Matching methods in firm data: analysing the impact of restructuring on firm performance

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Structure of the talk

- Setting the context
- Our approach
- What we find
- The methodology we use

The problem

Debt restructuring schemes

- ▶ Out-of-court restructuring of financially viable firms through workouts, coordinated by the banking supervisor.

  A response to systemic banking crisis, weak insolvency laws and poor credit markets.

- ▶ Two beneficiaries:
  1. Debtors get immediate debt relief and an opportunity to turnaround the firm.
  2. Creditors get an opportunity to avoid debt write-offs.

- ▶ Most cited: the "London Approach", debt restructuring nudges by the regulator. (Recession in 1970s in the UK, 1990s; Far East Asian Crisis, in 1997.)

- ▶ Literature on performance evaluation of debt restructuring schemes is scarce. (Iskander et al, 1999; Meyerman, 2000)

  Most focus of the impact is what happened to the financial health of the banks.

- ▶ Even fewer evaluation of impact of the restructuring on recipient *firms*, to the best of our knowledge.

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The India background

- India has traditionally suffered from poor insolvency and bankruptcy resolution processes.

  • *Evolution of the insolvency framework for non-financial firms in India* with Rajeswari Sengupta and Anjali Sharma. India Development Report 2017, IGIDR.

- Corporate Debt Restructuring (CDR) scheme: initiated by RBI, 2001.

- Debtors could restructure their debt only if:
    1. They could convince their lead banker of their viability;
    2. Jointly with the lead banker, convince the CDR Cell of the same.

- Acceptance of a restructured plan meant:
    - At least 75% of secured creditor participation by value and 60% by number to agree.
    - Terms of restructuring are binding on remaining creditors.

Observations

- From 2008, more cases accumulated under CDR application than have been accepted for restructuring.

- More cases have been withdrawn as *failed* than *successfully exited* between 2005 and 2013.

- Stressed, restructured and non-performing assets increased from 10.7% to 11.1% of total advances between September 2014 and March 2015.

- RBI withdrew forebearance in 2015 and CDR cases dropped sharply.

Questions and hypothesis

- ▶ Our question: **Was the restructuring beneficial to the firms?**

- ▶ Our hypothesis:
  - ▶ If the firms benefit from CDR, their post-CDR performance will be better than the performance of matched firms without CDR.
  - ▶ If firms did not benefit, then the creditors who obtained the benefit of avoiding debt write-offs were the only beneficiaries.
    (Literature shows that banks did benefit.)

The approach

Methodology

▶ An event study of performance of the firms that received CDR – Easy to do.

▶ More difficult: for each firm, establish a control as a firm who was eligible for CDR' and who did not get it.

▶ Information about firms that applied to the bank for CDR is not available readily.

▶ We identify controls as follows:

    ▶ Find a match for the CDR firm (treated) in the set of firms who have similar financial health before the CDR.

    ▶ Compare each treated and control firm performance in (a) an event study and (b) difference-in-difference estimation

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The data

- **Source for identities of firms that received CDR**: IDBI CDR Cell data from CAFRAL.

- **Source for balance sheet and profitability information**: CMIE Prowess.

- **Scope**: all manufacturing firms restructured under CDR mechanism.

- **Sample period**: 2003 - 2012.

- **Data set analysed**:
  - CDR approvals during the sample period: 491.
  - 205 manufacturing firms found in Prowess were used in the analysis.

What we find
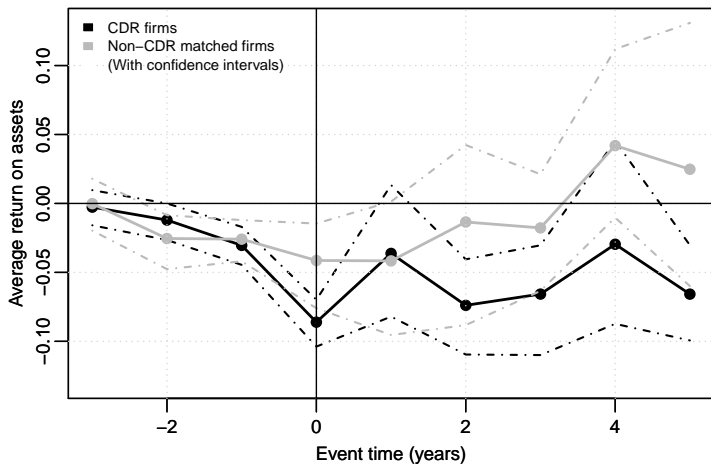
What we find

$$RoA_{i,t} \sim \alpha + \beta_1.D_{treated,i} + \beta_2.D_{postCDR,t} + \beta_3.D_{treated,i}.D_{postCDR,t} + \epsilon$$

	β_1	β_2	β_3
Estimate	0.00	0.01	-0.06
Std. error	0.01	0.01	0.01
p-value	0.52	0.51	0.00

What we find

- ▶ On average, CDR appears to have no positive benefits for the firms that received it over matched firms without CDR.

- ▶ A closer examination of the period post approval reveals
  1. some benefit in the year immediately after CDR is obtained.
  2. no benefit at the fifth year after CDR.
  3. there is cross-sectional variation in performance: some firms do perform well after CDR, but many of them do not.

Identifying controls for the treated firms

Matching methodology

- Restructuring offered under CDR is a *non-observational* experiment without a clearly defined control set.

- To find control firms, we use *matching* methodology using the *propensity score (PS)* model as defined in Rubin and Rosenbaum (1983) and *genetic matching* as defined in Diamond and Sekhon (2013).

- Covariates which are indicative of *financial health* are used to estimate propensity scores (PS) from logistic regression.

Matching methodology (contd.)

- *Financial health* of each company is defined using following balance sheet measures:

    1. **Size measures**: Net sales (NS), total assets (TA), retained earnings (RE).

    2. **Profitability measures**: Profit before tax (PBT).

    3. **Short-term indicators**: current assets (CA), current liabilities (CL).

    4. **Long-term debt**: Secured borrowings from banks (SB) and total borrowings (B).

- Matching is done one year prior to CDR approval using one-to-one nearest neighbour caliper with replacement.

- Caliper of 0.25 is applied on propensity score and distance tolerance of 0.02 is used on PBT.

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Econometric evaluation: event study anaysis

- ▶ Performance measure: **Return on assets (RoA)**

- ▶ Performance of treated and control samples are observed prior to and post the CDR event.

- ▶ *Event window*: Three years prior to CDR approval and five years post.

- ▶ For statistical accuracy, bootstrap confidence intervals are estimated to obtain range estimates along with point estimates.

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Econometric evaluation: difference-in-difference regression (DID)

- **Model 1**: performance of the two samples are compared prior to and post CDR.

$$RoA_{i,t} \sim \alpha + \beta_1.D_{treated,i} + \beta_2.D_{postCDR,t} + \beta_3.D_{treated,i}.D_{postCDR,t} + \epsilon$$

- **Model 2**: performance of the two samples are compared prior to and post CDR and post CDR period is split in two sub periods.

$$RoA_{i,t} \sim \alpha + \beta_1.D_{treated,i} + \beta_2.D_{postCDR1,t} + \beta_3.D_{postCDR2,t}$$
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$D_{treated,i} = 1$ for CDR firm, else 0
$D_{postCDR,t} = 1$ for years post CDR approval, else 0
$D_{postCDR1,t} = 1$ for immediate 2 years post approval, else 0
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Outcomes on matching

The matching exercise

- Out of 205 'treated' firms, control are found for 135 firms.
  70 firms were dropped because of very low caliper in matching.

- The graphs beelow shows the distibution of propensity scores
  before and after matching.
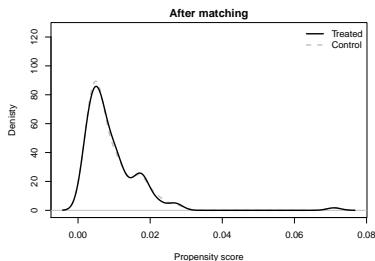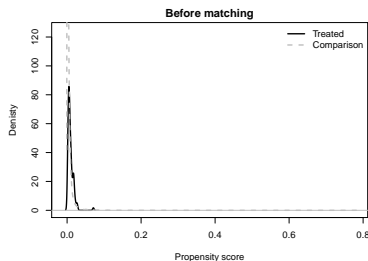
Match balance

- Post matching, KS bootstrap p-values are significant for all covariates – indicative of similarity between the control and treated sets.

Covariate	No. of years prior to CDR	p-values	
		Before match	After match
Net Sales	1	0	0.96
Total Assets	1	0	0.95
Borrowings	1	0	0.82
Secured bank borrowings	1	0	0.55
Fixed assets	1	0	0.17
Net working capital	1	0	0.23
Retained earnings	1	0	0.28
Current assets	1	0	0.46
Current liabilities	1	0	0.43
Profit before tax	1	0	0.73
Profit before tax	2	0	0.26
Return on assets	1	0	0.22
Return on assets	2	0	0.86

Match validation

- Standardised bias is defined as the difference in means of each covariate, divided by the standard deviation of the full treated group:

$$(\overline{X_t} - \overline{X_c})/\sigma_t$$

- The table below shows the standardised bias of covariates before and after matching. Absolute value less than 0.25 indicates 'good' balance.

Covariate	Standardised bias	
	Before matching	After matching
Profit before tax	1.46	0.05
Net sales	0.66	0.16
Borrowings	0.02	0.18
Secured bank borrowings	0.43	0.07
Current liabilities	0.22	0.25
Net worth	0.63	0.06
Fixed assets	0.23	0.09
Net working capital	0.20	0.05
Total assets	1.48	0.06
Current assets	0.23	0.16
Retained earnings	0.92	0.15

- The ratio of variances of propensity scores for the treated and control groups must lie between 0.5 and 2.
 In our case, it is 1.01.

Summary stats of covariates

► The table below presents the median and median absolute deviation of covariates in comparison, treated and control sets.

► Matching improves the balance of covariates between treated and control sets.

Covariates	Comparison set		Treated set		Control set	
Profit before tax	1.00	10.23	-9.50	94.59	6.30	103.63
Net Sales	149.00	220.46	1315.90	1233.37	1662.10	1481.86
Borrowings	75.10	109.12	1222.40	982.82	1234.90	1200.02
Secured bank borrowings	64.50	92.22	712.00	728.70	599.70	686.15
Current liabilities	32.20	47.15	306.90	306.31	387.50	423.88
Fixed assets	1.00	1.48	24.00	35.58	29.50	43.74
Net working capital	0.70	31.13	-37.20	212.90	-15.20	338.03
Total assets	148.10	211.42	2261.50	2008.77	2220.30	2015.89
Current assets	41.10	60.49	643.80	610.09	793.00	723.36

Analysis: the impact of CDR on firm performance

Event study of firm performance around CDR
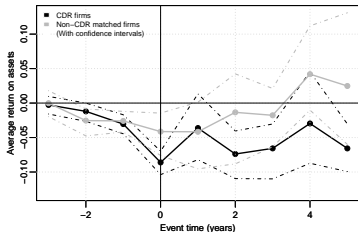
1. Before restructuring (through CDR): treated and control firms had similar levels of average RoA.

2. After restructuring: treated firms showed *lower* profitability than control firms.

3. The negative impact is significant especially in Year 1 and Year 2 after the restructuring under CDR. After this, the significance goes down. (Partly, this is because of the smaller sample available for comparison for greater than two years in the sample.)

DiD estimates

- **Model 1:**

$$RoA_{i,t} \sim \alpha + \beta_1.D_{treated,i} + \beta_2.D_{postCDR,t} + \beta_3.D_{treated,i}.D_{postCDR,t} + \epsilon$$

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Estimate	0.00	0.01	-0.06
Std. error	0.01	0.01	0.01
p-value	0.52	0.51	0.00

β_3 is *negative* and significant. Firms that restructured their loans under CDR performed *worse* than similar firms that did not receive restructuring benefits.

- **Model 2:** Where the post-CDR period is broken into two: the immediate two years, and the remaining five.

$$lRoA_{i,t} \sim \alpha + \beta_1.D_{treated,i} + \beta_2.D_{postCDR\,1,t} + \beta_3.D_{postCDR\,2,t}$$

$$+\beta_4.D_{treated,i}.D_{postCDR\,1,t} + \beta_5.D_{treated,i}.D_{postCDR\,2,t} + \epsilon$$

	β_1	β_2	β_3	β_4	β_5
Estimate	0.00	-0.03	0.02	-0.03	-0.08
Std. error	0.01	0.01	0.01	0.02	0.01
p-value	0.52	0.05	0.04	0.05	0.00

Both β_4 and $\beta5$ are *negative* and significant. The short-term as well as long-term performance of the firms that restructured their loans under CDR was *worse* than similar firms that did not receive restructuring benefits.

Heterogeneity of CDR impact
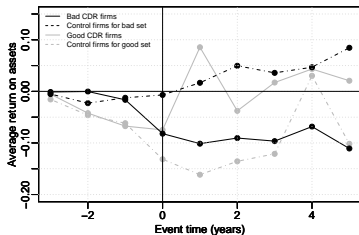
- ► To check for heterogeneity in impact of CDR, we divide CDR firms into 2 sets, based on comparative performance of these firms w.r.t control peers.
- ► **Observation**: A subset of 'CDR' firms (approximately 20%) do better than their control.
- ► **Observation**: Those 'CDR' firms that do worse than their controls, show a deterioration in performance **prior** to receiving CDR.

Some future research questions

- ▶ If CDR did not benefit the debtor who receives it, then who did?

  • *Corporate Debt Restructuring, Bank Competition and Stability: Evidence from creditor's perspective*, M. Mostak Ahamed and Sushanta Mallick, Review of Financial Stability, 2017.

- ▶ The CDR mechanism involves guidelines on possible workouts.

  Is heterogeneity of outcomes in firms driven by guidelines, or firm characteristics (such as industry, size, type of borrowings)

- ▶ CDR was replaced by SDR (2015), S4A (2016), IBC (2016).

  Varying degrees of forbearance in these: did they impact firms differently?

Thank you.

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Comments / Questions?