The Impact of Repossession Risk on Mortgage Default

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July 02, 2018
ZEW Summer Workshop for Young Economists

Does reducing repossession risk lead to an increase in mortgage default?

Repossession Risk and Mortgage Default

- ▶ Moral hazard
- ▶ Policy question: existence and magnitude
- ▶ Policy importance: mortgage modification, counter-cyclical policy

This paper

- Exploit *quasi-experimental variation in Irish repossession law* to test whether repossession risk matters for mortgage default.
- Analyse whether *treated loans defaulted at a higher rate* after a legal ruling striking down law.
- Explore heterogeneous treatment effects using *causal forest* algorithm.

Preview of results

- ▶ Methodology
  - Cut-off date in a legal judgment: law does not apply to originated before cut-off
  - Two cohorts originated either side of the cut-off date
  - Difference-in-differences research design comparing pre and post default rates
- ▶ Removing repossession risk lead to an immediate increase in default rates.
  - 1-2 pp increase in cumulative default probability in one year after event.
  - ~40% increase over estimated counterfactual.
- ▶ Treatment effect highest for loans with lowest and negative home equity

What does economic theory tell us?

- ▶ Reducing the cost associated with mortgage default should increase the demand for it.
  - Home repossession large cost of default
  - Default may not be optimal
- ▶ Strategic default:
  - inframarginal borrowers default
- ▶ Social theory:
  - Mortgage default isn't a rational cost-benefit calculation
  - Driven by emotion, not amenable to economic analysis
  - Reduced default costs should not matter

Economic evidence

- ▶ Public finance, health: moral hazard exists
  - Einav & Finkelstein (2018): "compelling evidence that moral hazard in health insurance exists"
- ▶ Mortgage market
  - Mayer et al (2014): mortgage renegotiation programme led to increased default rates in U.S.
  - Ganong & Noel (2017): **Low** moral-hazard cost because mortgage default primarily driven by affordability
  - Collins & Urban (2016): No default response to New Jersey foreclosure moratorium

Research Design

Ireland: 2011 Court Judgment

- 2009 Land Act
  - December 2009: Land and Conveyancing Law Reform Act replaces 1964 law.
- July 2011: Justice Dunne rules that 2009 Act **failed to preserve relevant parts of the older law**
- After July 20111, mortgages originated before 1st December 2009 *cannot be repossessed* if borrower defaults.
  - 2 years passed before law fixed

A natural experiment

- ► For loans originated around *1st December 2009*: repossession risk quasi-randomly removed 1.5 years later in July 2011.
  - Treatment group originated before
  - Control group after
- ► Plausbily exogeneous: treatment group did not rush to get mortgages before the new law
  - Minor change to conveyancing law, routine procedure
- ► Difference-in-difference: use outcome of control group to estimate missing counterfactual for treatment group.

Hundreds of home repossession cases may be struck out

High Court judge finds gap in 2009 land Act

FIONA GARTLAND

HUNDREDS of property repossession cases could be struck out following a High Court ruling there was a "lacuna" – or gap – in legislation introduced in 2009.

On foot of the decision, counsel for one lender said his client would take a constitutional challenge of the Land and Conveyancing Law Reform Act 2009, which Ms Justice Elizabeth Dunne said yesterday may have had "unintended consequences".

The new Act was introduced on December 1st, 2009, and it only applied to mortgages created after that date, the judge found.

It repealed older conveyancing legislation and failed to save elements of the Registration of Title Act 1964 that would have allowed lenders to repossess properties with mortgages taken out before December 2009 that went into arrears after that date.

"It is not for the court to supply

tion of the Registration of Title Act 1964. In two of the cases, borrowers were sent demands for vacant possession of the property prior to December 1st, 2009, while in the other two, the demands were after that date.

Ms Justice Dunne ruled that legal proceedings started prior to the December date could continue.

Proceedings started after December 1st, but where a demand for possession had been made prior to the date, it could

Ms Justice Elizabeth Dunne: "not for court to supply that which is not contained in 2009 Act"

also continue. But in cases where a demand had not been made until after the date, lenders had no right to apply for possession.

He said there was an argument to be made about whether the Act could be valid, given it would deprive lenders of the remedy of repossession. He asked for time to consider notifying the Attorney General. The judge adjourned the case to November.

In a case taken by Bank of Ireland with a demand after the December date, the court was told the borrower was living in the US and had consented to an order for possession. Counsel for the lender asked the judge to consider making an order, given the consent.

"I can't do it and I'm not going to do it," Ms Justice Dunne said. "As far as I can see it, I have no jurisdiction to make an order. I will strike it out. I don't think there is anything else I can do in the matter."

Some 11 orders for possession were granted for older cases yesterday out of a list of 94.

These included an order

Loophole prompts surge in calls to mortgage group

FIONA GARTLAND

A VOLUNTARY group that defends mortgage holders in danger of losing their homes has said it is receiving up to 50 inquiries a day following a court

2009. It repealed older conveyancing legislation, but failed to save elements of the Registration of Title Act 1964.

Ms Justice Dunne ruled that borrowers who went into arrears before December 1st, 2009, and

had been inundated with calls since the ruling.

He also acknowledged that it would be possible for the Dáil to simply amend the legislation to close the loophole.

"It would be possible for the

Data

- ▶ Central Bank of Ireland Loan-Level Data
- ▶ Collected from regulated banks for stress-testing, 2010-present
- ▶ Quarterly panel data with information on
  - *current* loan characteristics
  - *origination* borrower characteristics

Paper data set

- Take loans originated 180 days before and after the cut-off date in legal ruling: 1st December 2009 - Pre cut-off are the treatment group
- Q3/2010 - Q2/2012
- Loans are matched by an estimated propensity score
  - Future treatment group status as a function of first period covariates
  - Matching without replacement to eliminate observations without counterpart
- 80,732 observations. 7,913 loans. Half treatment, half control.

Mortgage default

$$\text{default}_{it} = P(\text{90DPD}_{it} = 1 \mid \text{90DPD}_{is} = 0 \text{ for all } s < t)$$

- ► Loan i is in default at time t if it has accumlated greater than 90 days worth of missed payments.
- ► Standard Basel definition of loan default
- ► Less noisy than using surrogate measures such as 30 days past due etc.
- ► Loan drops out of data once in default
  - Theoretical interest is in the *transition* to default and not the state of being in default

Difference in means

Stock (left) v transition (right)
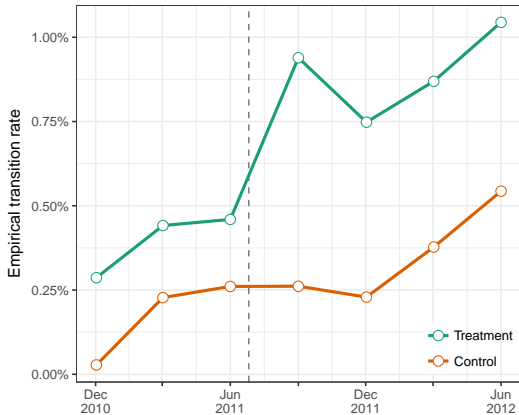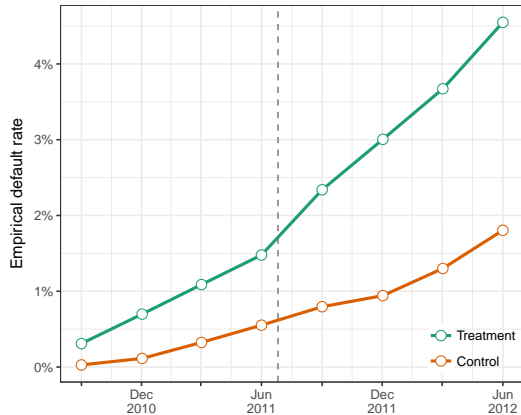
Estimation and Inference

Estimating Equation

$$\text{default}_{ibfgrt} = \alpha + \beta^{DD}(\text{Treatment}_g \times \text{Post}_t) + X_{it} + \phi_{r,t} + \tau_{b,f,t} + \epsilon_{ibfgrt} \qquad (1)$$

where:

- $treatment_i$ is an indicator for whether the loan was originated before the cut-off.
- $Post_t$ is an indicator for whether the observation is after the ruling (July 2011).
- β_{DD} is treatment effect of interest
- X_{it} is a matrix of control variables including treatment status, interest rate, loan-to-value ratio, borrower income, borrower age
- $\phi_{r,t} + \tau_{b,f,t}$ are region-time and interest rate type - time fixed effects
- Identification: within-group changes between treatment and control groups over time
  - Conditional on controls and fixed effects, treament β^{DD} is an unbiased estimator of treatment effect
- Inference: errors clustered at loan level.

Results

| | Default | | |
	(1)	(2)	(3)
Treatment	0.002***	0.0001	
	(0.001)	(0.001)	
Treatment∗Post	0.003***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)
Observations	80,667	80,663	80,663
Time-varying controls	N	Y	Y
Time FE	N	Y	-
Loan FE	N	N	Y
Region∗RateType∗Time FE	N	N	Y

*p$<$0.1; **p$<$0.05; ***p$<$0.01

Eventy study

- ▶ Interact treatment dummy with time fixed effects

	Pre-judgment
Treatment∗Mar-2011	−0.00003
	(0.001)
Treatment∗Jun-2011	0.0003
	(0.001)

	Post-judgment
Treatment∗Sep-2011	0.005***
	(0.002)
Treatment∗Dec-2011	0.006***
	(0.002)
Treatment∗Mar-2012	0.005***
	(0.002)
Treatment∗Jun-2012	0.006***
	(0.002)

Tricky inference

- Issue: quasi-randomisation at group level
- Two groups: originated pre and post 1st December 2009
- Errors correlated within group? Effective sample size of 2

$\implies$ Permutation inference

Permutation Inference

- Permutation inference aka randomisation inference
- Fisher (1936); Computing power has seen resurgence (Efron & Hastie, 2017)
- "Permute" the treatment vector many times and calculate your test statistic
  - Effect of "true" treatment vector should lie in the tails
  - Easy to calculate an exact p-value to test null
- Intuition: if there is nothing going on, your test statistic should be similar to a vector of random treatments

How to permute a natural experiment?

- ▶ This natural experiment: treatment based on cut-off date
- ▶ Idea: permute the cut-off date and perform the analysis exactly as before
  - Extract data, match with PSM, event study regression
- ▶ 1000 random dates; *save* treatment effects
- ▶ Compare "true" treatment effect to the distribution of permuted ones
  - Similar to Ganong and Jaeger (2017) on Regression Kink Design

Why? Perhaps there is something different about treatment and control groups, but this should also show up in regressions based on similar research designs
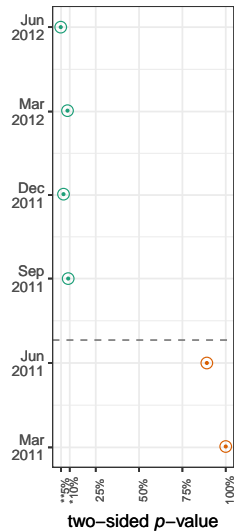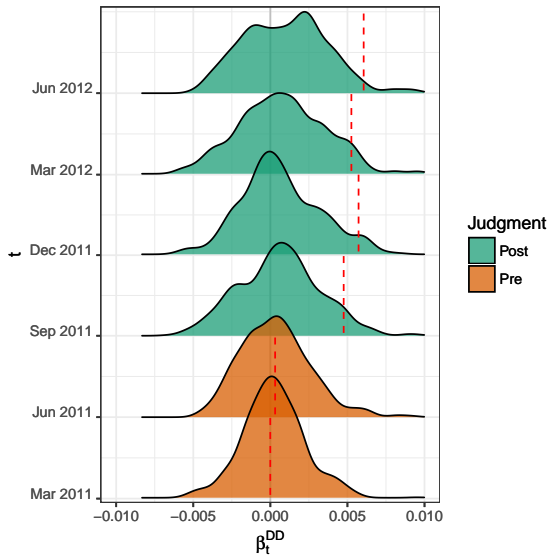
Heterogeneous treatment effects

Beyond the avearage treatment effect

- ► Average treatment effect is interesting
- ► How can you extrapolate from this research to policy design?
- ► Estimate heterogeneous treatment effects
  - • How does this fit into theory?

Machine learning for causal inference

- ▶ Heterogeneous treatment effects estimation very popular area in the intersection of ML and econometrics
- ▶ Imai and Ratkovich: Use LASSO to select appropriate interactions in saturated regression
- ▶ Hill: Bayesian Additive Regression Trees
- ▶ Zeileis et al: Model-based recursive partitioning
- ▶ Wager & Athey: Causal forest

Causal forest

Uses a random forest to reduce the curse of dimensionality in a k-nearest neighbour estimation problem

- Intuition: I want to group treatment and control observations on different dimensions and compare the difference in treatment effects across these groups
- Not obvious what variables to group on and what intervals to use
- You could use a kernel regression to do it but quickly run into curse of dimensionality

Causal forest

- ▶ Splits data into 2

1. First half: use random forest to decide which variables are important in predicting default
   - One tree: variable x and y are important
   - Second tree: variable x and z are important
   - Nth tree: varialbe x and w are important
   - Weighted regression: x gets 3, y gets 2, z 1, rest get 0
2. Second half: calculate unit-level treatment effects using information from step 1
   - Avearage them to produce ATE
   - Explore how they change by covariates gives a CATE

- ▶ Implemented in grf R package

Treatment effect function

$$Y_i = (Y_{i1} - Y_{i0}) = \tau(X_{i0}, Z_{i1}) + \epsilon_i \qquad (2)$$

- ► Loan-level treatment effect is the difference in potential outcomes
- ► Model how each individuals treatment effect varies according to covarites
- ► 2 matrices: X and Z
- ► Panel data collapsed: endline Y as a function of pre-treatment covariates

Predicted treatment effect of loan-to-value ratio

Highly leveraged borrowers have lowest opportunity cost of defaulting
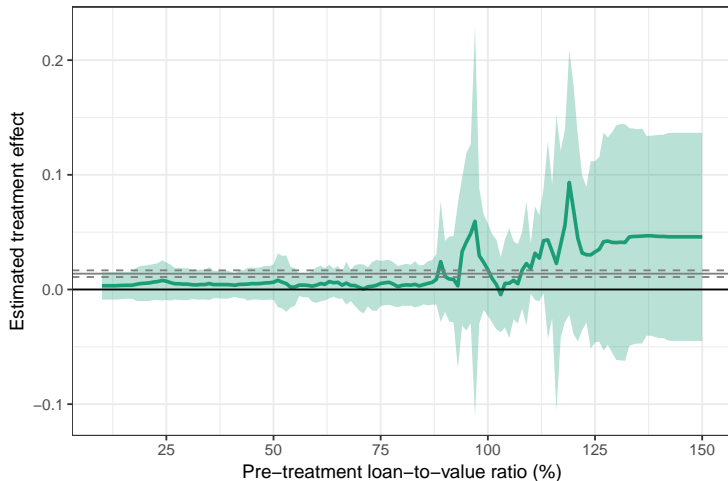
How to generally interpret a highly non-linear, non-parametric model?

Extracting heterogeneity

- Causal forest highly non-linear, non-parametric
- How to extract something sensible?
- Predict individual potential outcomes
  - Assign to each loan a $Y_i(0)$ and $Y_i(1)$
- Simple linear regression: difference in predicted potential outcomes as a function of covariates

	Treatment effect
LTV	0.0002***
	(0.00001)
log(Income)	−0.002*
	(0.001)
Interest rate	0.002**
	(0.001)
Year of birth	−0.00001
	(0.00004)
Constant	0.027
	(0.088)
Observations	12,298

$^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Conclusion

- ▶ Quasi-experimental evidence of moral hazard in the mortgage market
- ▶ Between 1 and 2 pp one-year difference in default probability
- ▶ Doesn't look like *strategic default*
  - • Causal forest reveals lower income, higher leverage, higher interest rate associated with high treatement effect
  - • Marginal not inframarginal borrowers default after the ruling
- ▶ Policy implications: reducing repossession risk as a social insurance programme?
  - • Of course other costs: transfers default cost from borrower to bank
  - • Other GE effects: risk pricing, banking losses