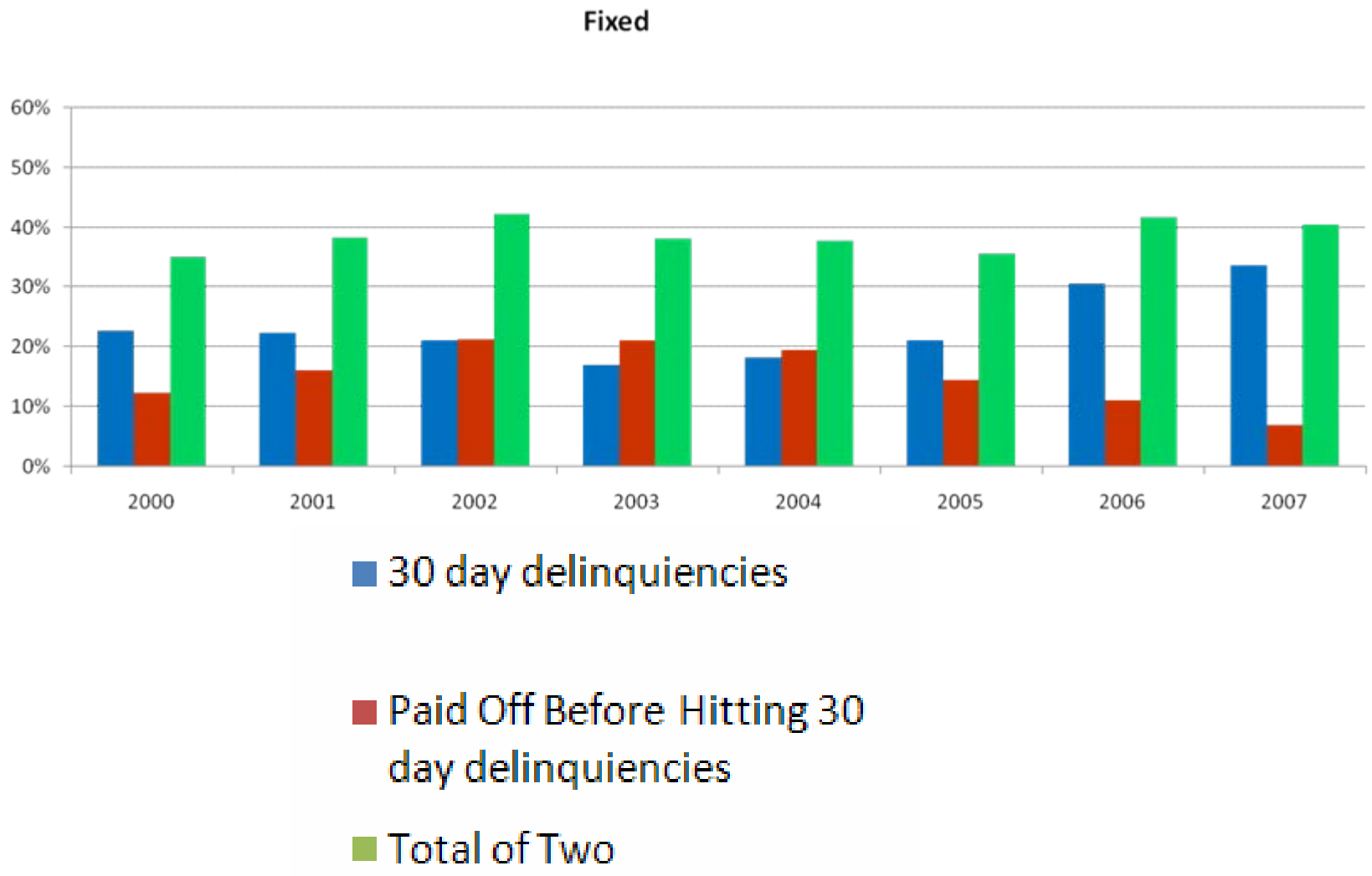
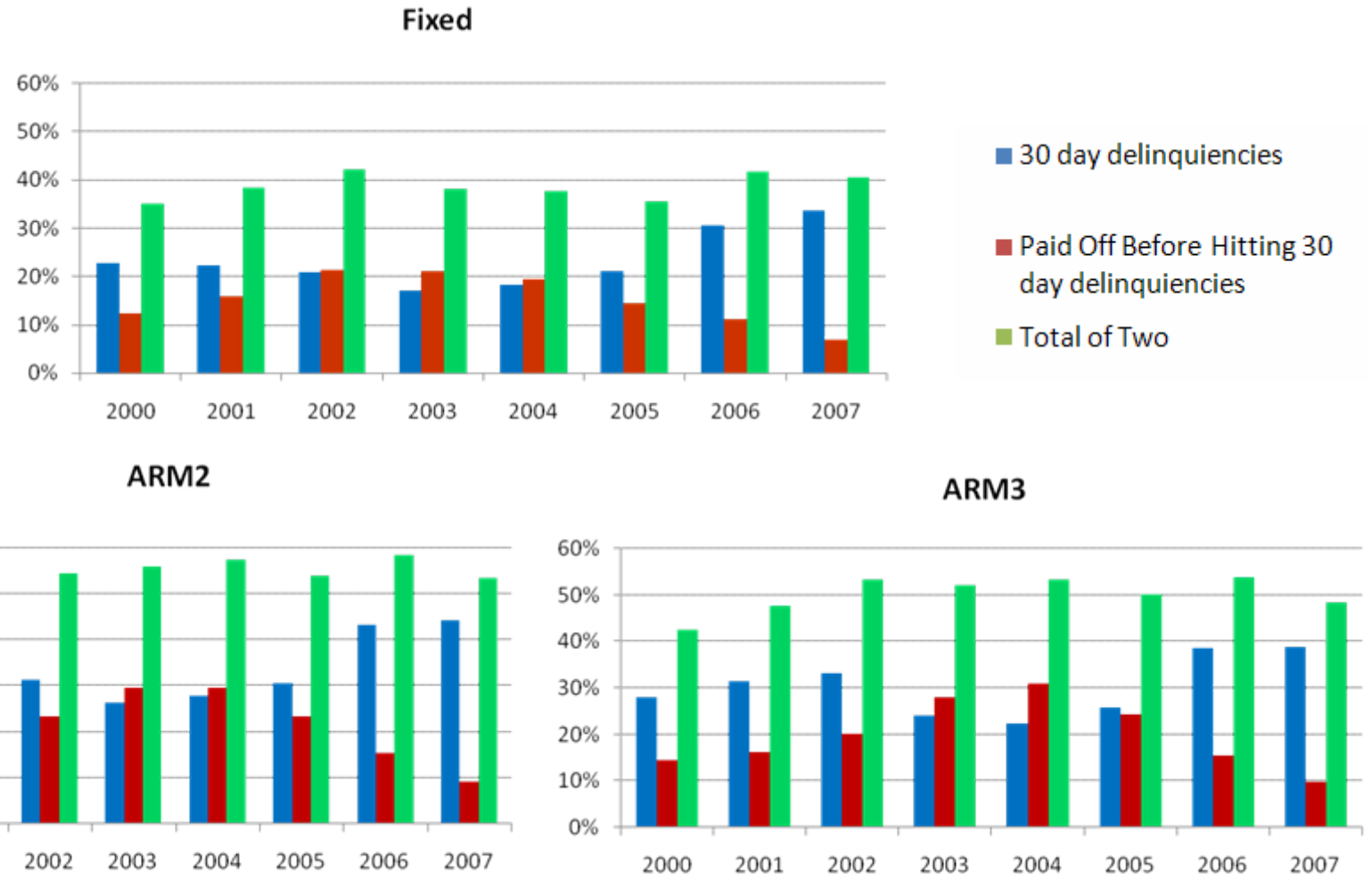


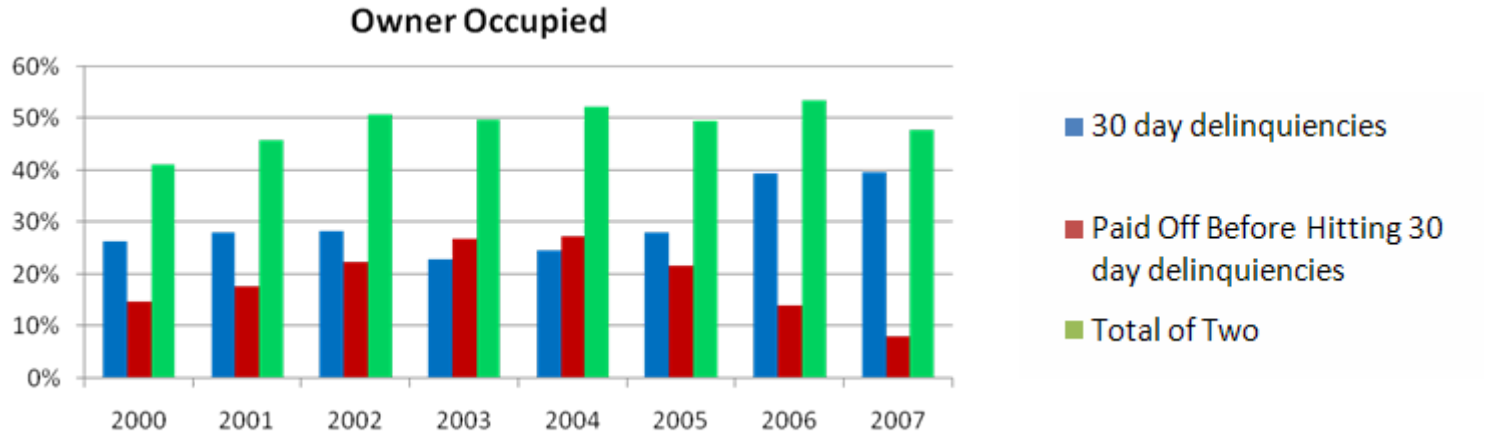
Pre-delinquency Behavior for FRMs (up to loan age of 18 months)

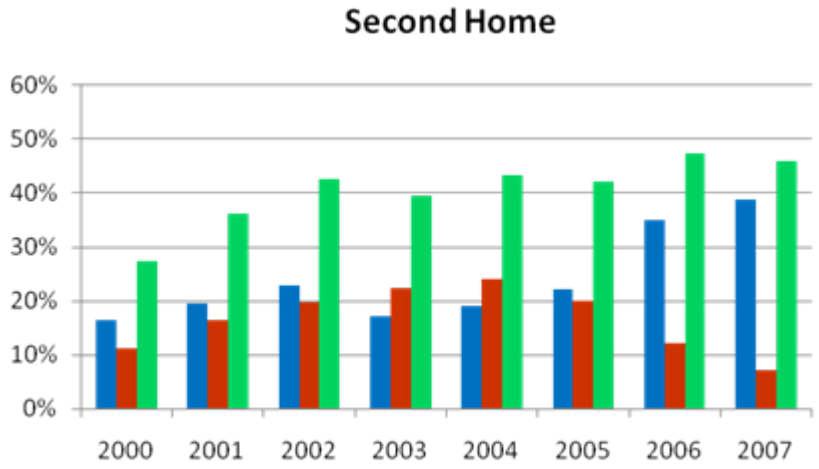


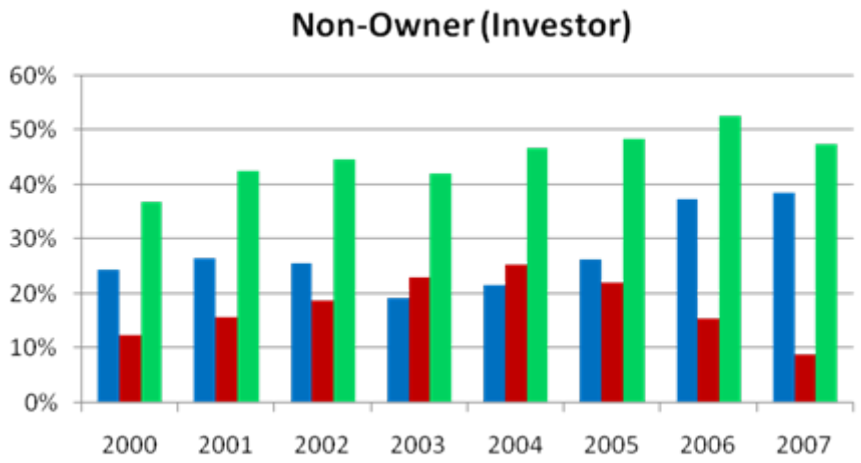
Pre-delinquency Behavior by Product Type (up to loan age of 18 months)



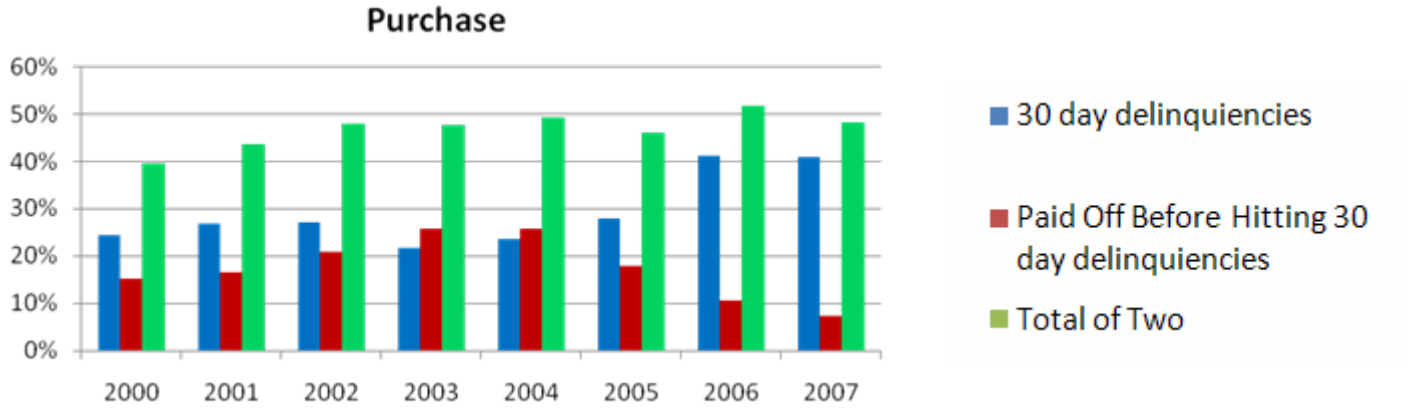
Pre-delinquency Behavior by Occupancy (up to loan age of 18 months)

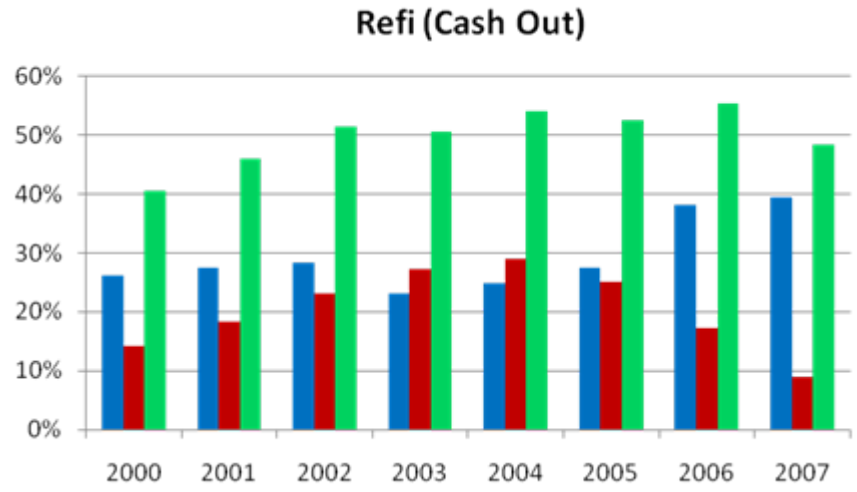


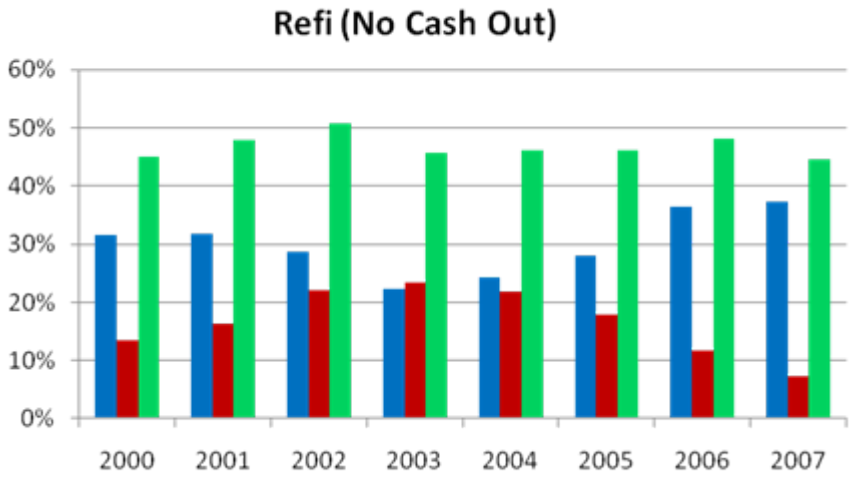




Pre-delinquency Behavior by Purpose (up to loan age of 18 months)







Results

- Difficult to argue in favor of a secular **dramatic weakening of lending standards** within the subprime market.

- **Credit score is a good predictor** of ex-post default specially for latter vintages

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

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

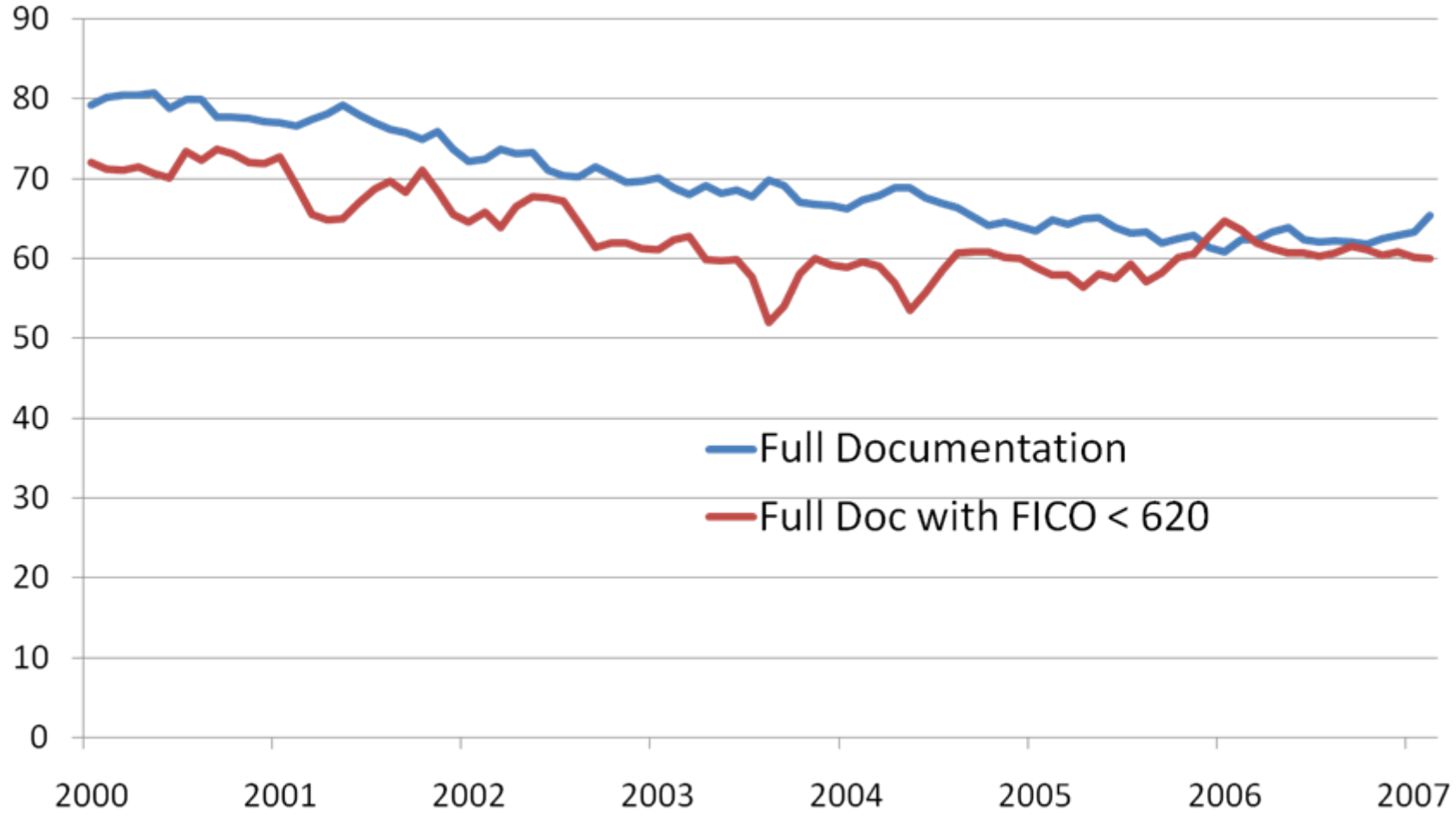
Summary Trends: 1998-2006

- 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.**

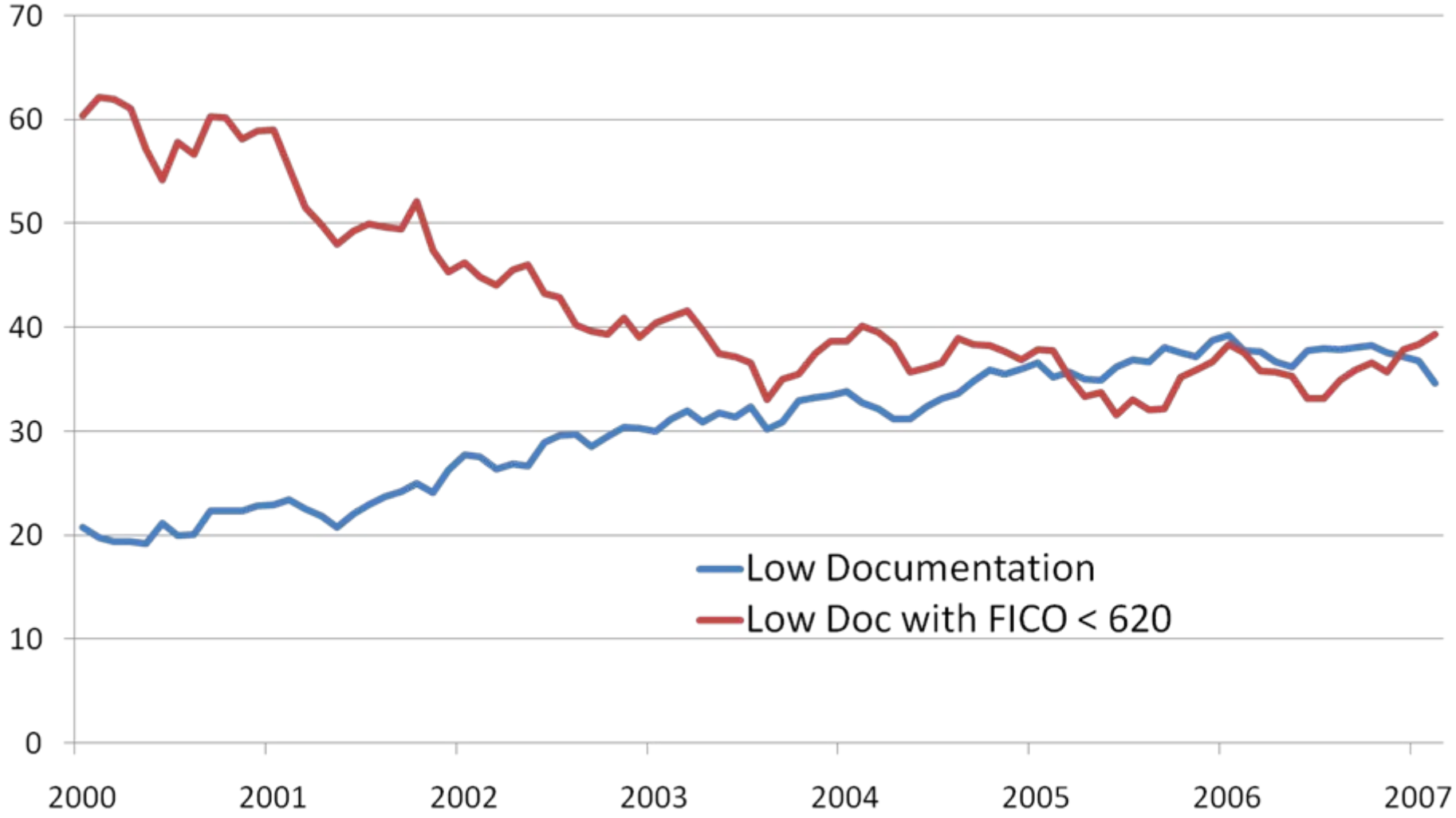
Multivariate Nature of Underwriting Standards

- 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.
- Similar trend observed for other characteristics, Like Occupancy Type, LTV etc.

FICO and Full Documentation



FICO and Low Documentation



FICO and Default

- Why did lenders choose higher FICO Scores?

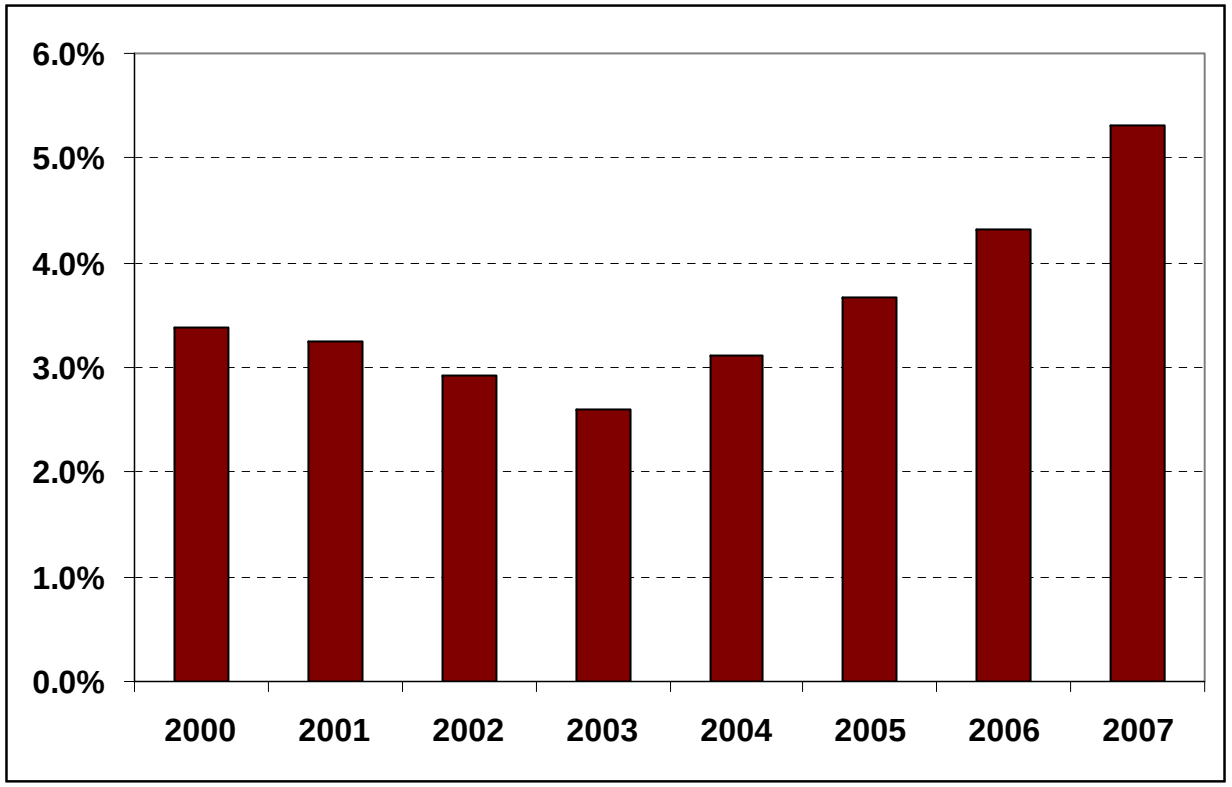
- Ex post, some industry experts have even faulted originators on this account:

  – "*... 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- Fortune Magazine, Aug. 4, 2008

FICO as a predictor of default

Average Impact of Improvement in FICO on ex-post probability of surviving delinquency event

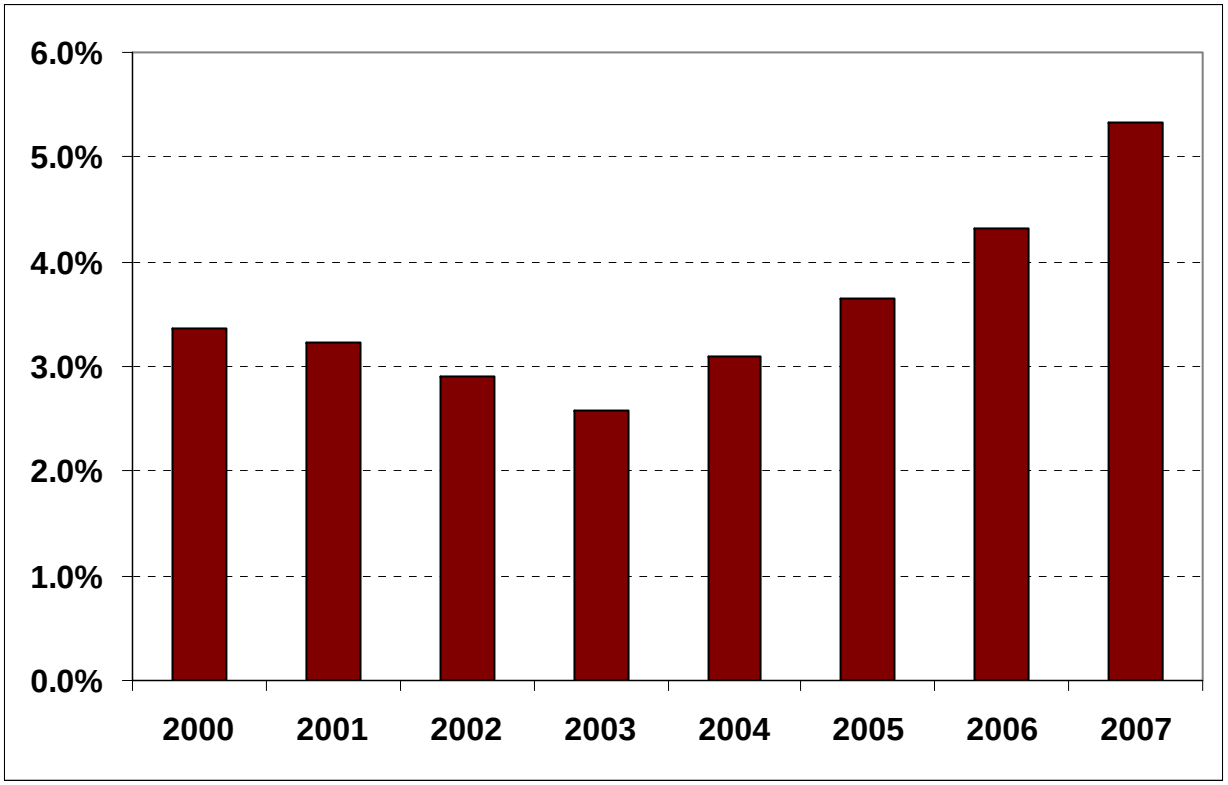


FICO BINS

< = 539	540 - 579	580 - 619	620- 659	660 - 699	700 - 739	> = 740

FICO as a predictor of default

Average Impact of Improvement in FICO on ex-post probability of surviving delinquency event



FICO BINS

< = 540	541 - 580	581 - 620	621- 660	661 - 700	701 - 740	> = 741

Determinants of Default

- We show that a higher FICO score *at origination* significantly lowers the probability of (*ex post*) default.
- What Explains our Contrarian Results?
- Do not account for the endogeneity bias introduced by including mortgage terms in a default regression

Endogeneity of Mortgage Terms: *Asymmetric Information* Theory

- **Adverse Selection:** 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**: 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

- ***Advances in empirical contract theory*:** Chiappori and Salanie, (2000); Chiappori et al. (2006)

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

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

Option One Mortgage Corporation, west area rate sheet, effective 11/09/2007, downloaded on 07/03/2008, http://www.oomc.com/broker/broker_rateguide.asp

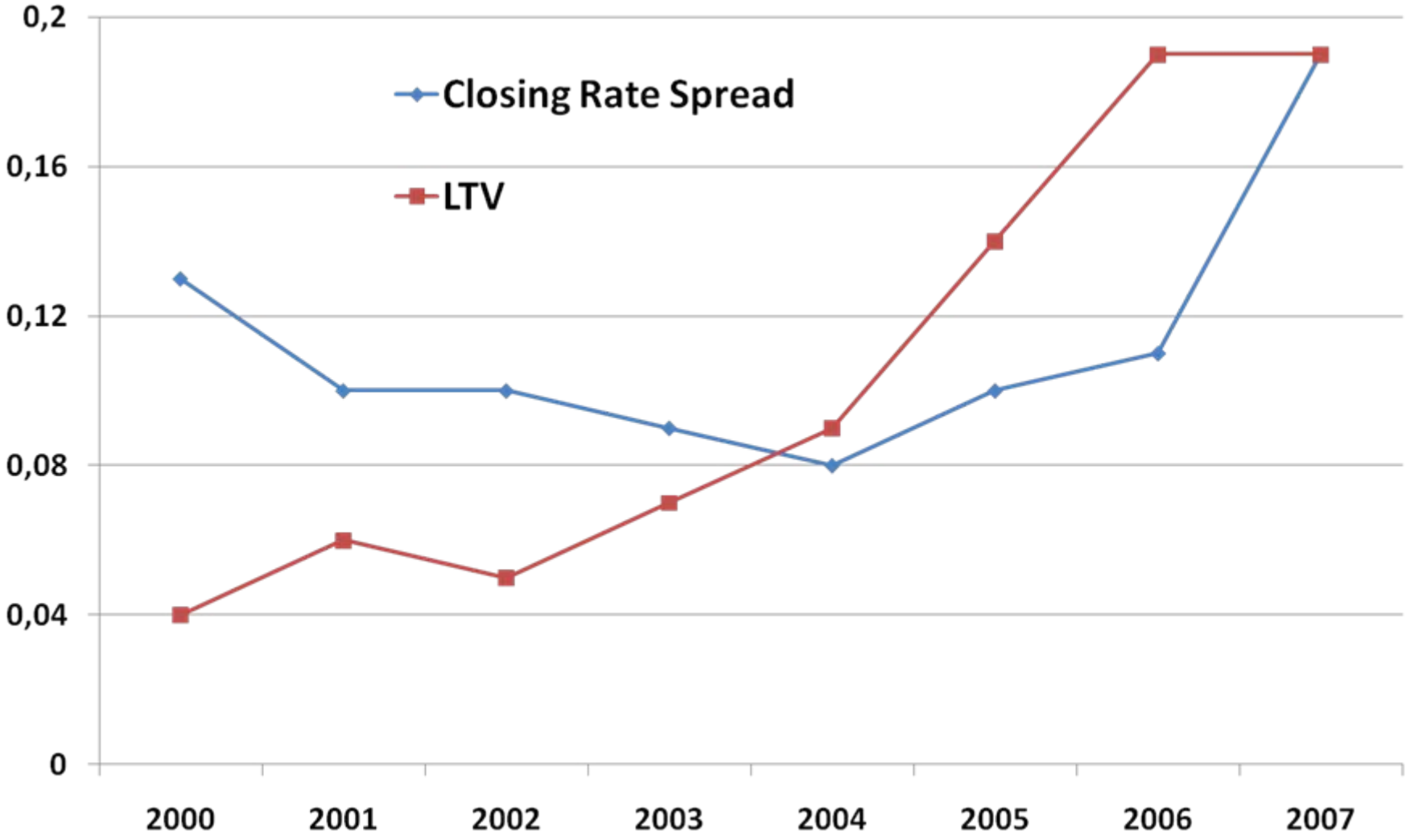
Mortgage Pricing Sheet: Cutts and Van Order (2005)

Table 4. 30-year fixed-rate mortgage pricing for subprime loans.

Credit grade	*Credit score*	*Mortgage history*	*Loan-to-value ratio*						
			65%	*70%*	*75%*	*80%*	*85%*	*90%*	*95%*
AA	680	<80% LTV and [1 × 30 days late last 12	7.45	7.60	7.85	8.10	8.60	9.20	9.80
	650	months or 3 × 30 days late last 24 months]	7.75	7.90	8.15	8.40	8.90	9.49	10.10
	620	or =80% LTV and 1 × 30 days late last 12	8.20	8.35	8.60	8.85	9.35	9.90	10.30
	600	months	8.49	8.65	8.90	9.15	9.65	10.15	10.40
	580		8.65	8.80	9.05	9.30	9.80	10.25	
A	660	<80% LTV and [2 × 30 days late last 12	8.20	8.35	8.60	8.85	9.35	9.95	
	620	months or 0 × 60 days late last 24 months]	8.45	8.60	8.85	9.10	9.60	10.20	
	580	or =80% LTV and 2 × 30 days late last 12	8.85	9.00	9.25	9.60	10.00	10.60	
	560	months	9.05	9.20	9.45	9.70	10.49	11.30	
B	640	<80% LTV and [4 × 30 days late last 12	8.70	8.85	9.10	9.45	9.95		
	600	months or 1 × 60 days late last 24 months]	9.05	9.20	9.45	9.80	10.30		
	580	or =80% LTV and 4 × 30 or 2 × 30 or	9.30	9.49	9.70	10.05	10.49		
	540	1 × 60 days late last 12 months	10.10	10.30	10.49	10.90			
C	600	6 × 30 or 1 × 60 or 1 × 90 days late last 12	10.15	10.40	10.90				
	570	months	10.49	10.75	11.25				
	540		11.15	11.40	11.90				
	520		11.35	11.60	12.10				
CC	580	Exceeds "C"	11.60						
	550		12.05						
	530		12.35						
	500		13.05						

Positive Correlation: Endogeneity Bias

Chiappori and Salanie, (2000)

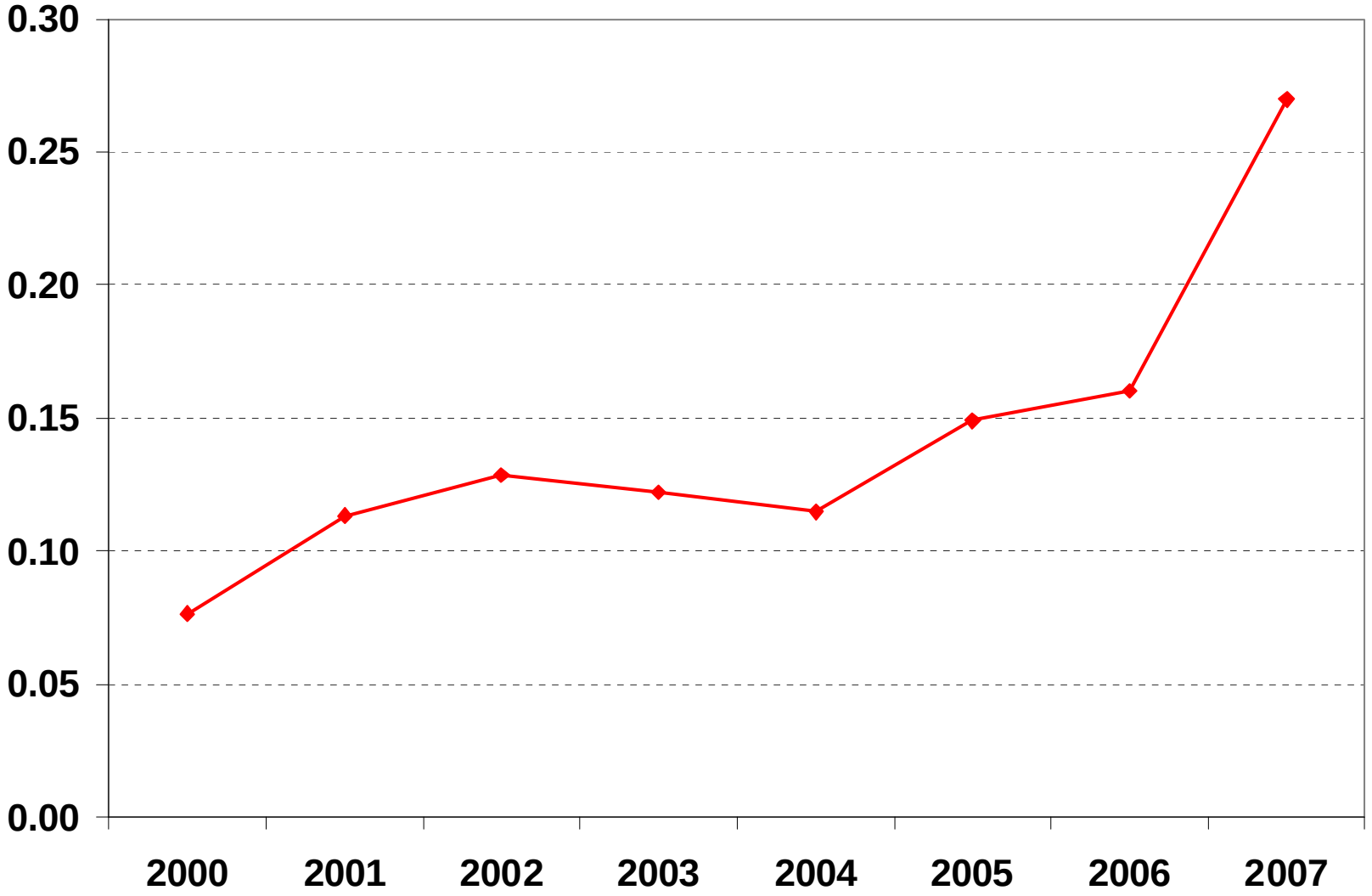


Impact of Endogeneity Bias

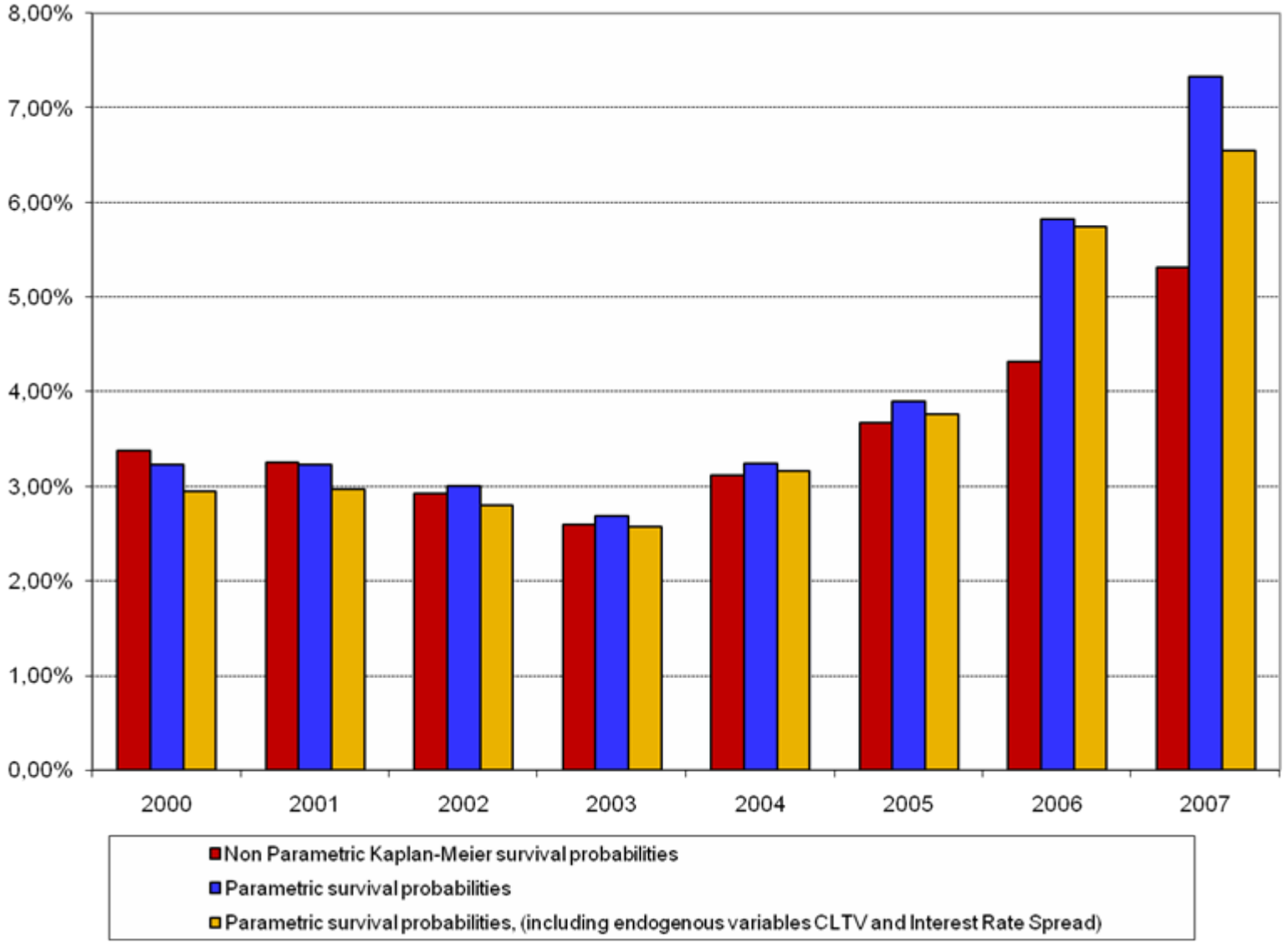
On the Interpretation of Structural relationship between Underwriting and Default

	Estimated Hazard Ratios					
	FICO			Full-Doc Dummy		
		With Closing Rate Spread	Bias		With Interest Rate Spread	Bias
2000	0.450	0.526	0.077	0.875	0.902	0.027
2001	0.440	0.553	0.113	0.862	0.884	0.021
2002	0.413	0.542	0.129	0.822	0.867	0.045
2003	0.367	0.489	0.122	0.745	0.806	0.061
2004	0.399	0.514	0.115	0.752	0.835	0.083
2005	0.485	0.634	0.149	0.692	0.802	0.110
2006	0.550	0.711	0.160	0.652	0.754	0.102
2007	0.556	0.826	0.270	0.666	0.816	0.151

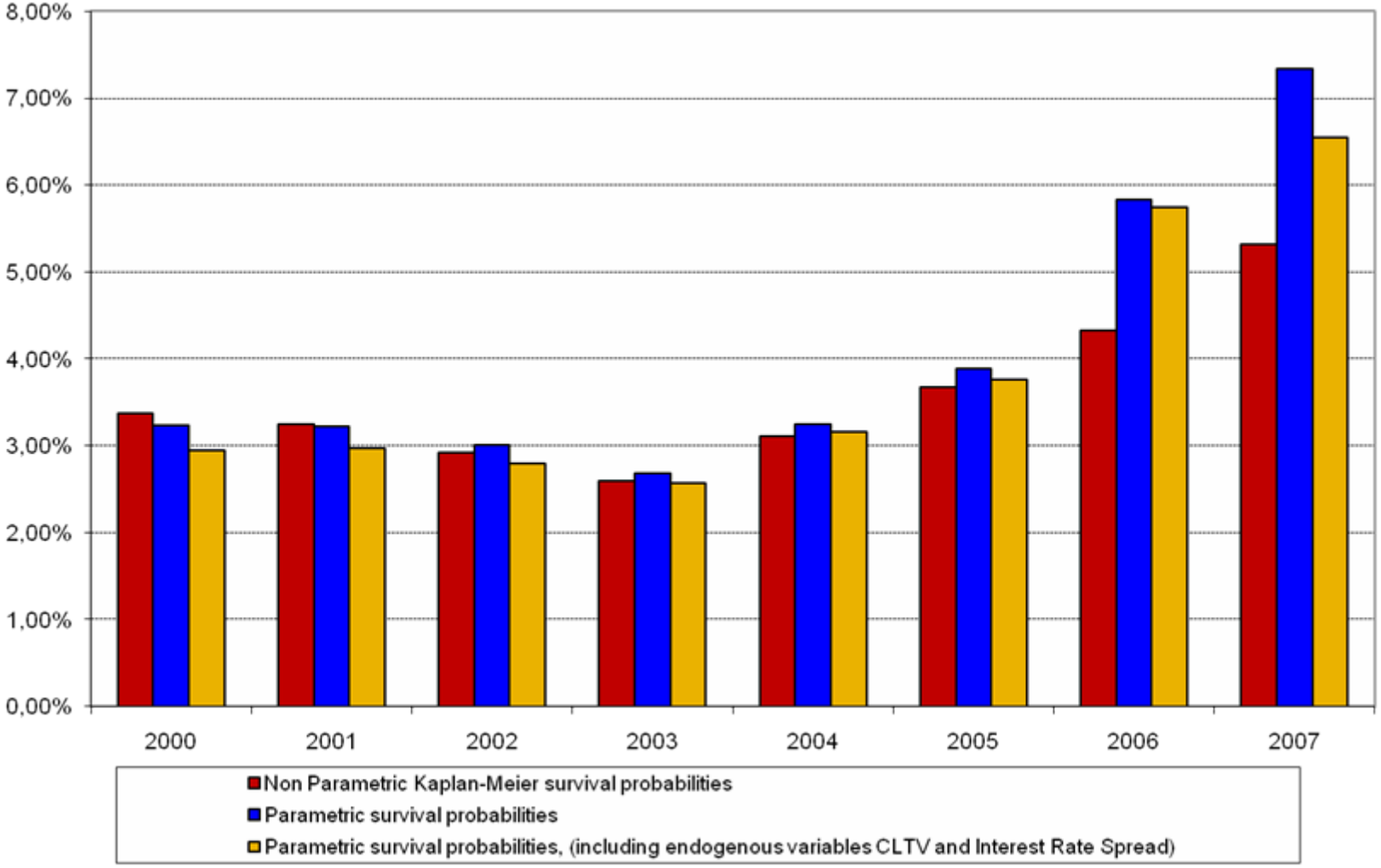
Magnitude of Bias in FICO Hazard Ratios



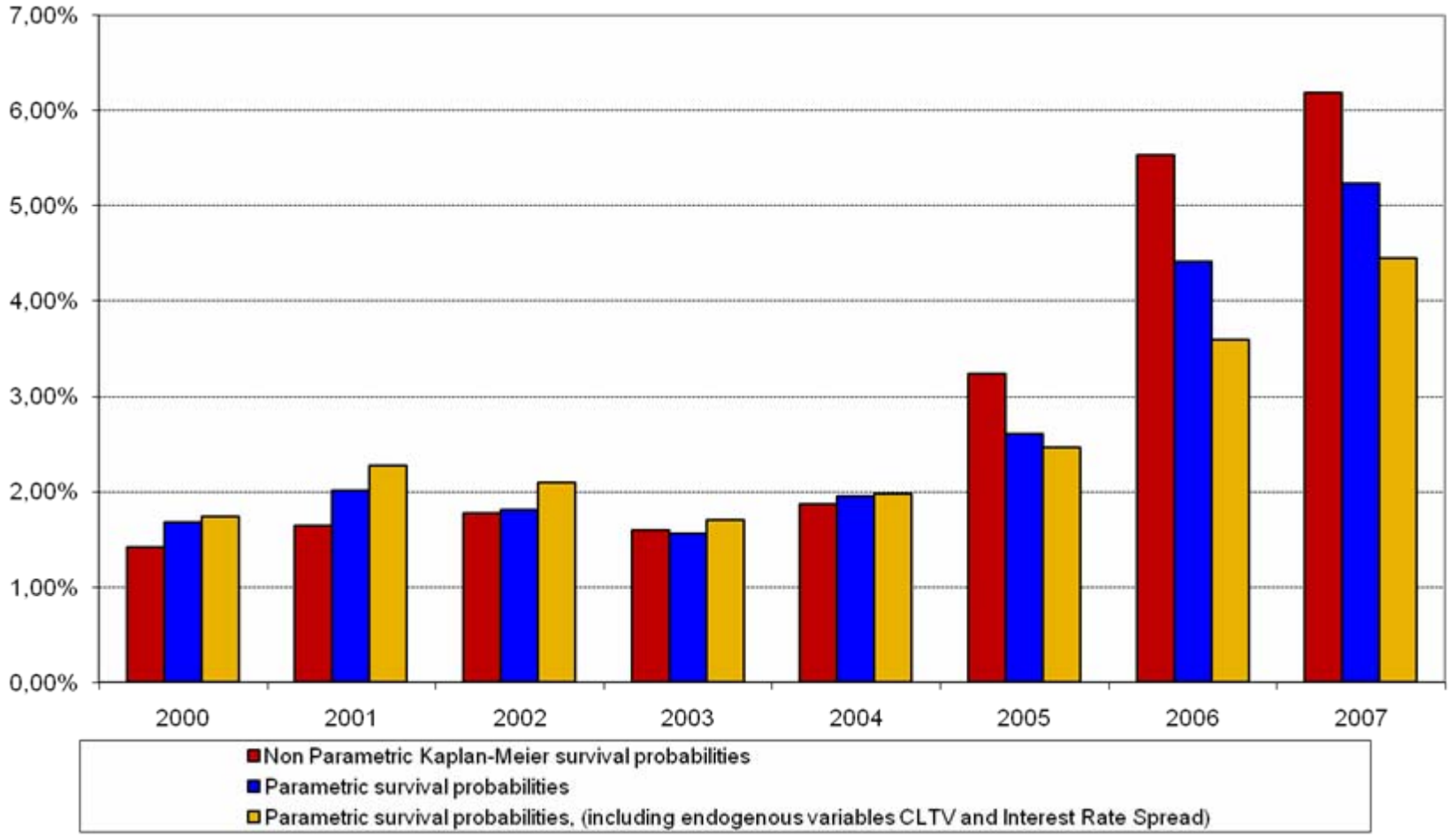
Performance of FICO



Performance of FICO: Lower FICO scores



Performance of FICO: Higher FICO scores



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

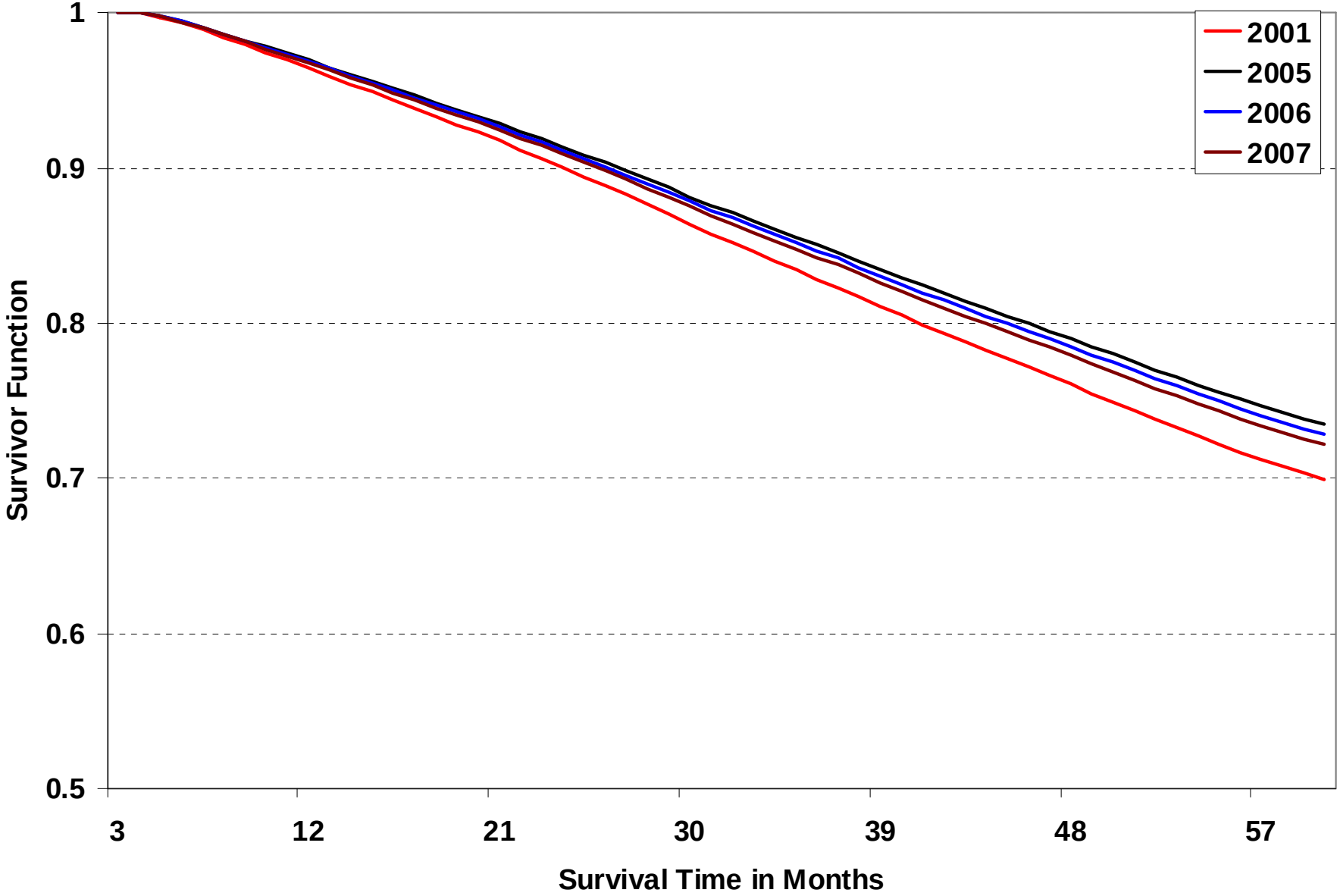
Counterfactual Analysis

- 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?

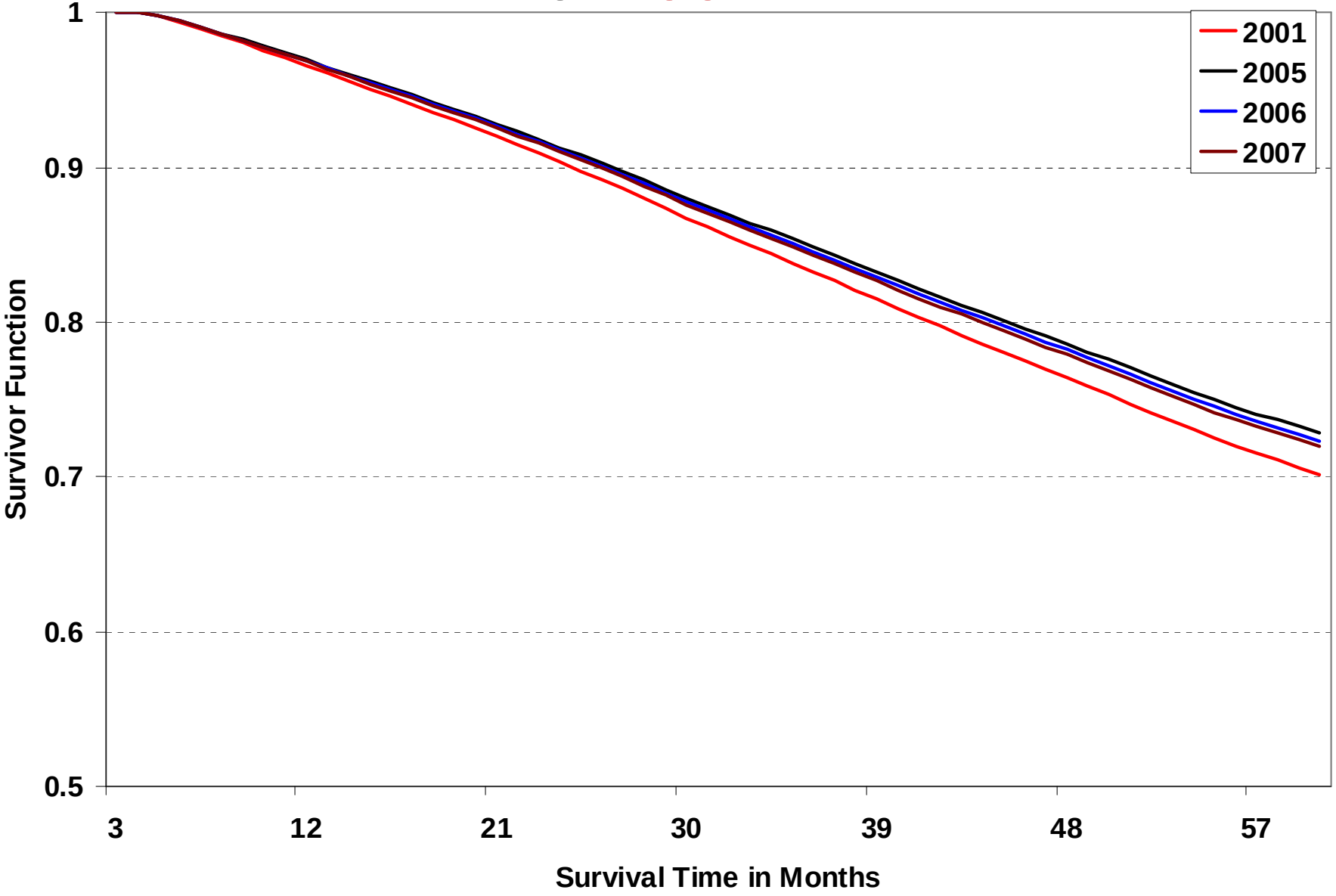
Counterfactual Analysis:

Survival Plots, Base Year 2001



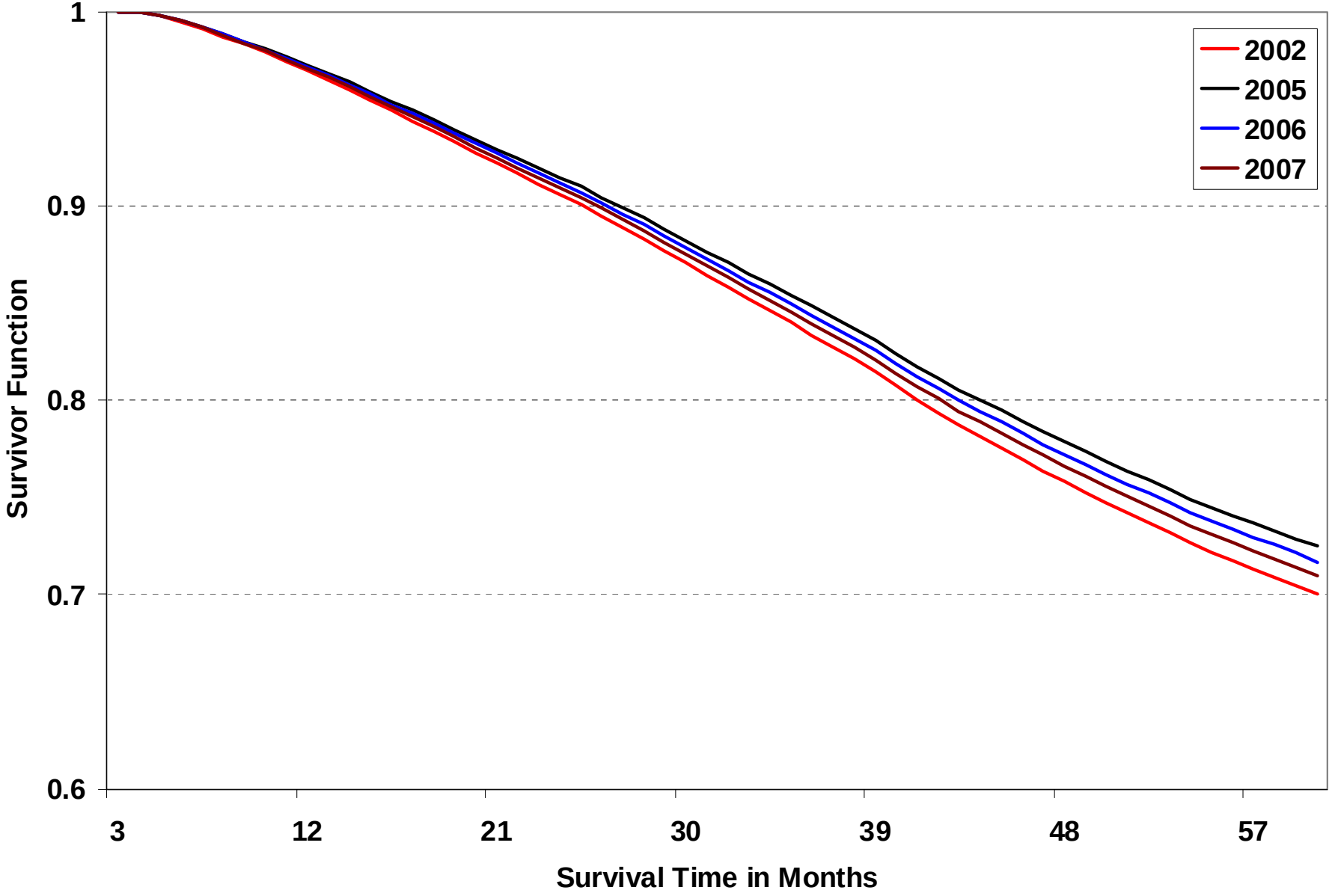
Counterfactual Analysis:

Robustness: Including mortgage terms, Base Year 2001



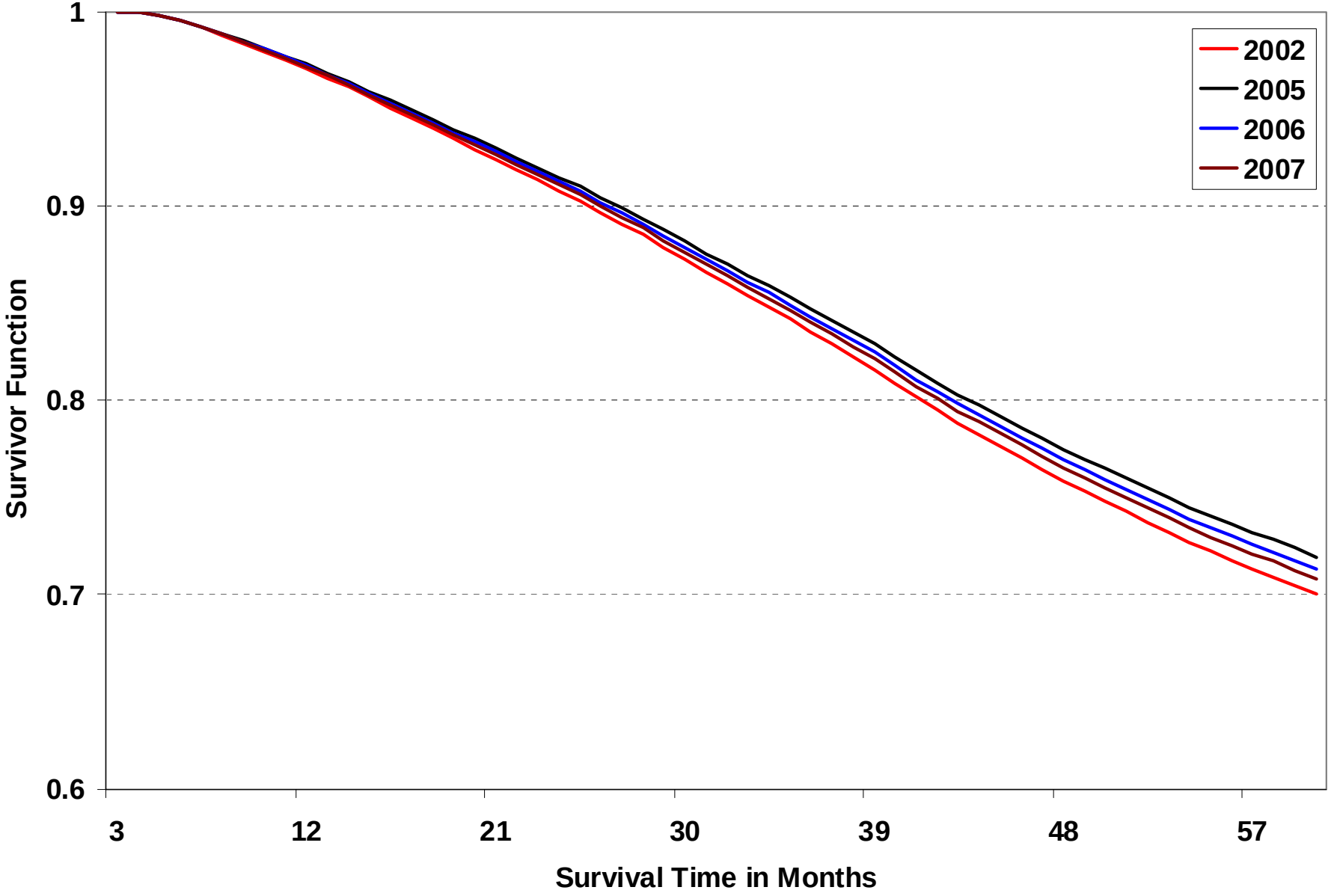
Counterfactual Analysis:

Survival Plots, Base Year 2002



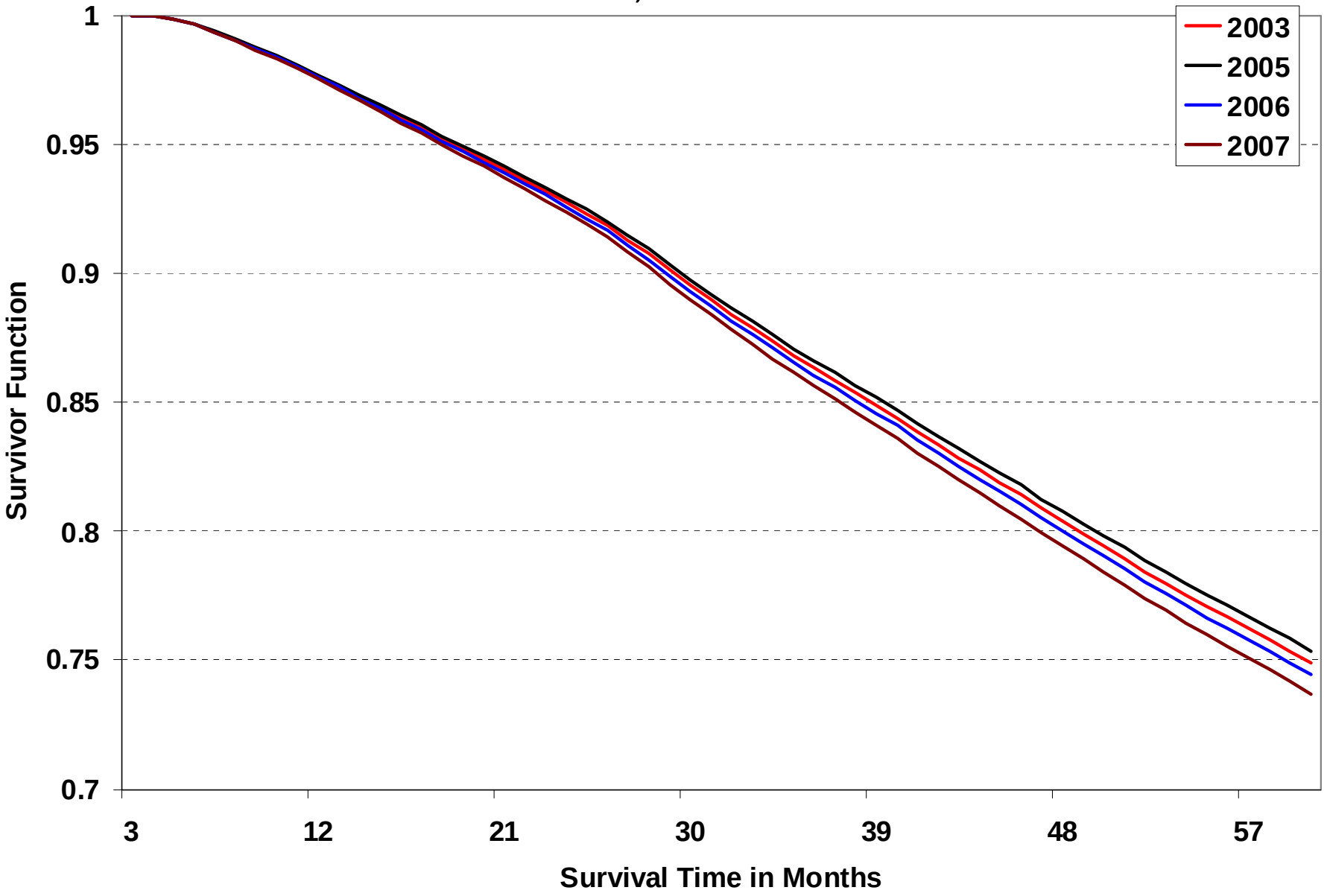
Counterfactual Analysis:

Robustness: Including mortgage terms, Base Year 2002



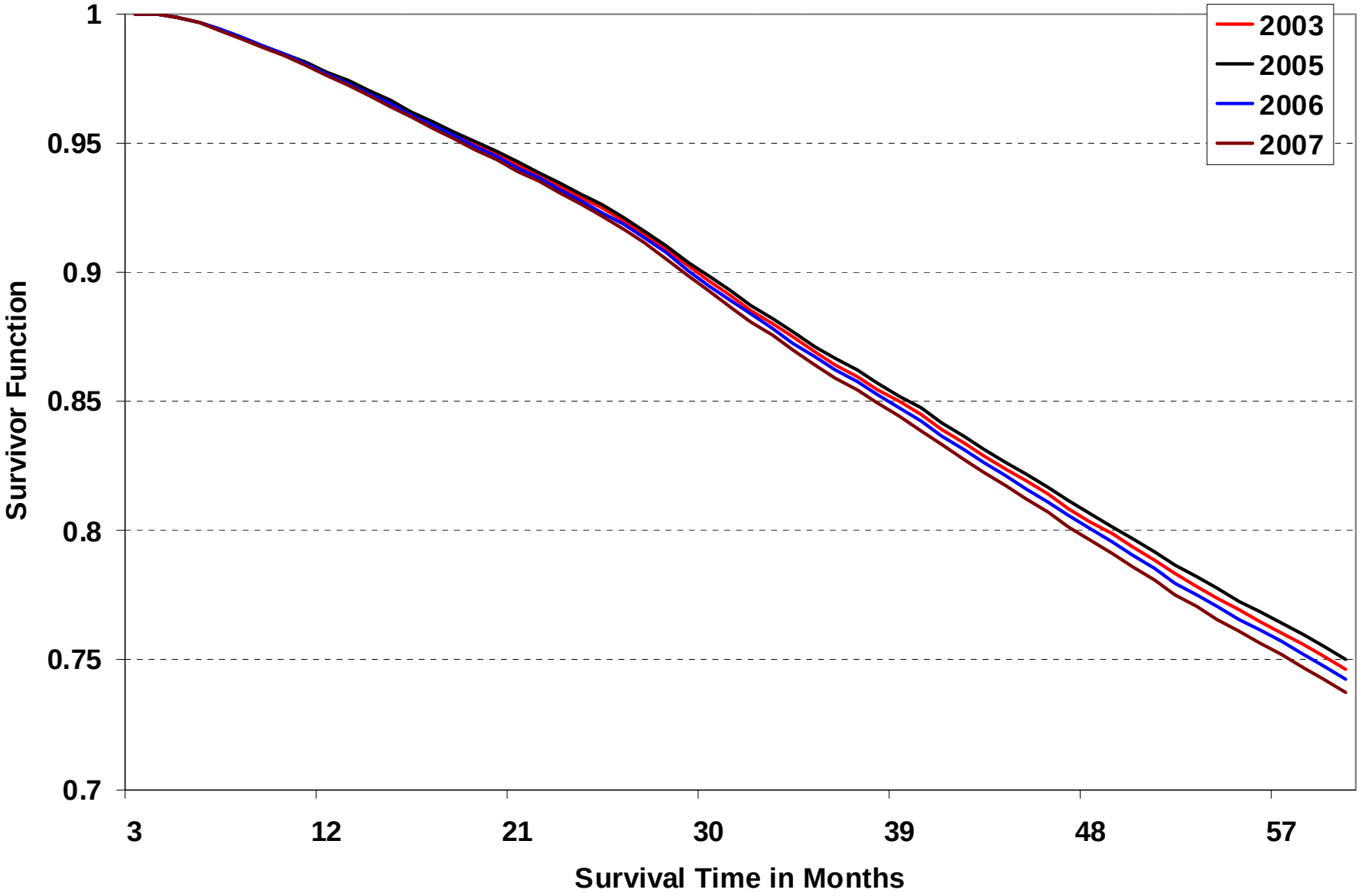
Counterfactual Analysis:

Survival Plots, Base Year 2003



Counterfactual Analysis:

Robustness: Including mortgage terms, Base Year 2003



Conclusion of 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 2006 vintages and that of the 2003 vintage

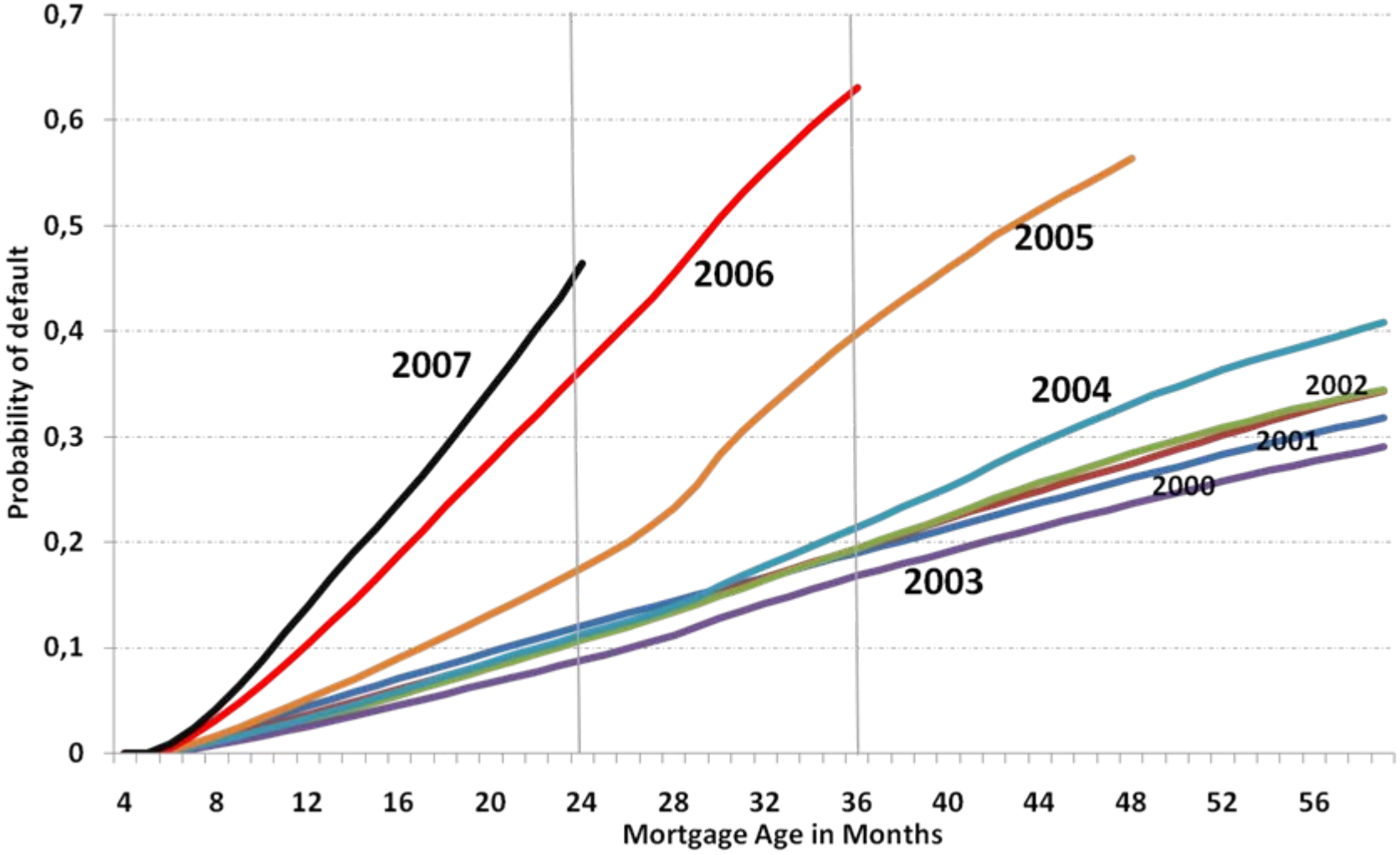
Conclusion

- Difficult to argue that deterioration in underwriting for subprime mortgages led to the collapse of this market

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

- **Flaw in subprime mortgage design**

Subprime Default Probabilities

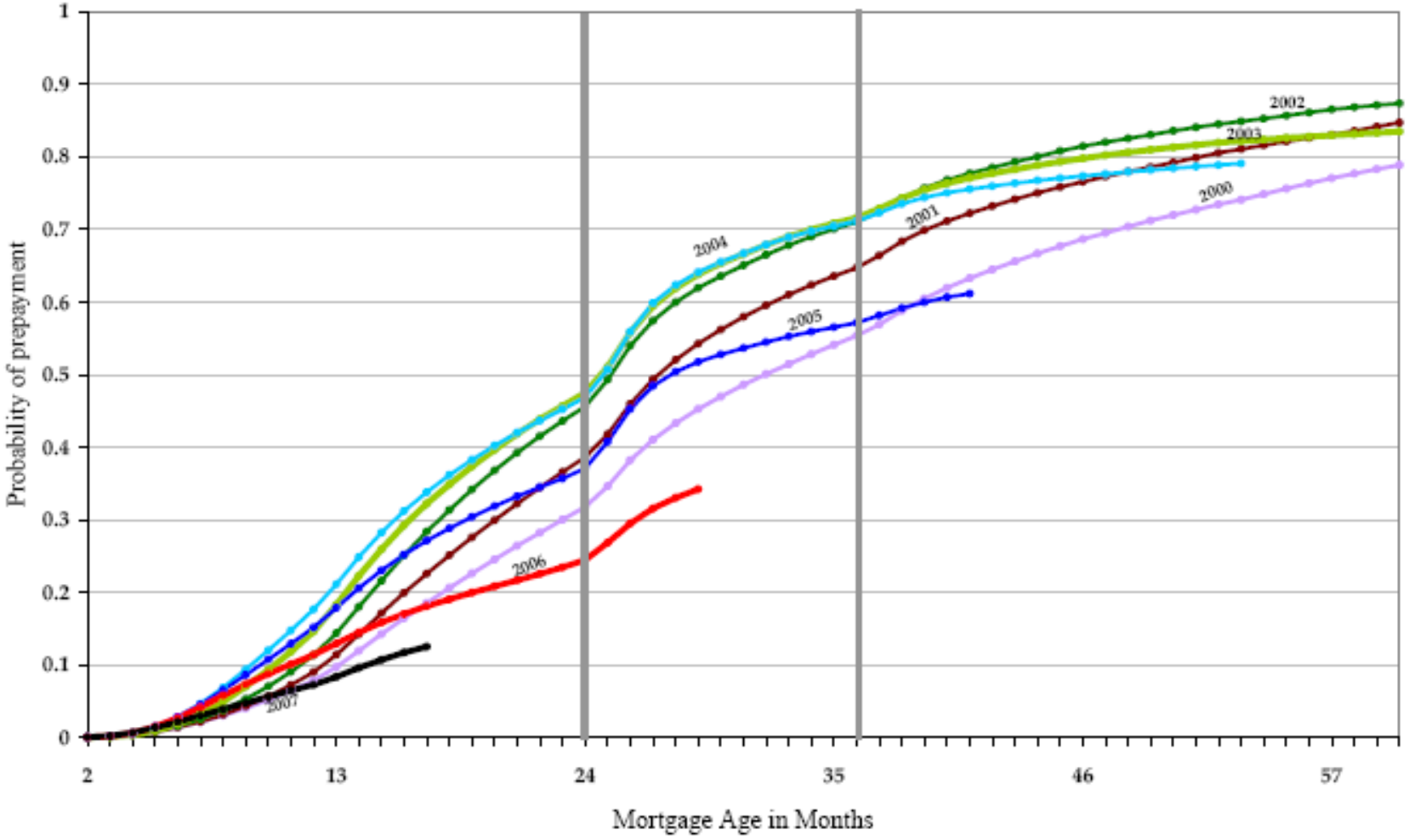


Additional Slides

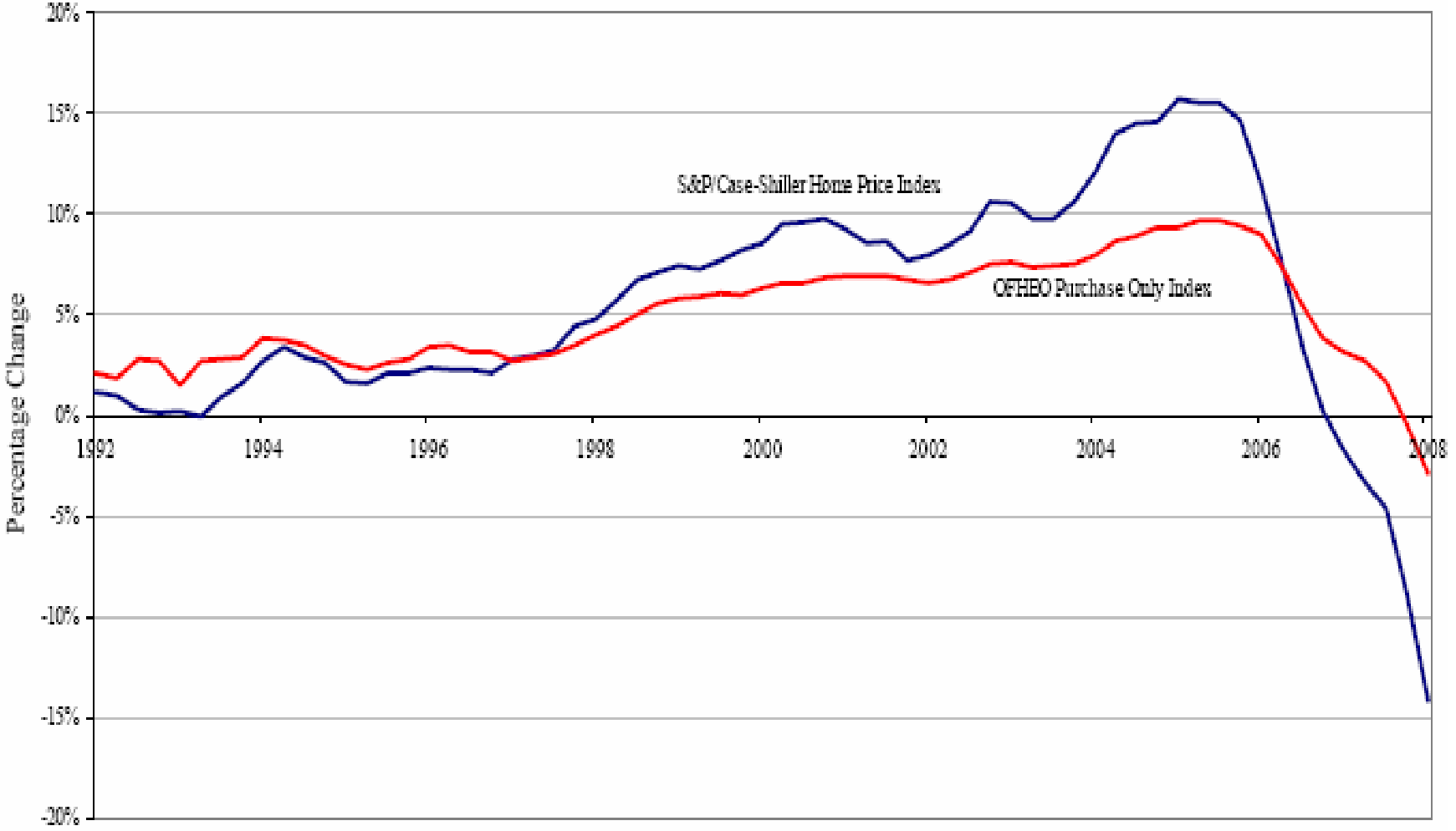
DTI: Missing Values on early vintages

	<=20	20-40	40-60	60-80	80-100	Information Missing
1998	12.60%	52.40%	34.70%	0.30%	0.00%	**50.30%**
1999	9.60%	48.30%	42.00%	0.10%	0.00%	**40.80%**
2000	8.10%	45.40%	46.40%	0.10%	0.00%	**36.90%**
2001	7.80%	44.70%	47.40%	0.10%	0.00%	**34.90%**
2002	6.30%	43.80%	49.90%	0.10%	0.00%	**34.80%**
2003	5.20%	44.20%	50.60%	0.00%	0.00%	**29.00%**
2004	4.60%	42.20%	53.20%	0.00%	0.00%	**26.30%**
2005	3.80%	39.60%	56.60%	0.00%	0.00%	**30.20%**
2006	3.40%	35.50%	61.10%	0.00%	0.00%	**20.30%**
2007	3.50%	35.00%	61.60%	0.00%	0.00%	**31.80%**

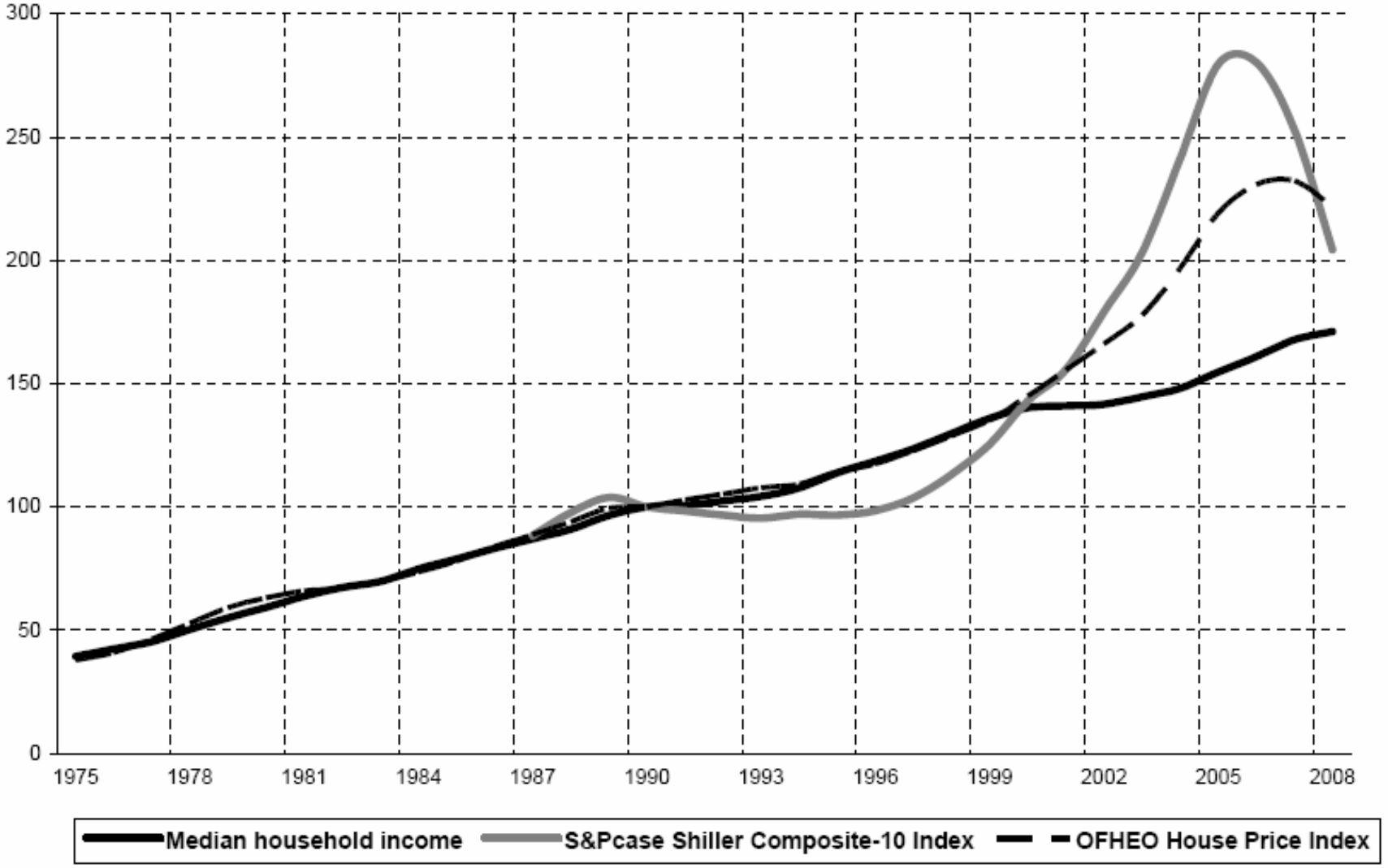
Prepayment Probabilities



Growth rate of House Prices

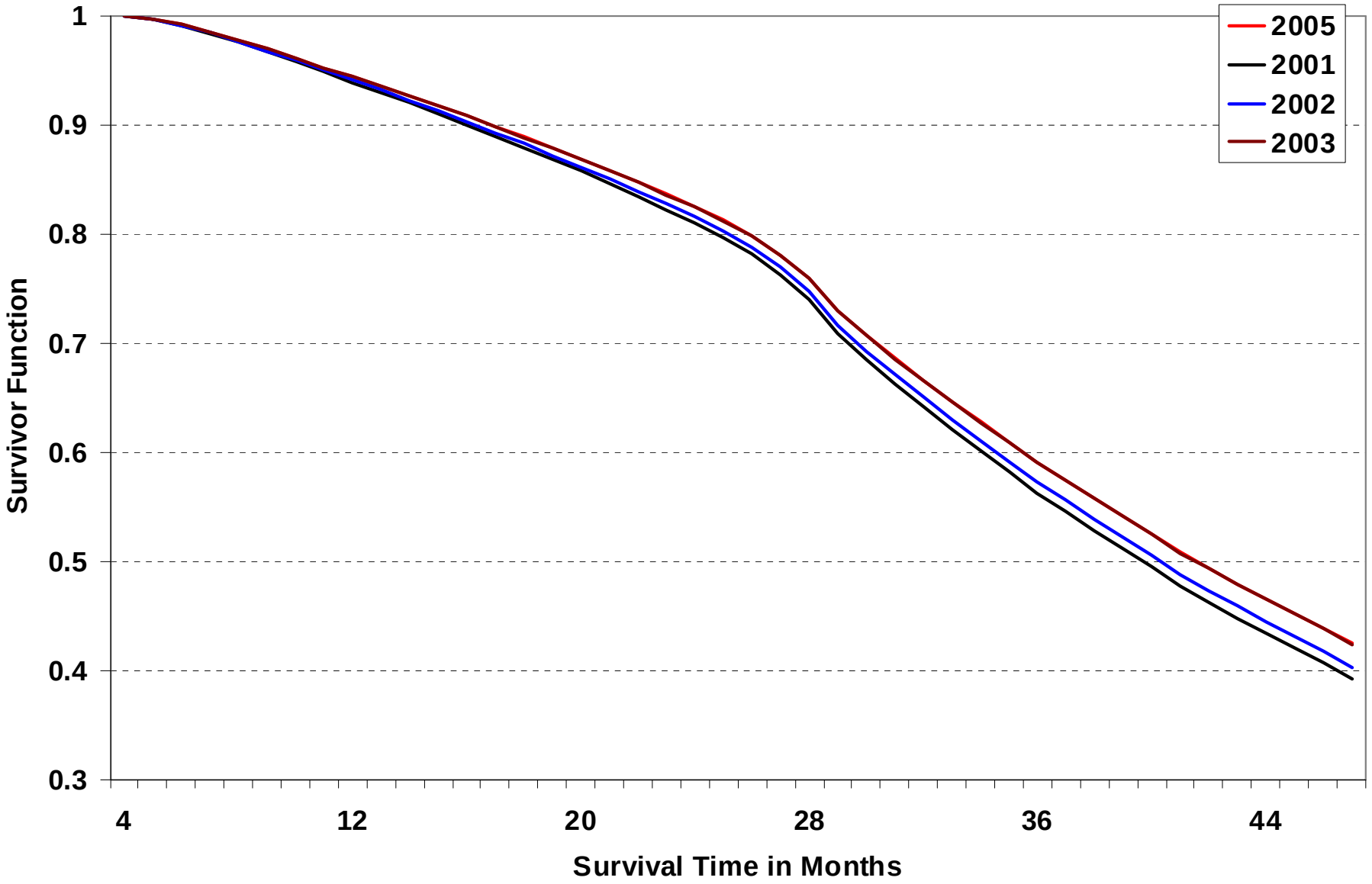


Sustainable?



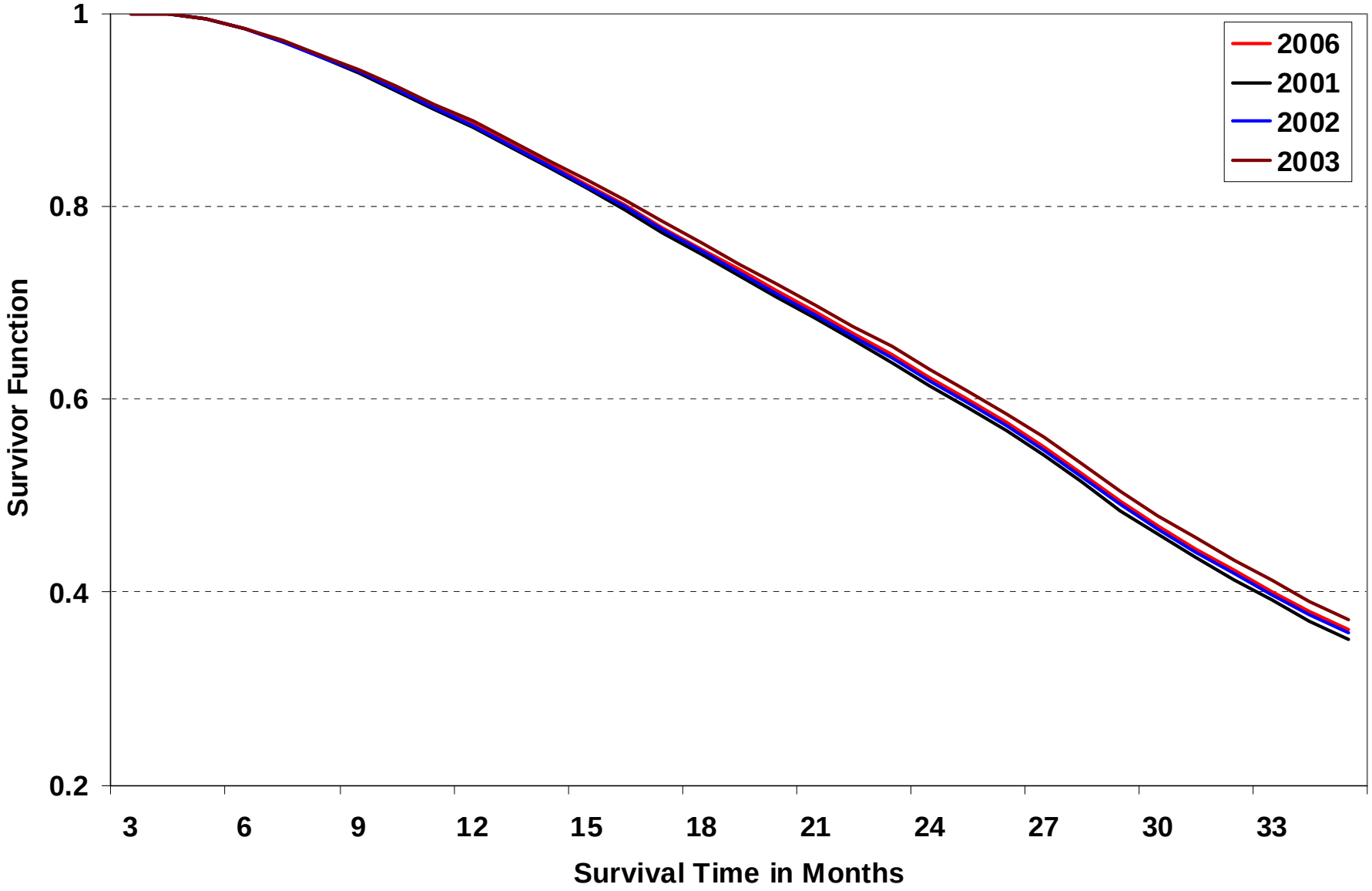
Counterfactual Analysis:

Robustness: Reverse Counterfactual, Base Year 2005



Counterfactual Analysis:

Robustness: Reverse Counterfactual, Base Year 2006



Counterfactual Analysis:

Robustness: Reverse Counterfactual, Base Year 2007