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# Do Default Hazards Change over Time? Implications for Effective Loan Modification Strategies

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# Organization

- Motivation of research
- Empirical methods and data
- Estimation results
- Implications and immediate future research



## Motivation

- The impacts of the Great Recession
  - Almost 1 in 10 mortgages are delinquent
  - Q4 2009 1/138 U.S. housing units received foreclosure filing
  - 11.3 million homes 'under water' as of end 2009
  - Unemployment rate close to 10%, worse in some places
- Loan modification to the rescue
  - Home Affordable Modification Program (HAMP)
- High re-default rate in modification programs
  - As high as 50%



## Motivation

- Earlier loan modification programs have been viewed as successful
  - Capone and Metz (2003)
  - They point out loss mitigation efforts are less successful when economic condition worsens
- Why current modification programs face performance challenge?



# Motivation

- Previous success and experience may be time specific
- We are interested in the default hazard changes before and after the onset of the housing crisis
- Can loan modification programs be more effective?



# Empirical strategy

- Competing risk, proportional (Cox) hazard model
- Hazard rate: conditional event probability

$$\lambda_i^r(t | X_i(t)) = \lim_{\Delta t \rightarrow 0} \frac{\Pr(t < T_i^r < t + \Delta t | T_i^r \geq t, X_i(t))}{\Delta t}$$



## Empirical strategy

- Specifications

$$\lambda_i^r(t | X_i(t)) = \exp(\lambda_0^r(t) + X_i(t) * \beta_r)$$

$$\lambda_0^r(t) = \alpha_1^r * t + \alpha_2^r * t^2$$



# Empirical strategy

- Specifications

$$S_i(t | X_i(t)) = \Pr(T_i \geq t) = \Pr(T_i^D \geq t) * \Pr(T_i^P \geq t)$$
$$= \exp\left(\int_0^t [\lambda_i^D(s | X_i(t)) + \lambda_i^P(s | X_i(t))] ds\right)$$



# Empirical strategy

- Sample of Community Reinvestment Loans
  - Self-Help – CAP loans
  - Around 50,000 loans
  - Loans originated up to very recent
- Samples before and after second quarter of 2006 which is chosen as the ‘crisis date’
  - The choice of ‘crisis date’ does not seem to affect the results significantly



## Variable definition -- Self Help mortgage data

MPRICE (t)	Estimated Market price of housing unit
CLTV (t)	Estimated Current loan to value ratio
RPSAPP (t)	Estimated appreciation provided by Fannie Mae
OCRSCORE	Original credit score
MRATE (t)	Market mortgage rate
UNEMPR (t)	Local unemployment rate
MULTIFAM	Multifamily housing dummy



## Descriptive statistics (Mean) of Self Help mortgage data

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MPRICE (t)	Estimated market price of housing unit (10k)	11.619
CLTV (t)	Estimated current loan to value ratio	0.759
RPSAPP (t)	Estimated appreciation rate	0.005
OCRSCORE	credit score at origination	6.802
MRATE (t)	market mortgage rate	6.000
UNEMPR (t)	local unemployment rate	0.055

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# Results

- Default and prepayment hazards are similar qualitatively for many factors pre and post the housing crisis
  - Current loan to value ratio, market mortgage rate, credit score at origination, appreciation rate, unemployment



**Table 3 Completing Risk Analysis of Pre Crisis Date Sample**

Default/Prepay	Variables	Definition	Coefficient	Stan. Error
Default	CLTV	current loan to value ratio	0.624***	0.097
	MPRICE	market price of housing unit	-0.056***	0.010
	MRATE	the market mortgage rate	0.199***	0.068
	OCRSCORE	credit score at origination	-1.222***	0.050
	RPSAPP	appreciation rate	-3.565***	0.877
	T	time in quarters	0.383***	0.069
	T^2	time squared	-0.019***	0.005
	UNEMPR	local unemployment rate	6.104**	2.544
Prepayment	CLTV	current loan to value ratio	-1.588***	0.106
	MPRICE	market price of housing unit	0.004***	0.001
	MRATE	the market mortgage rate	-0.953***	0.038
	OCRSCORE	credit score at origination	0.088***	0.027
	RPSAPP	appreciation rate	5.760***	0.369
	T	time in quarters	0.595***	0.038
	T^2	time squared	-0.031***	0.002
	UNEMPR	local unemployment rate	6.830***	1.253

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%



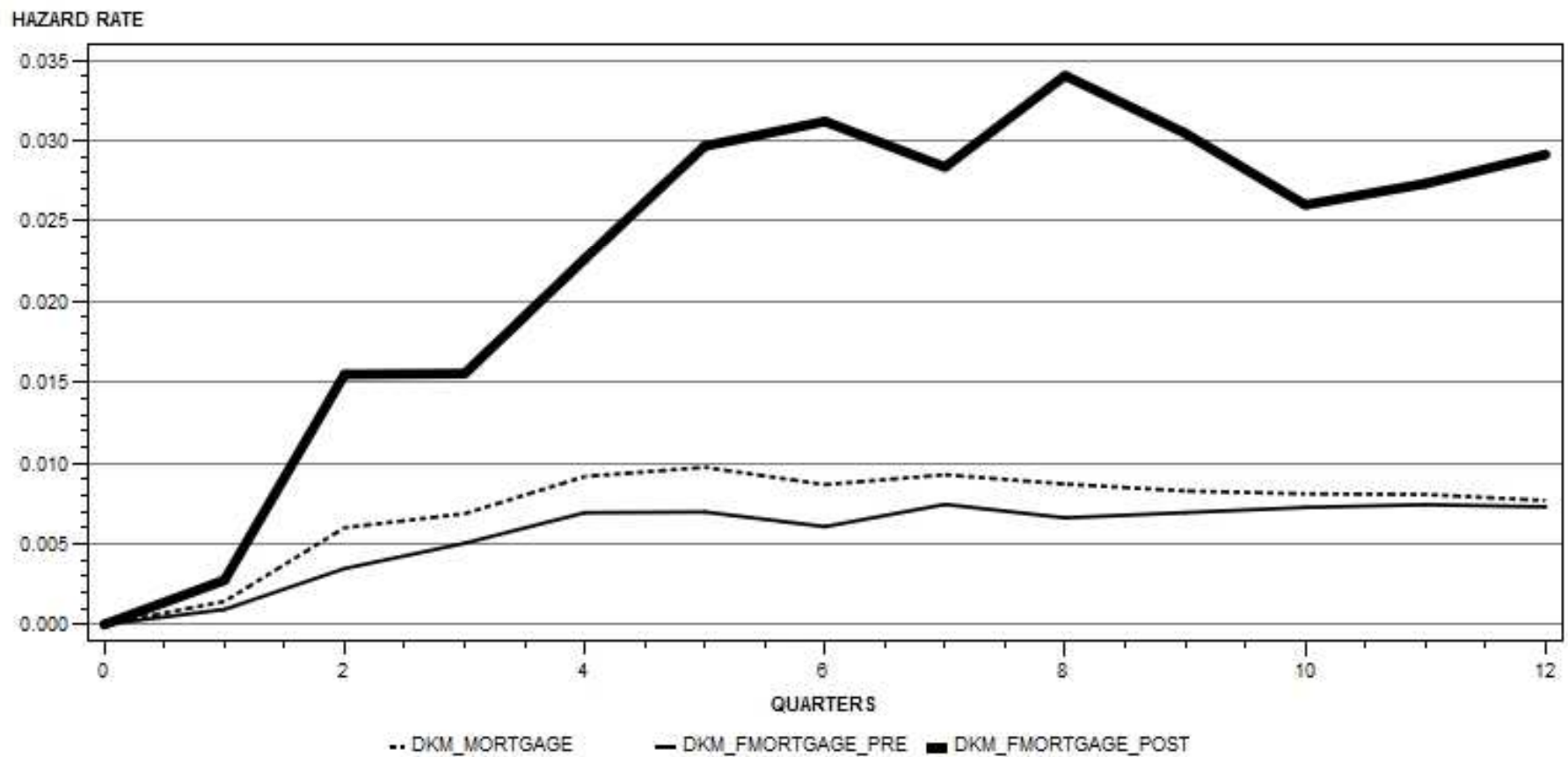
**Table 4 Completing Risk Analysis of Post Crisis Date Sample**

Default/Prepay	Variables	Definition	Coefficient	Stan. Error
Default	CLTV	current loan to value ratio	0.643***	0.118
	MPRICE	market price of housing unit	0.034***	0.011
	MRATE	the market mortgage rate	0.160**	0.066
	OCRSCORE	credit score at origination	-1.270***	0.072
	RPSAPP	appreciation rate	-1.574***	0.777
	T	time in quarters	0.539***	0.067
	T^2	time squared	-0.038***	0.006
	UNEMPR	local unemployment rate	12.135***	2.257
Prepayment	CLTV	current loan to value ratio	-2.711***	0.458
	MPRICE	market price of housing unit	0.028	0.017
	MRATE	the market mortgage rate	-0.819***	0.112
	OCRSCORE	credit score at origination	0.151***	0.103
	RPSAPP	appreciation rate	0.846	1.345
	T	time in quarters	0.657***	0.123
	T^2	time squared	-0.043***	0.010
	UNEMPR	local unemployment rate	-10.239**	4.281

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

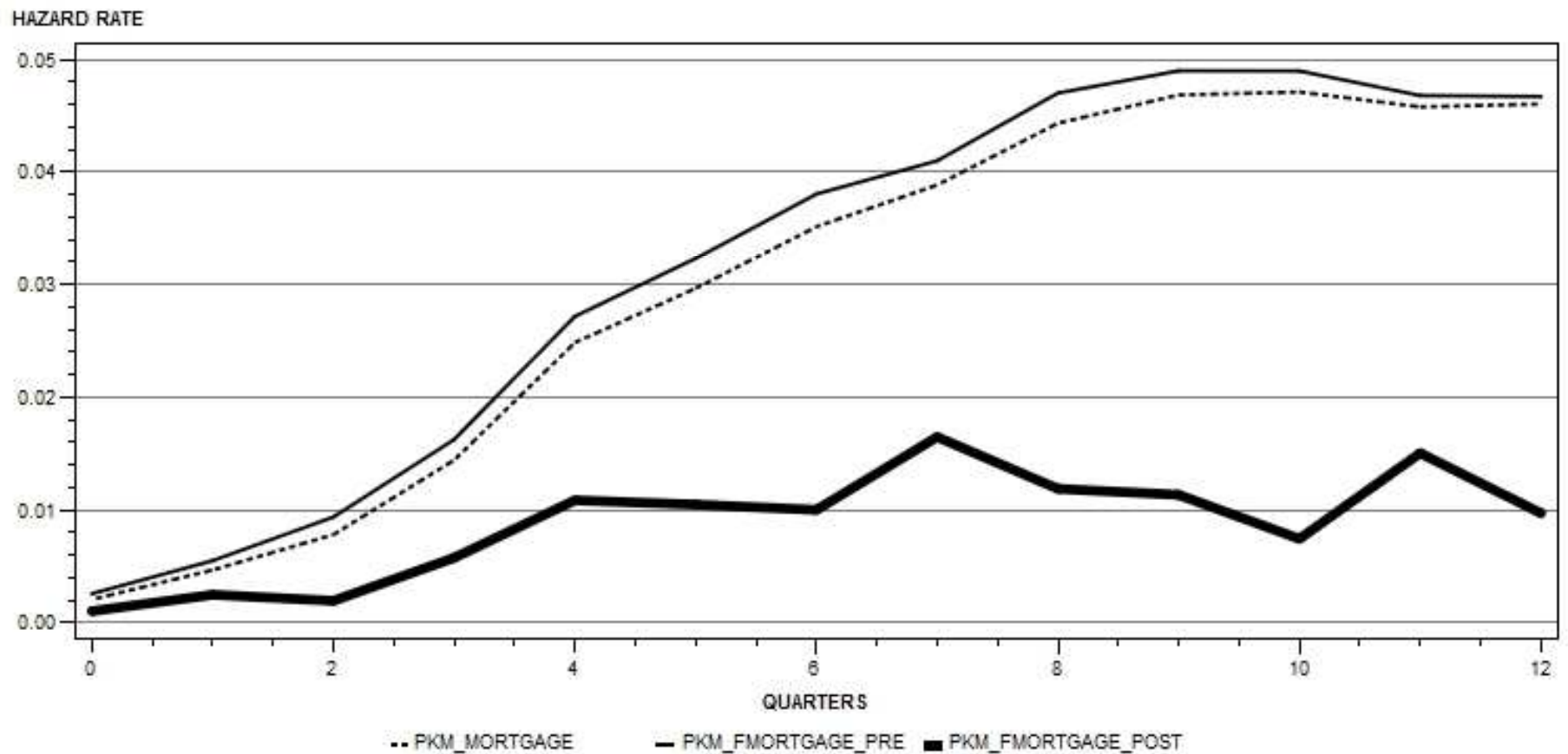


## Kaplan-Meier default hazards





## Kaplan-Meier prepayment hazards





## Results

- Magnitude of impact that individual factors have on hazards changed after the onset of the crisis
  - Controlling for appreciation rate



## Pre-crisis

Default/Prepay	Variables	Coefficient	Stan. Error
D	MPRICE	-0.056***	0.010
D	UNEMPR	6.104**	2.544

## Post-crisis

Default/Prepay	Variables	Coefficient	Stan. Error
D	MPRICE	0.034***	0.011
D	UNEMPR	12.135***	2.257



## Immediate future steps

- Incorporating more variables:
  - Borrower characteristics, initial mortgage conditions, front end, back end ratios



## Policy implications: house price level

- Market price seems to be an indicator for risk rather than credit worthiness compared to pre-crisis date experience
- Tailor loan modifications promoting a more effective use of principal reduction



## Policy implications: high unemployment

- The importance of employment status in determining default has amplified
- To minimize loss of home among unemployed and underemployed borrowers, interventions need to go beyond loan modification
- Recent changes to HAMP are a step in the right direction but 3 months (up to 6) of lower mortgage payments may not be enough with the economy not generating enough jobs