Bouncing back: heterogeneous effects of loan renegotiations

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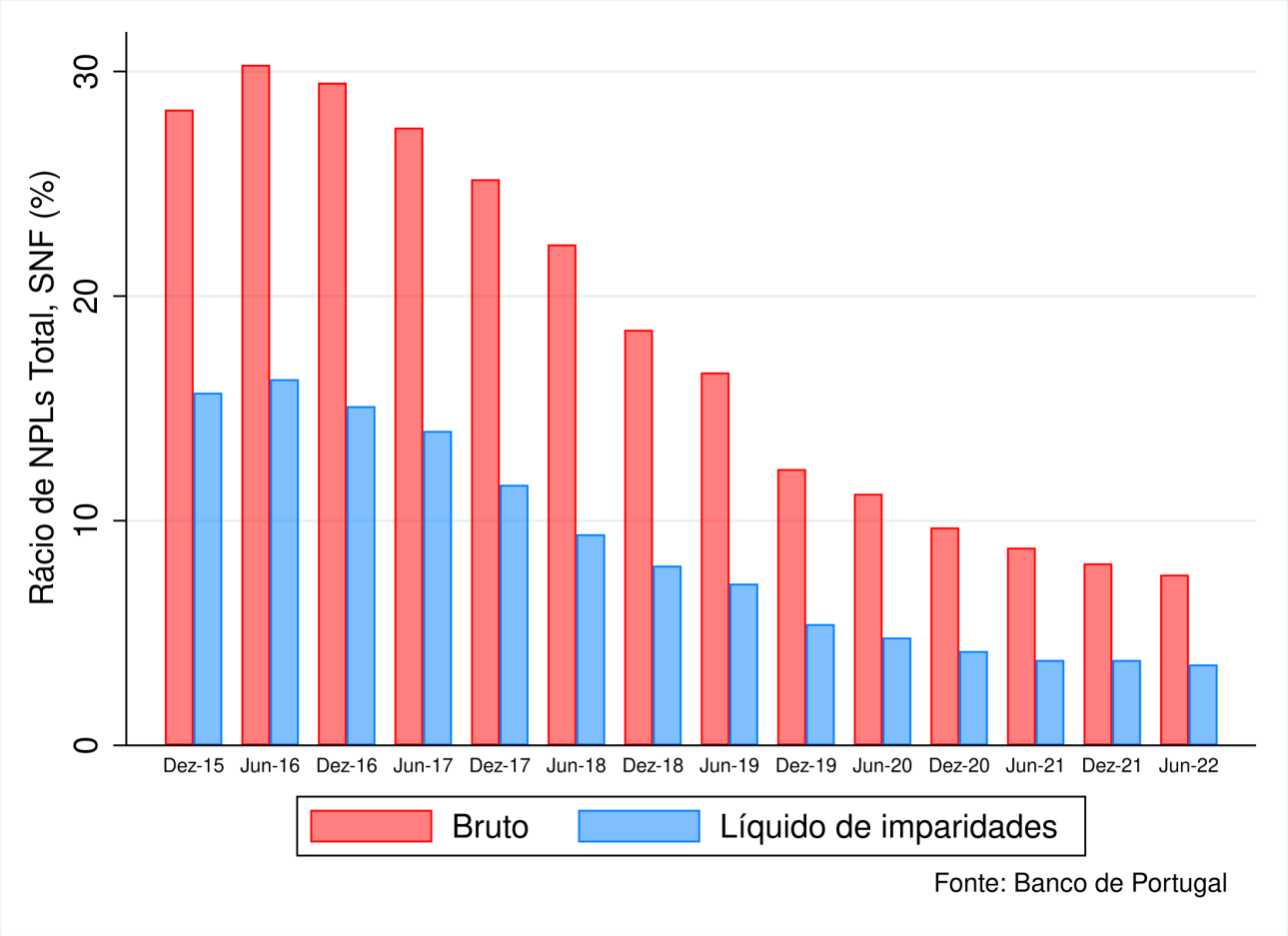
October 13, 2023

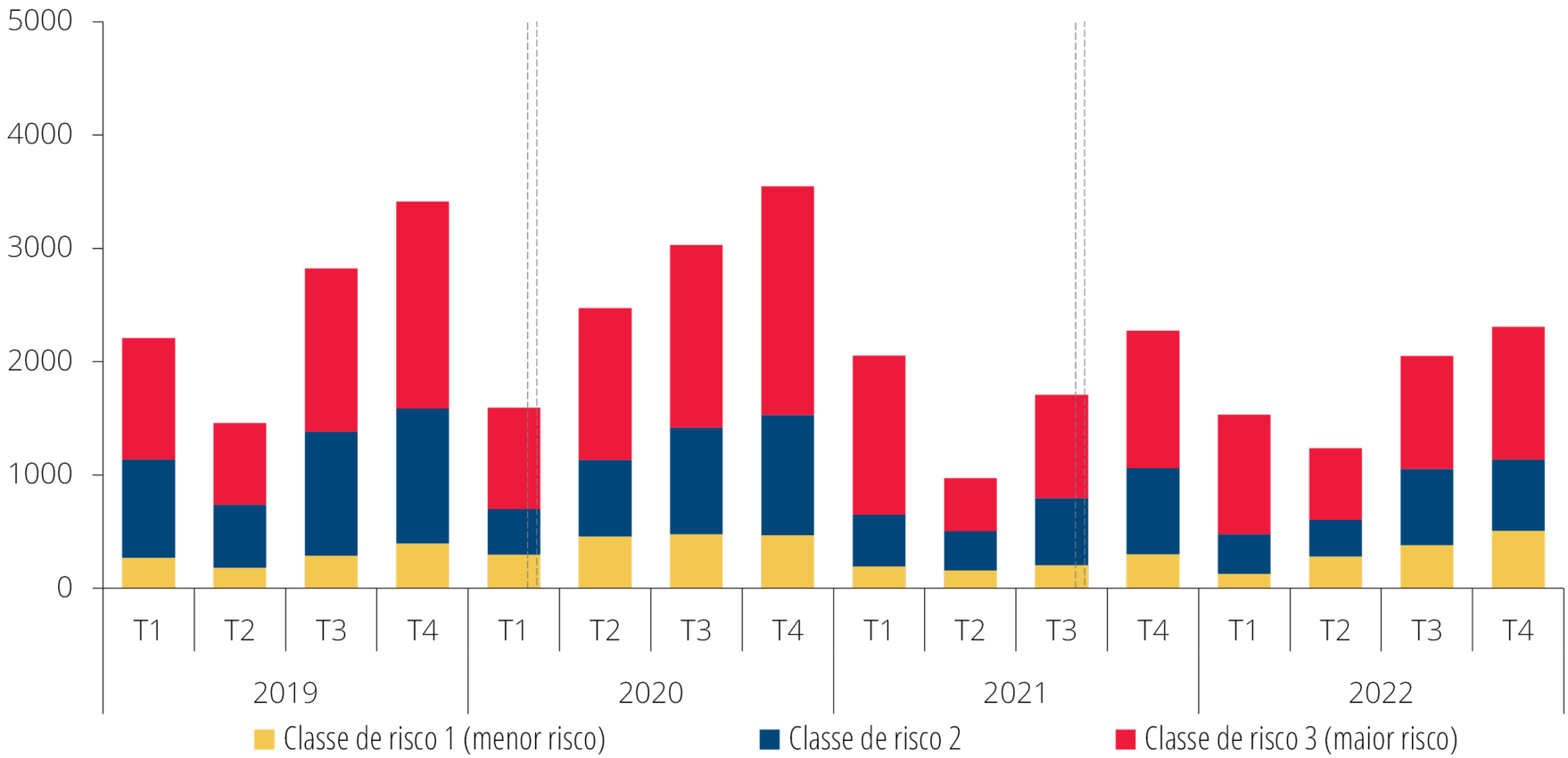
Roadmap

Motivation



- NPL ratio of the Portuguese non-financial firms has been in a steady decline since 2015.

Motivation



- Volume of loan renegotiations has also declined in recent years, while maintaining a seasonal pattern.
- Renegotiations concentrated on firms with highest level of credit risk.

Motivation

Why it matters:

- Systemic risk: are there incentives in place to renegotiate specific credit contracts?
- Good renegotiations vs. bad renegotiations.
- Evergreening: used to conceal potential losses?
- Prudential supervision: loss recognition and capital buffers.
- Credit misallocation: productivity of distressed borrower $\leq$ productivity of new market entrant.
- Policy: is it an efficient tool to improve corporate performance?

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Paper overview

Research questions:

1. Do loan and firm characteristics affect loan renegotiation decision?
   - *Any measure and by type of loan renegotiation*
2. Do loan renegotiations improve firms' performance?
   - *Probability of default, return-on-assets, and debt ratio*

Methodology:

1. Probit analysis
2. Marginal treatment effects

Main findings:

- Shorter-term and high-value loans are more likely to be renegotiated.
- Positive, large, and significant effects of renegotiation in firms' probability of default and ROA.
- Firms with higher resistance to renegotiation benefit the most from it.

Literature

Drivers of loan renegotiation: focus on bank characteristics

- Bank's financial distress: Bergant and Kockerols (2020)
- Evergreening: Mourad, Schiozer, and Santos (2020)
- Relationship between loan officers and firms: Papoutsis (2021)
- US publicly traded firms: Roberts and Sufi (2009)

Effect of loan renegotiation

- Logit analysis: Bergant and Kockerols (2020)
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Contribution

- Use of loan, firm, and firm-bank characteristics.
- Granularity allows to capture five different renegotiation measures.
- Half of renegotiations involve an extension of maturity.
- High-value, short-term loans are more likely to be renegotiated.
- Longevity of borrower-creditor relationship isn't a relevant determinant of renegotiation.
- Loan renegotiation is effective in the short and medium terms.
- Heterogeneity in gains: firms less likely to renegotiate benefit more from it.

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Roadmap

Data

Loan-level data from the Portuguese Credit Registry (CRC)

- Loans from all private, non-financial Portuguese firms
- Quarterly from 2019Q1 - 2022Q4
- 15M observations (loan x time)
- +350 000 firms
- +3M loans, ∼150 000 renegotiated at some point in time

Firms' characteristics from IES - *Central de Balanços*

Credit risk data from SIAC - BdP internal model

Data

Loan renegotiation identification

Loan renegotiation

Any unexpected change in the terms of the credit agreement initiated by either the creditor or the borrower, prior to its full repayment.

- Crucially, this definition leaves out automatic renegotiations.
- We include regular renegotiations and those due to default.
- Renegotiations agreed under the Covid moratoria are not considered.

- Time mismatch between first CRC report of renegotiation and actual date of renegotiation.

see mismatch

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Loan renegotiation measure identification

Time mismatch between date of renegotiation and its actual materialization (change in loan terms).

- We follow the renegotiated loan for the six months after the renegotiation.

We identify five measures of renegotiation:

- Loan value extension
- Term (maturity) extension
- Interest rate change
- Capital or interest deferment
- Other

see measures

see mismatch

Data

Loan renegotiation measure identification

- We identify 193 000 renegotiations and 266 000 measures.
- 83% of renegotiated loans are renegotiated only once in our period.
- 69% of renegotiations only go through one renegotiation measure, 24% two, and 7% three or four.

Data

Almost half of all renegotiations involve a change in maturity; change in loan amount and deferment also very frequent.

Measures	By number of loans (%)	By outstanding balance (%)
Amount	23	32
Interest Rate	10	23
Maturity	47	49
Deferment	18	28
Other	31	24

Note: each renegotiated contract can have more than one measure.

Data

Overall balance of firm characteristics; some discrepancies on credit risk.

		All loans		Renegotiated loans	
		By number of loans (%)	By outstanding balance (%)	By number of loans (%)	By outstanding balance (%)
Size	Micro	55	31	46	30
	Small	27	27	27	27
	Medium	12	26	16	29
	Large	6	16	11	14
Sector	Agriculture	4	4	3	3
	Energy and Mining	1	3	1	4
	Manufacturing	18	21	16	17
	Real estate	8	19	6	22
	Other construction	5	5	3	5
	Retail	30	20	40	19
	Transportation	6	7	5	9
	Tourism	6	9	6	10
	Telecoms	2	1	2	1
	R&D	10	4	11	4
	Other services	8	5	7	5
Risk class	Safe	32	37	37	27
	Average	41	37	41	40
	Risky	27	26	22	32

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Data

Firms with renegotiated loans have a higher average EBITDA but a lower mean interest coverage ratio.

	All loans			Renegotiated loans		
Variable	Mean	Median	SD	Mean	Median	SD
ROA	0.1	0.1	0.1	0.1	0.1	0.1
ICR	16	5	31	10	3	24
Financial autonomy	0.3	0.3	0.2	0.2	0.2	0.2
Debt ratio	0.5	0.4	0.2	0.5	0.5	0.2
Cash ratio	0.1	0.0	0.1	0.1	0.0	0.1
EBITDA	1,507,212	440,476	1.9M	1,770,713	594,168	2M

Note: values weighted in terms of outstanding balance.

Data

Mixed interest rate more common in renegotiated loans and are less frequently backed by public collateral.

		All loans		Renegotiated loans	
		By number of loans (%)	By outstanding balance (%)	By number of loans (%)	By outstanding balance (%)
Type	Current account	29	12	36	17
	Loans to businesses	31	63	24	62
	Leasing & factoring	31	19	33	14
	Other loans	10	6	7	7
Interest rate	Fixed	40	16	34	15
	Variable	58	81	65	72
	Mixed	1	2	1	13
	Other	1	1	0	0
Collateral	Real estate	6	32	8	39
	Other real estate	5	9	4	7
	Financial	12	23	11	22
	Personal: individuals	56	57	54	52
	Personal: entities	3	3	0	0
	Public guarantee	11	12	7	5
	Other	8	15	9	11
NPL	Performing	88	91	94	86
	Non-performing	12	9	6	14

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Data

Renegotiated loans have a higher average outstanding amount and a lower mean maturity; median collateral value is also higher

	All loans			Renegotiated loans		
Variable	Mean	Median	SD	Mean	Median	SD
Out. balance	81,711	821,321	11,824	129,821	21,964	1,399,372
Original maturity (y)	5	5	6	2	3	5
Residual maturity (y)	2	2	6	2	1	4
Spread	2.2	2.0	3.9	2.6	2.3	9.3
Number of collateral	1	1	6	2	1	4
Collateral value	699,131	18,000	14M	2,630,654	20,000	62M

Data

Overall balance in terms of bank-firm characteristics

	All loans			Renegotiated loans		
Variable	Mean	Median	SD	Mean	Median	SD
Seniority (years)	5	6	3	5	6	2
Number of rels.	4	3	3	4	3	3

Note: values weighted in terms of outstanding balance.

Roadmap

Drivers of loan renegotiation

Probit model

$$\mathbb{P}(Reneg_{i,j,k,t+1}) = \alpha + X_{i,t} + \Lambda_{i,t} + \Omega_{j,t} + \Theta_{j,b,t} + \sigma_{year} + \mu_b + \varepsilon,$$

- $\mathbb{P}(Reneg_{i,j,k,t+1})$: probability of any or one of the five renegotiation measures indexed by k being applied at a given loan i related to borrower j and bank b in the next quarter.
- $\Lambda_{i,t}$ are loan characteristics: outstanding balance, maturity, performing status, collateral, maturity, spread, loan type.
- $\Omega_{j,t}$ are firm characteristics: sector, size, risk class, previous renegotiation, ROA and debt ratio.
- $\Theta_{j,b,t}$ are firm-bank characteristics: relationship seniority, number of bank relationships, main bank.
- σ_{year} and μ_b denote, respectively, year and bank fixed-effects.

Drivers of loan renegotiation

Current account loans are more likely to be renegotiated.

	(1) Loan	(2) Bank	(3) Firm	(4) B-F
Loan type				
Loans to businesses	-0.822***	-0.814***	-0.869***	-0.752***
	(0.008)	(0.007)	(0.007)	(0.006)
Leasing & factoring	-0.632***	-1.008***	-1.063***	-0.921***
	(0.008)	(0.009)	(0.009)	(0.008)
Other	-0.478***	-0.585***	-0.668***	-0.588***
	(0.011)	(0.011)	(0.012)	(0.010)
		(...)		
Year FEs	YES	YES	YES	YES
Bank FEs	NO	YES	YES	YES
N	6,547,570	6,252,065	5,682,691	5,682,691

Baseline (all = 0): current-account credit, micro-sized firm, safe risk class.
Non-clustered standard errors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Drivers of loan renegotiation

The greater the amount of the loan, the greater the predicted probability of renegotiation; non-performing and short-maturity loans more likely to be renegotiated; spread becomes statistically insignificant.

	(1) Loan	(2) Bank	(3) Firm	(4) B-F
Log(Out.Balance+1)	0.127***	0.109***	0.082***	0.077***
	(0.002)	(0.002)	(0.002)	(0.002)
Spread	0.050***	0.003**	0.011***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Non-performing	0.044***	-0.050***	0.171***	0.086***
	(0.007)	(0.007)	(0.008)	(0.007)
Log(Maturity+1)	-0.044***	-0.091***	-0.096***	-0.142***
	(0.003)	(0.003)	(0.003)	(0.002)
		(...)		
Year FEs	YES	YES	YES	YES
Bank FEs	NO	YES	YES	YES
N	6,547,570	6,252,065	5,682,691	5,682,691

Drivers of loan renegotiation

Greater ability to seize collateral associated with lower renegotiation probability.

	(1) Loan	(2) Bank	(3) Firm	(4) B-F
Type of collateral				
Real estate	0.104***	0.115***	0.169***	0.107***
	(0.008)	(0.008)	(0.009)	(0.007)
Other real	-0.180***	-0.215***	-0.198***	-0.174***
	(0.013)	(0.014)	(0.014)	(0.012)
Financial	0.049***	-0.033***	-0.034***	-0.011*
	(0.007)	(0.007)	(0.007)	(0.006)
Personal: ind.	-0.108***	-0.060***	-0.068***	-0.105***
	(0.006)	(0.006)	(0.007)	(0.006)
Public	-1.140***	-0.262***	-0.208***	-0.163***
	(0.033)	(0.032)	(0.034)	(0.031)
Other	0.024***	-0.158***	-0.149***	-0.116***
	(0.009)	(0.009)	(0.009)	(0.008)
		(...)		
Year FEs	YES	YES	YES	YES
Bank FEs	NO	YES	YES	YES
N	6,547,570	6,252,065	5,682,691	5,682,691

Drivers of loan renegotiation

Loan renegotiations are more likely among large and riskier firms.

	(1) Loan	(2) Bank	(3) Firm	(4) B-F
Firm size				
Small			0.092***	0.046***
			(0.006)	(0.006)
Medium			0.148***	0.042***
			(0.009)	(0.009)
Large			0.215***	0.075***
			(0.013)	(0.013)
Risk class				
Average			0.129***	0.110***
			(0.006)	(0.005)
Risky			0.158***	0.132***
			(0.008)	(0.007)
Year FEs	YES	YES	YES	YES
Bank FEs	NO	YES	YES	YES
N	6,547,570	6,252,065	5,682,691	5,682,691

Drivers of loan renegotiation

ROA negatively correlated with the probability of renegotiation; longevity of client-bank relationship doesn't seem to play a role, but being the bank most exposed does.

	(1) Loan	(2) Bank	(3) Firm	(4) B-F
log(ROA+1)			-0.053***	-0.050***
			(0.011)	(0.010)
Prev. renegotiation				0.431***
				(0.005)
Main bank				0.068***
				(0.005)
Bank seniority				-0.001
				(0.001)
Number of banks				0.016***
				(0.001)
Year FEs	YES	YES	YES	YES
Bank FEs	NO	YES	YES	YES
N	6,547,570	6,252,065	5,682,691	5,682,691

Drivers of loan renegotiation: by measure

Previous renegotiations is a strong predictor of loan renegotiation across all measures; non-performing loans less likely to see term extension.

Estimated with model (4) - with bank and year FEs:

	Any	ΔAmount	ΔInterest	ΔMaturity	Stop	Other
log(Out.Balance+1)	0.077***	0.105***	0.052***	0.076***	0.088***	0.062***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Spread	0.002	0.017***	0.020***	0.019***	0.026***	-0.038***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)
Non-performing	0.086***	-0.003	0.094***	-0.043***	0.106***	0.336***
	(0.007)	(0.012)	(0.014)	(0.008)	(0.011)	(0.013)
log(Maturity+1)	-0.142***	-0.078***	-0.079***	-0.233***	0.016***	-0.008*
	(0.002)	(0.004)	(0.004)	(0.003)	(0.005)	(0.005)
log(ROA+1)	-0.050***	0.064***	-0.016	-0.055***	-0.109***	-0.009
	(0.010)	(0.019)	(0.022)	(0.011)	(0.014)	(0.019)
Prev. renegotiation	0.431***	0.429***	0.408***	0.427***	0.092***	0.525***
	(0.005)	(0.008)	(0.009)	(0.006)	(0.008)	(0.009)
Main bank	0.068***	0.024***	0.074***	-0.020***	-0.054***	0.172***
	(0.005)	(0.008)	(0.009)	(0.005)	(0.007)	(0.010)
Bank seniority	-0.001	-0.007***	0.015***	0.003**	-0.006***	-0.021***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Number of banks	0.016***	0.016***	0.019***	0.013***	0.028***	0.006***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
N	5,682,691	5,667,284	5,585,401	5,659,532	5,309,266	5,678,863

Drivers of loan renegotiation: by measure

Larger firms are less likely to receive term extensions and amortisation/interest deferment measures; riskier borrowers tend to be more subject of renegotiations.

	Any	ΔAmount	ΔInterest	ΔMaturity	Deferment	Other
Firm size						
Small	0.046***	0.050***	0.169***	0.020***	0.004	0.035***
	(0.006)	(0.009)	(0.011)	(0.006)	(0.009)	(0.011)
Medium	0.042***	0.023	0.130***	-0.067***	-0.050***	0.153***
	(0.009)	(0.014)	(0.016)	(0.010)	(0.014)	(0.016)
Large	0.075***	0.079***	0.327***	-0.195***	-0.170***	-0.001
	(0.013)	(0.024)	(0.021)	(0.018)	(0.025)	(0.021)
Risk class						
Average	0.110***	0.074***	0.092***	0.135***	0.138***	0.057***
	(0.005)	(0.008)	(0.010)	(0.006)	(0.008)	(0.010)
Risky	0.132***	0.054***	0.063***	0.139***	0.208***	0.113***
	(0.007)	(0.011)	(0.014)	(0.008)	(0.011)	(0.013)
N	5,682,691	5,667,284	5,585,401	5,659,532	5,309,266	5,678,863

Drivers of loan renegotiation

Likelihood of renegotiation:

- Loan size (+)
- Maturity (-)
- Type of collateral (difficulty to seize collateral) (+)
- Firm size (+)
- Credit risk (+)
- Previous renegotiation (+)
- Number of bank relationships (+)
- Main bank (+)
- Bank-firm seniority (0)

Roadmap

Effects of loan renegotiation

- What is the effect of loan renegotiations on the performance of firms?
- We would like to observe the performance of a firm with and without renegotiated loans. . . but we do not observe the two states simultaneously.
- Also, loan renegotiations are not random across firms: they likely depend on the anticipated benefits of the renegotiation.
- Firms whose performance will increase the most from loan renegotiations are more likely to have their loans renegotiated.

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- We would like to observe the performance of a firm with and without renegotiated loans... but we do not observe the two states simultaneously.
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Effects of loan renegotiation

Selecting a model

- Use an exogenous variation in loan renegotiations unrelated to the performance of firms (policy shock).
  - Possibly use a quasi-exogenous policy shock as robustness test.
  - Credit moratoria.
- Use marginal treatment effects (Heckman and Vytlacil, 2005)
  - Uncovers treatment heterogeneity not only in observed characteristics, but also in unobserved.
  - Selection on levels, but also on gains.
  - Deviates from LATE/IV by allowing to estimate aggregate treatment effects.

Effects of loan renegotiation

Addressing selection bias

We take the counterfactual framework:

$$Y_{ji} = X_i\beta_j + U_{ji}, \qquad j = 0, 1,$$

where the potential outcomes (performance under treatment Y_{1i} or non-treatment Y_{0i}) are expressed as a function of **observable** firm characteristics X_i and **unobservable** factors U_i.

Suppose a firm has its loans renegotiated if the benefits from renegotiation are large enough, that is,

$$D_i^* = Z_i\mu_d - V_i$$
$$D_i = 1 \quad \text{if } D_i^* \geq 0, \qquad D_i = 0 \quad \text{otherwise,}$$

where Z_i is a vector of covariates relevant for determining whether a firm has renegotiated loans, and V_i represents the unobserved characteristics that make firms less likely to receive treatment.

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Effects of loan renegotiation

Marginal treatment effects

The marginal treatment effect is the benefit of loan renegotiation for firm i conditional on covariates $X_i = x$ and random resistance to treatment $V_i = v$ (renegotiation costs):

$$\text{MTE} = \mathbb{E}\left(Y_{1i} - Y_{0i} \,|\, X_i = x,\, V_i = v\right)$$

We know that firm i renegotiates whenever $Z_i\mu_d \geq V_i$. Let the **propensity score** of firm i be the probability that firm i has its loans renegotiated, that is, $P(Z_i) = \mathbb{E}(D_i = 1|Z_i)$. The MTE is obtained via

$$\mathbb{E}(Y|X = x, P(Z) = p) = X\beta_0 + x(\beta_1 - \beta_0)p + K(p),$$

where $K(p) = p\,\mathbb{E}(U_1 - U_0 \mid U_D \leq p)$ is a non-linear function of the propensity score which captures heterogeneity along the unobserved resistance to treatment U_D. Our goal is to estimate $K(p)$.

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Effects of loan renegotiation

Estimation steps

1. Choose variables that may determine both the performance of the firm and the likelihood that a firm ends up renegotiating its loans.
   - The set of variables determining loan renegotiation must include variables that do not determine performance.
2. Use covariates (X, Z) to predict treatment, that is, to estimate the propensity scores.
3. Model outcome Y as a function of the estimated propensity scores $P(Z) = p$ and controls X.
4. The MTE curve is obtained as the derivative of Y with respect to p.
5. Compute the aggregate effects: ATE, ATT, and ATU.

Effects of loan renegotiation

First stage: estimating the propensity scores

After converting loan-level quarterly data to the firm-level:

$$\begin{aligned}\mathbb{P}(Reneg_{j,t+1}) = \alpha &+ \beta_1 spread + \beta_2 prevReneg + \beta_3 log(Out.Balance + 1) \\ &+ \beta_4 collateralValue + \beta_5 bankRelations + \beta_5 log(ROA + 1) \\ &+ \Pi' firmSize + \Omega' firmSector + \Delta' riskClass \\ &+ \sigma_{year} + \mu_{mb} + \varepsilon,\end{aligned}$$

- $\mathbb{P}(Reneg_{j,t+1})$: probability of any renegotiation measure being applied to any loan related to borrower j in the next quarter.
- σ_{year} and μ_{mb} denote, respectively, year and main bank fixed-effects.

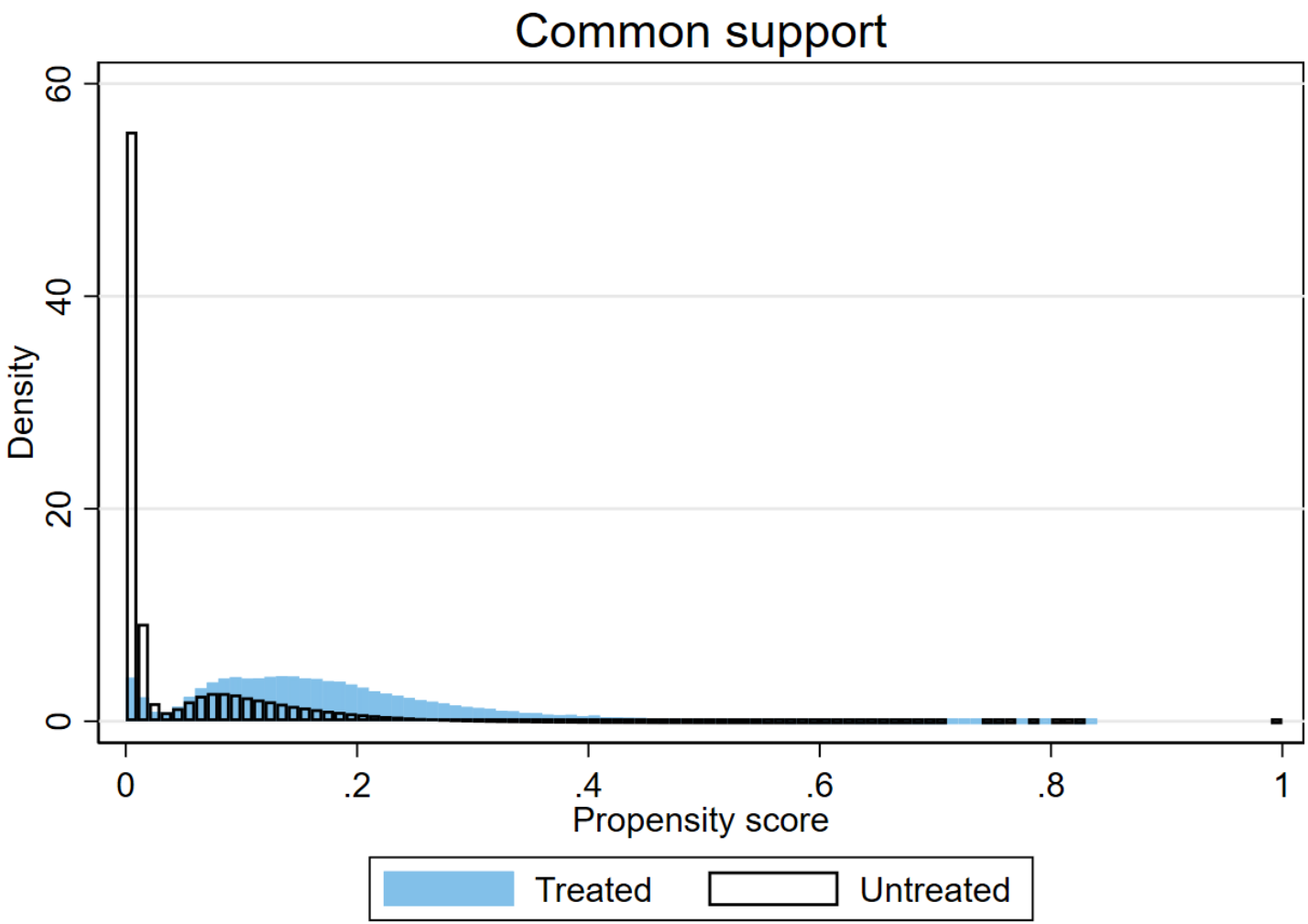
Effects of loan renegotiation

First stage: estimating the propensity scores

	Coefficients	SE
Log(Out.Balance+1)	0.014***	(0.002)
Spread	0.014***	(0.002)
Prev. renegotiation	0.868***	(0.015)
Collateral value	0.002***	(0.000)
Number of banks	0.055***	(0.001)
Log(ROA+1)	0.081**	(0.039)
Year & MB FEs	YES	
N	1,638,449	
R^2	0.24	

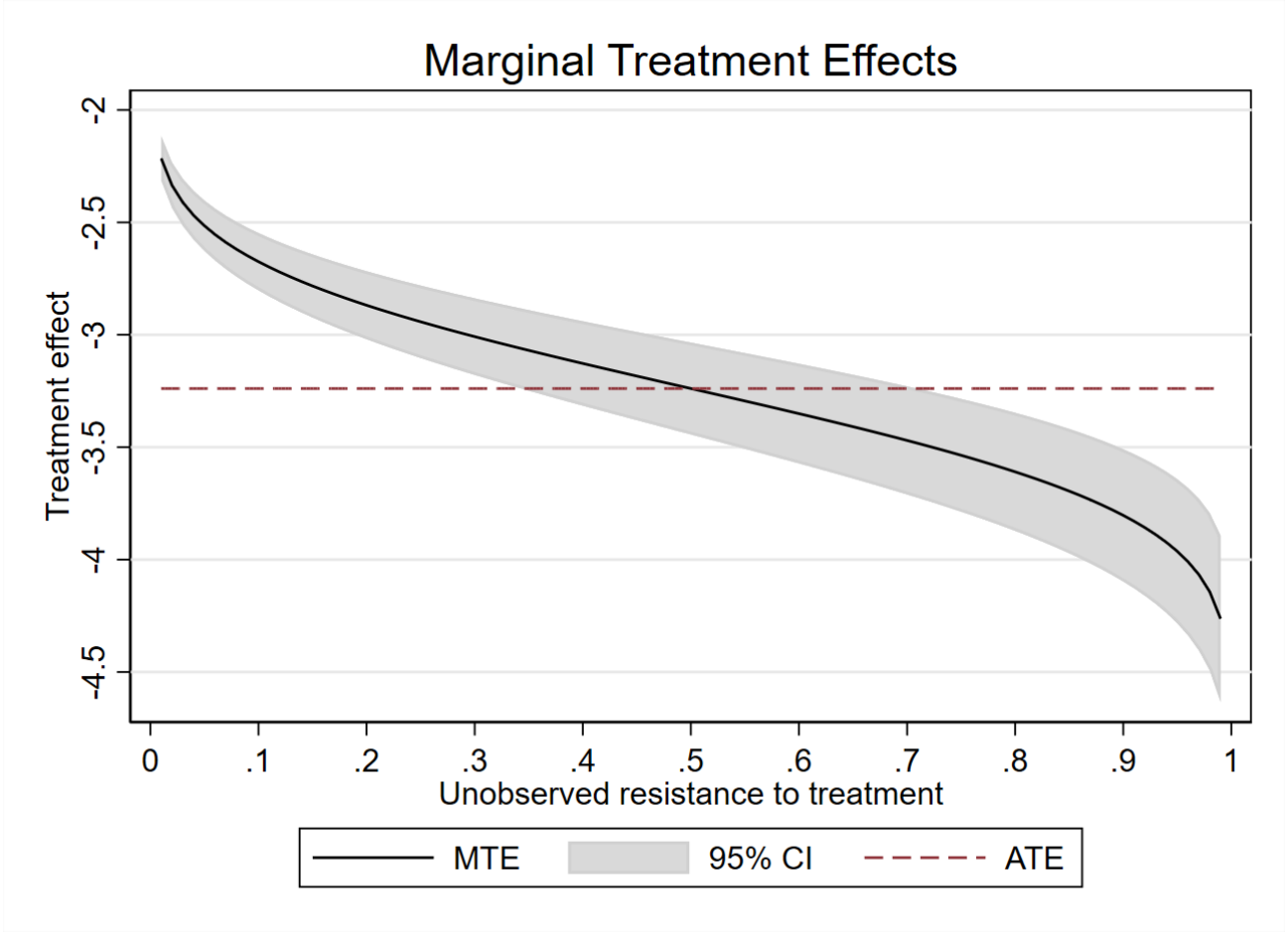
Effects of loan renegotiation

First stage: density of propensity scores



Effects of loan renegotiation

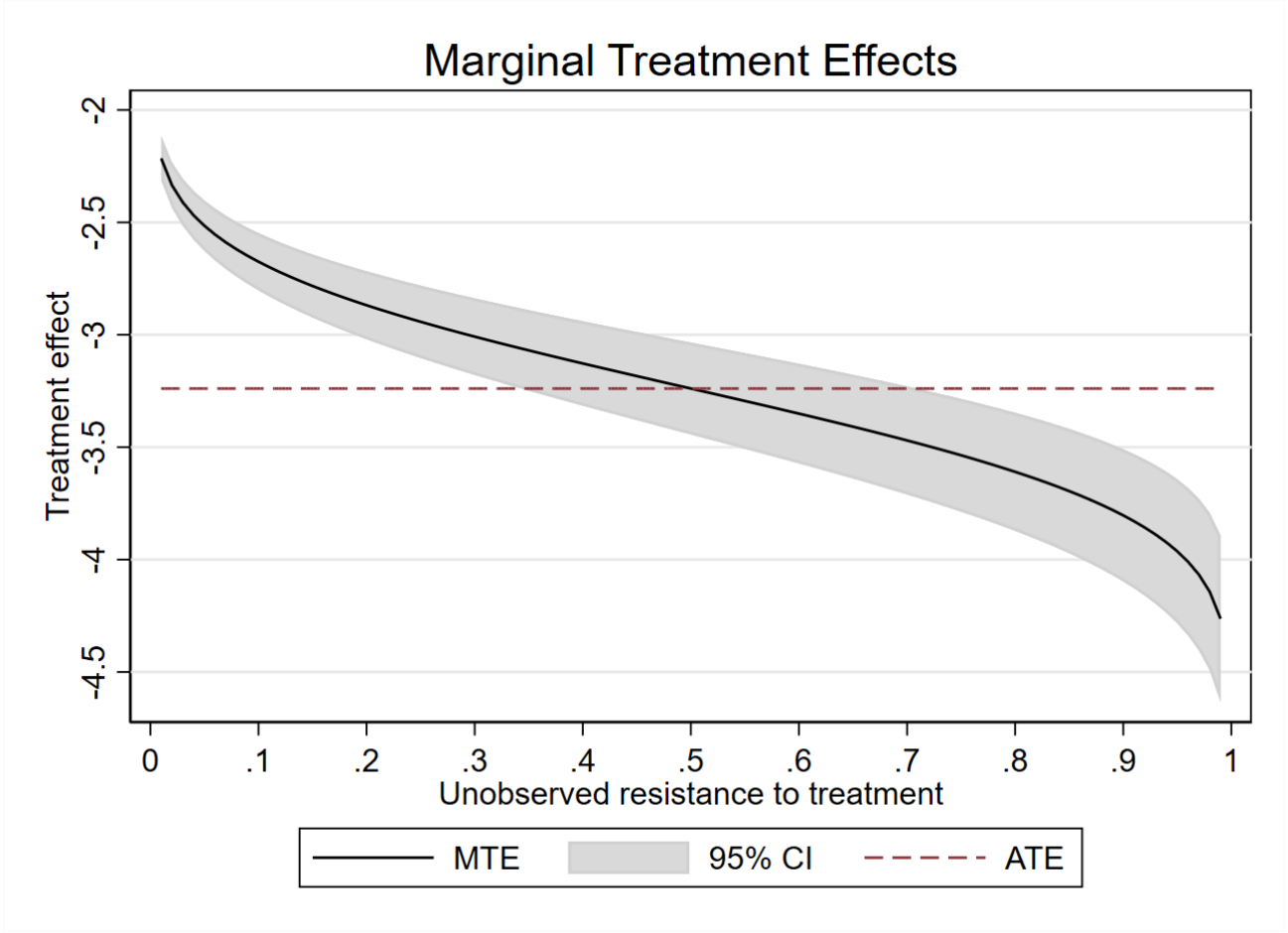
Second stage: probability of default, one year apart



ATE: for the average treated firm, renegotiation results in a reduction of the probability of default.

Effects of loan renegotiation

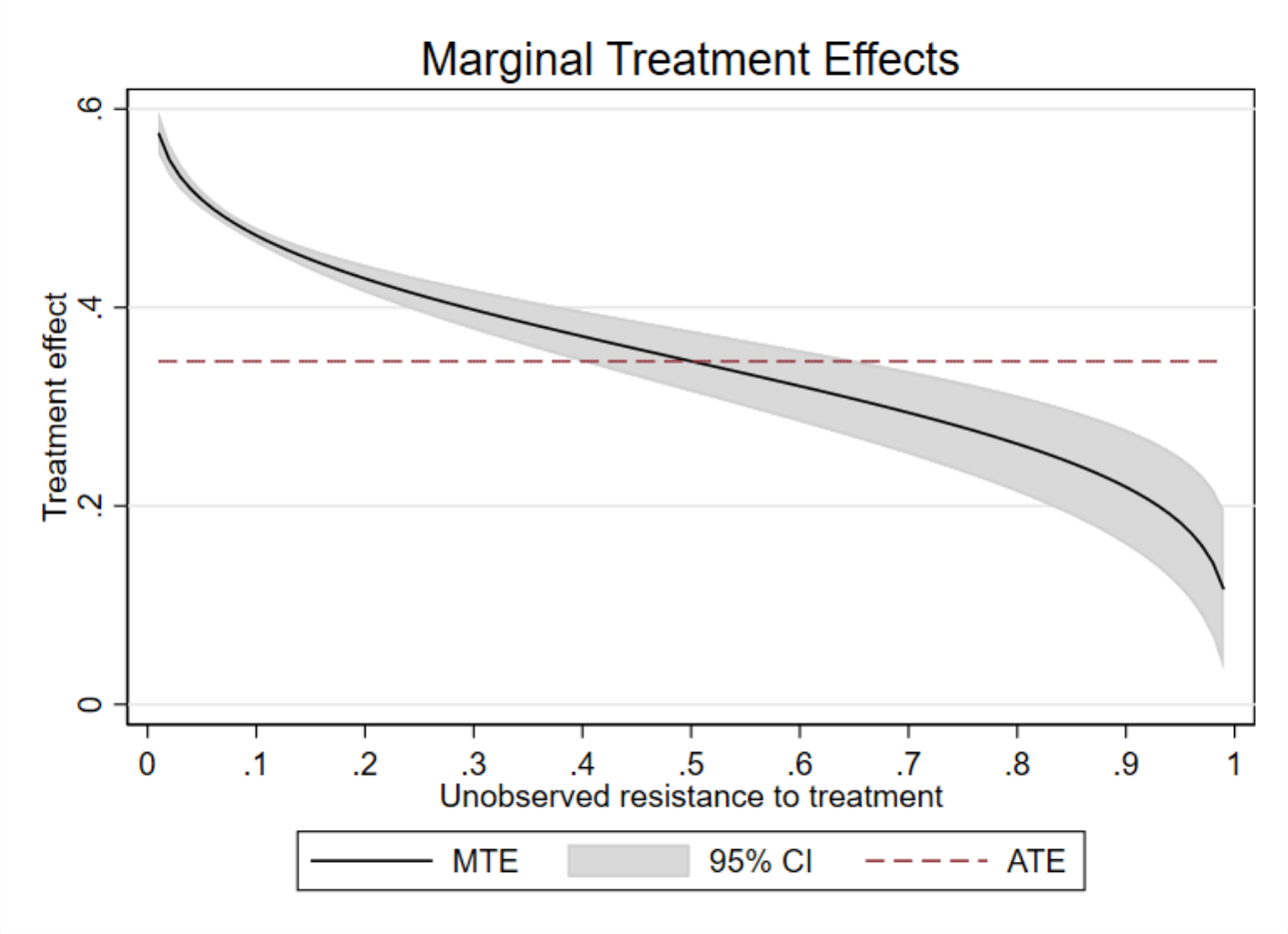
Second stage: probability of default, one year apart



MTE curve: downward slopping, firms with higher unobserved resistance would obtain higher benefits from renegotiation.

Effects of loan renegotiation

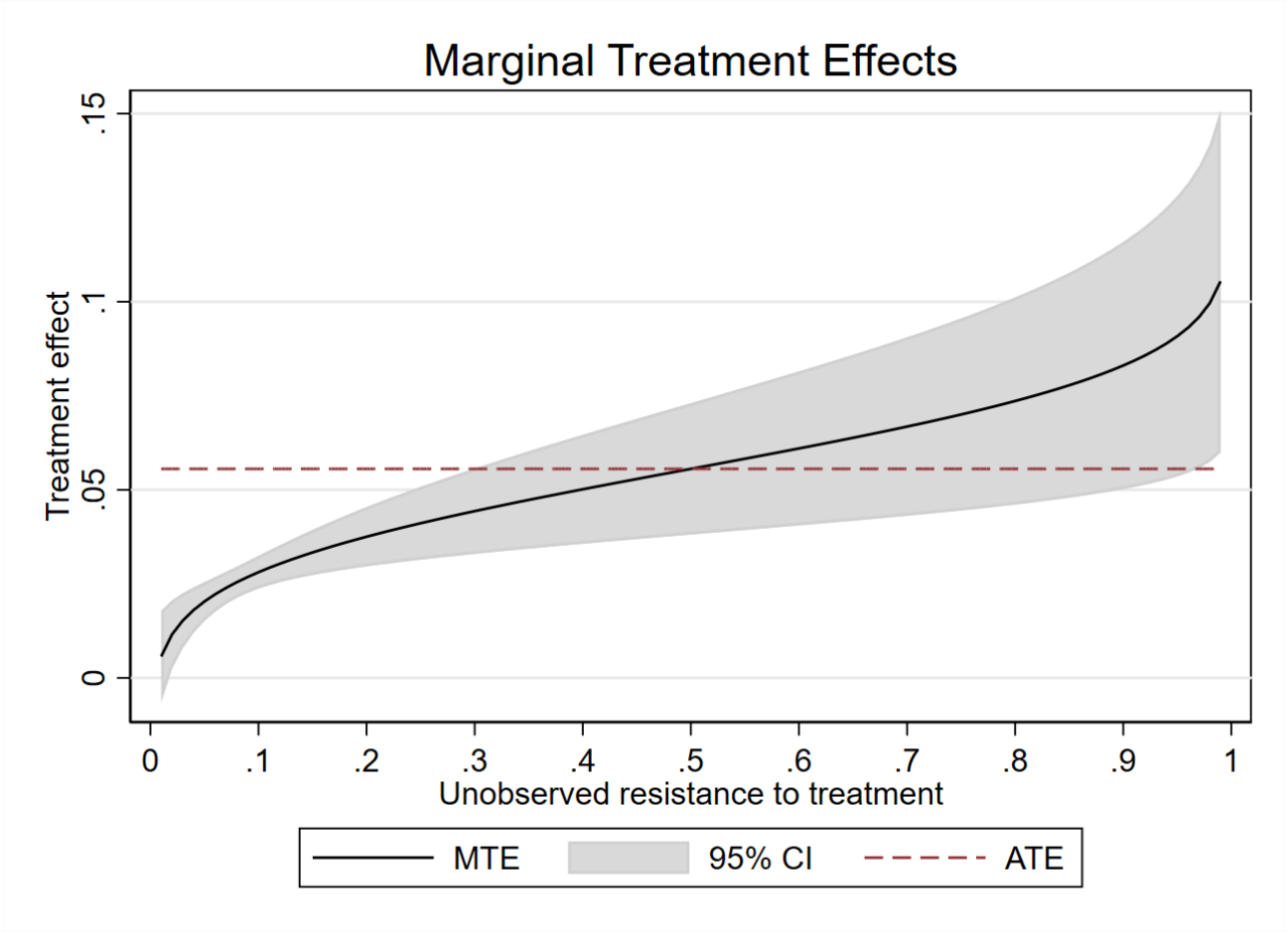
Second stage: debt ratio, one year apart



ATE: positive, that is, loan renegotiation seems to increase debt ratio of the random treated firm.

Effects of loan renegotiation

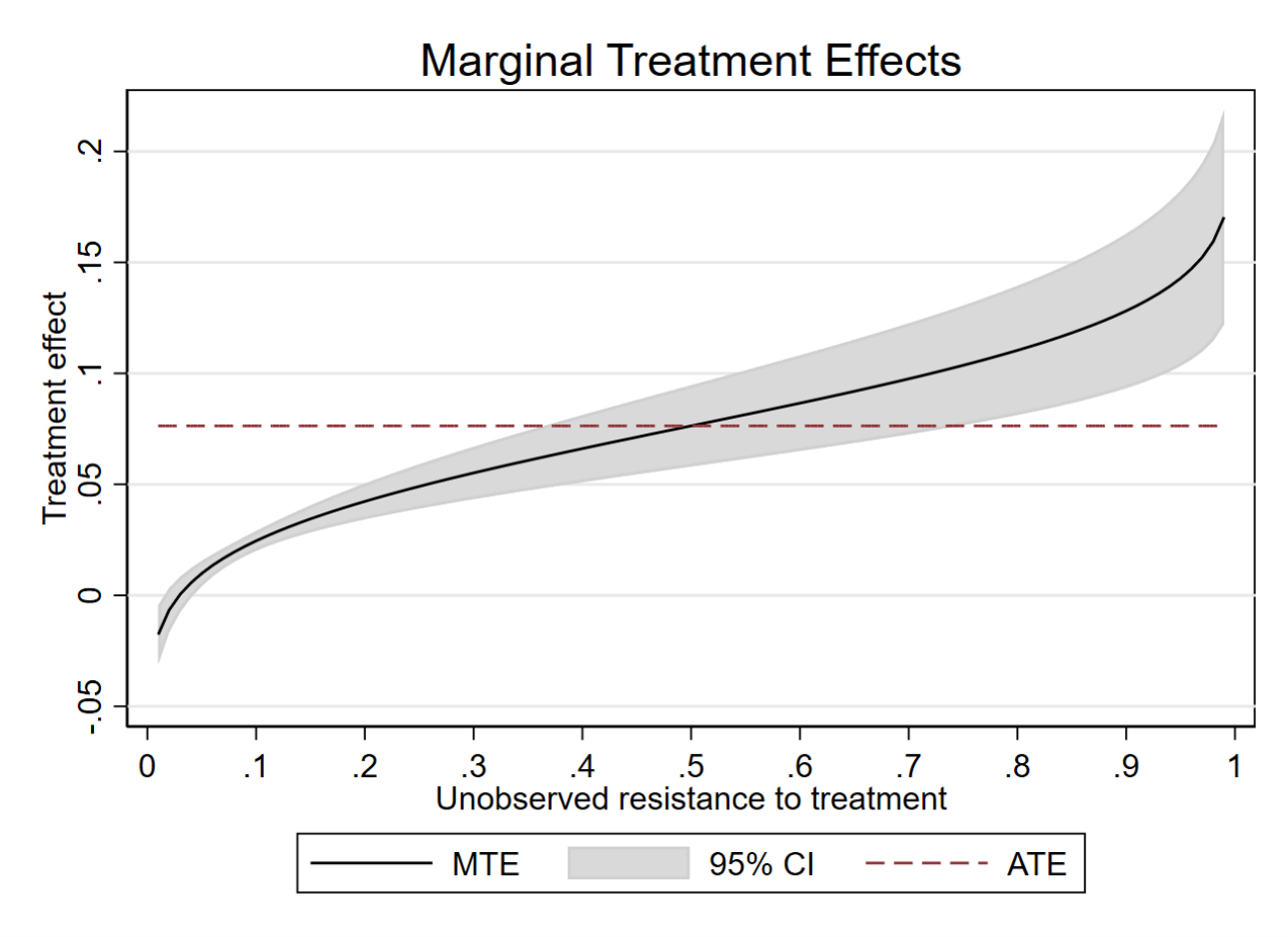
Second stage: return-on-assets, one year apart



ATE: positive, ≈ 0.05. For a firm picked at random, having a loan renegotiated increases the ROA by 0.05 points.

Effects of loan renegotiation

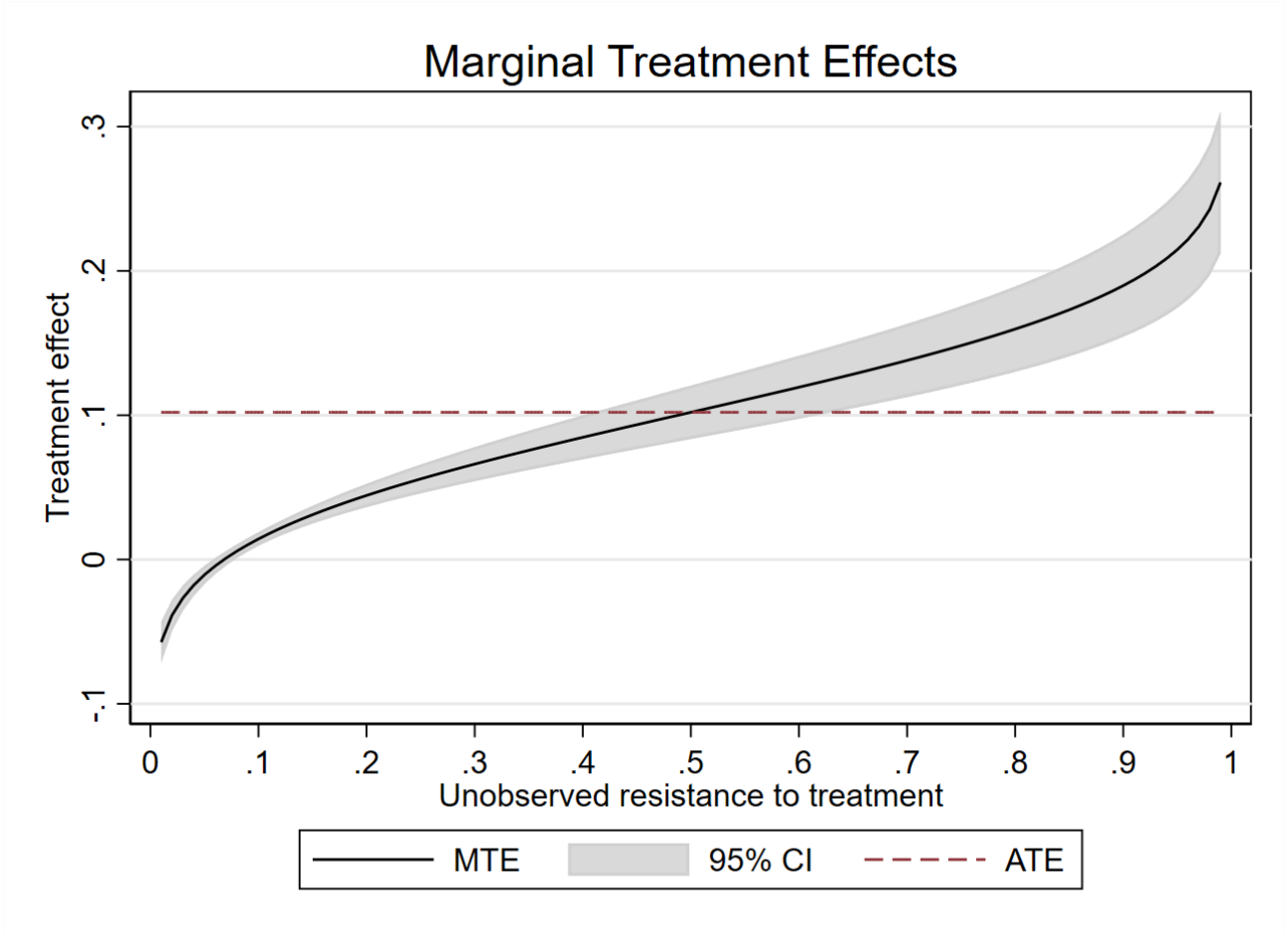
Second stage: return-on-assets, one and a half years apart



ATE: positive, ≈ 0.08.

Effects of loan renegotiation

Second stage: return-on-assets, two years apart



ATE: positive, ≈ 0.1.

Effects of loan renegotiation

Second stage: return-on-assets, summary

Takeaways:

- ATE is positive - and statistically significant - independently of the time gap.
- ATE increases with the lag: effects are larger in the medium to long-term.
- Strong heterogeneity in returns to loan renegotiation.
- MTE curve increases with unobserved resistance to treatment.
- Firms that are most likely to renegotiate their loans benefit the least from it.
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Roadmap

Conclusion

1. High-value, short-term loans are more likely to be renegotiated.
2. Longevity of borrower-creditor relationship isn't a relevant determinant of renegotiation.
3. Loan renegotiation is effective in improving the firms' probability of default and ROA in the short and medium terms - but not the debt ratio.
4. Reverse selection: firms less likely to renegotiate benefit more from it.

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Next steps

- How do our results compare to those of a random forest?
- Which measure is more successful in improving firms' performance?
  - Perform MTE on each renegotiation measure.
- Both firm and bank have to sign off on renegotiation: bank's decision into our selection model.
- Robustness: deviate from MTE model assumptions (normality).
- Moratoria: explore potential policy shock.

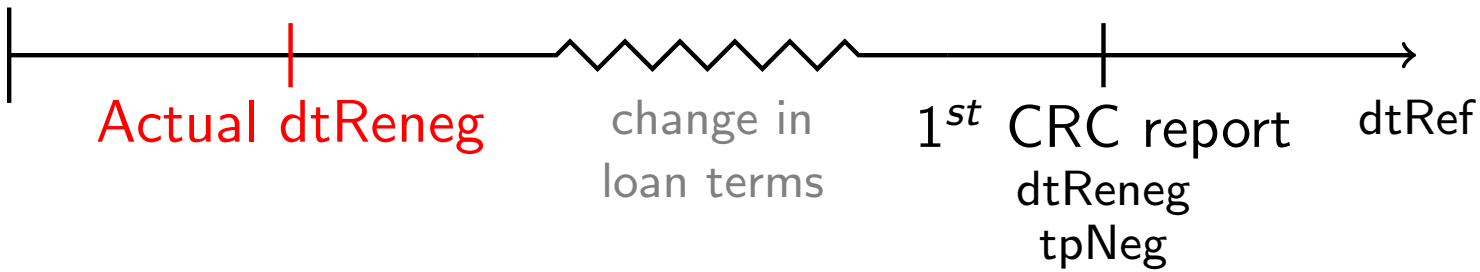
Thank you

Identification of loan renegotiation

Time mismatch between first CRC report and actual renegotiation date

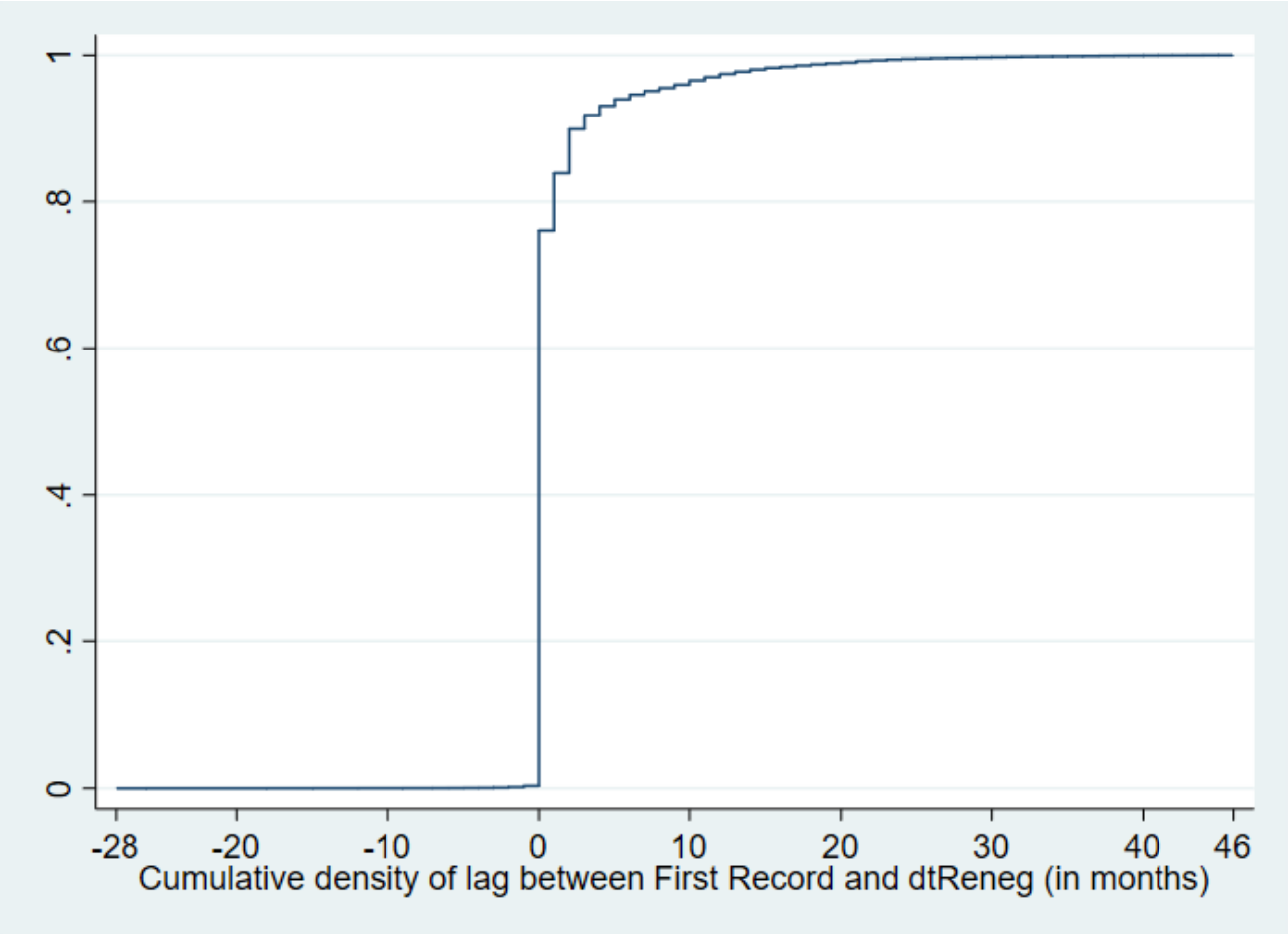
We focus on three different events:

1. First report in the CRC of the date of renegotiation.
2. Actual date of renegotiation - as reported.
3. Materialization of the renegotiation: change in loan terms.



Identification of loan renegotiation

Most renegotiations are identified at the exact moment they happen



Measures of loan renegotiation

Loan value extension:

- Rationale: bank extends loan value/overall limit to borrower, possibly to pay back another product.
- Variable: if outstanding balance/overall limit of the loan has increased.

Term extension:

- Rationale: bank extends maturity to borrower in distress hoping that she will be able to pay back at a later point in time.
- Variable: if maturity of the loan was extended (overdrafts excluded).

Measures of loan renegotiation

Interest rate change:

- Rationale: bank eases interest payments of distressed borrower.
- Variable: any change in interest rate type and/or spread.

Capital/interest deferment:

- Rationale: bank agrees that borrower pays only capital and/or interest in order to support borrower.
- Variable: did borrower stop paying capital/interest on any of his products?

Amortisation/Interest stop:

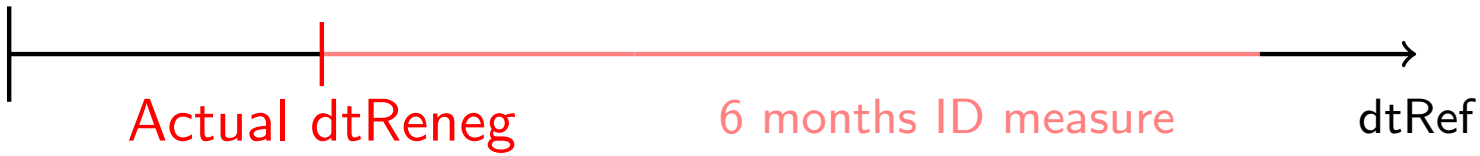
- Variable: any other unidentified measure.

go back

Identification of loan renegotiation

Time mismatch between date of renegotiation and its actual materialization

We identify the five renegotiations measures by looking at changes in the contract terms up until 6 months after the renegotiation takes place.



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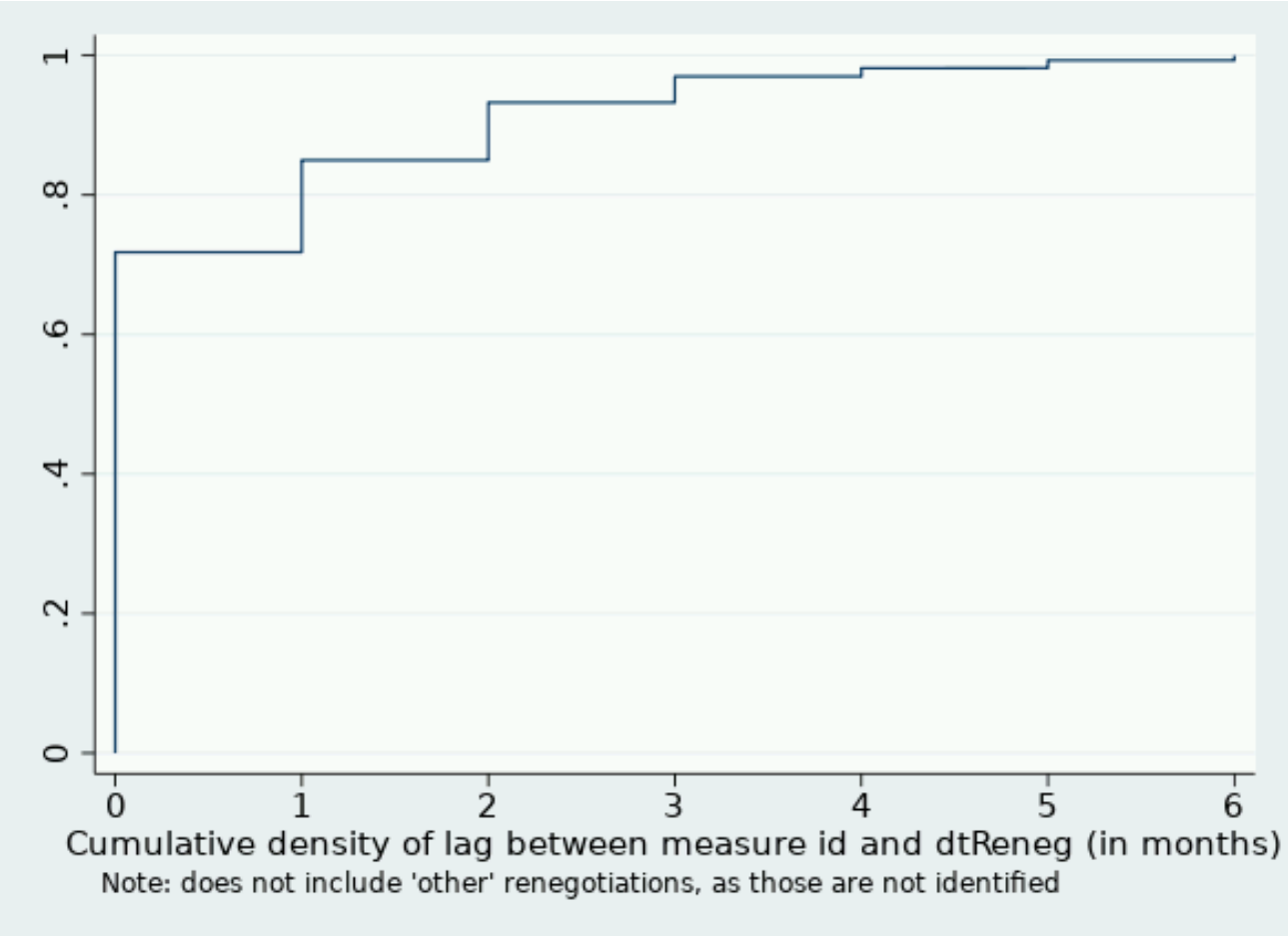

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