Sell or Work Out? Bank Continuation Value and Policy Design in NPL Resolution

Panagiotis Avramidis

Alba Graduate Business School, The American College of Greece

Dimitris Malliaropulos

Bank of Greece, University of Piraeus

Filippos Petroulakis

Bank of Greece

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Motivation

- Greek banks entered the 2010s with an unprecedented stock of NPLs (about half of total loans at the peak) and a severe credit crunch to the real economy.
- Policy response combined:
  - a large-scale secondary market for distressed assets (via HAPS securitizations), and
  - Deferred Tax Credits (DTCs) that monetize realized losses.
- Banks face a key resolution choice for distressed loans:
  - **Sell** to third-party investors via securitizations, or
  - **Work out** on-balance sheet through restructurings.
- We ask: **When do banks sell vs. restructure?** How do continuation value, borrower relationships and policy design shape this choice, and what are the consequences for loan cures and firm performance?

Related literature

- **Loan sales and securitization**
  - Loan sales, capital and liquidity: Pennacchi (1988); Irani & Meisenzahl (2017).
  - Information content of loan sales and borrower outcomes: Dahiya, Puri & Saunders (2003); Drucker & Puri (2009).
- **Workouts, renegotiation, and relationship banking**
  - Incomplete contracts and ex-post renegotiation: Hart & Moore (1998).
  - Frequent, information-driven renegotiation in private credit: Roberts & Sufi (2009); Roberts (2015).
  - Relationship lending and loan contracts: Boot (2000); Gorton & Kahn (2000).
  - Zombie lending and misallocation: Caballero, Hoshi & Kashyap (2008).
- **Our contribution**
  - Jointly study *loan sales and in-house workouts* for the same banks and borrowers in a systemic NPL episode.
  - Provide a unified, loss-based selection mechanism across the two resolution tools emphasizing on the role of relevant policies and incentives
  - Show that workouts durably restore performance and (weakly) boost productivity after correcting for selection.

Data overview

- **Source**: AnaCredit database (Bank of Greece).
  - Non-financial corporate loans $>$ 25k.
  - Four systemic banks (>95% of corporate lending).
  - Quarterly frequency, 2019Q1–2024Q4.
- **Sample restrictions**
  - Exclude financials, real estate (NACE 64–68), public sector, non-domiciled firms.
  - Exclude paid-off and written-off loans: focus on *sale vs. restructure* margin.
  - Collapse to a single loan-level cross-section for each analysis.
- **Main variables**
  - Loan status: `SOLD`, `NPL`, `RES`, `RECOV`.
  - Relationship and borrower structure: `RELAS` derived using PCA on `Contracts` and `Duration`, `MULTB`, `CORP`.
  - Firm characteristics: `SIZE`, `AGE`, `INDBT`, `PRODG`.
  - Loan terms: `LTV`, `INT`, `TENO`.

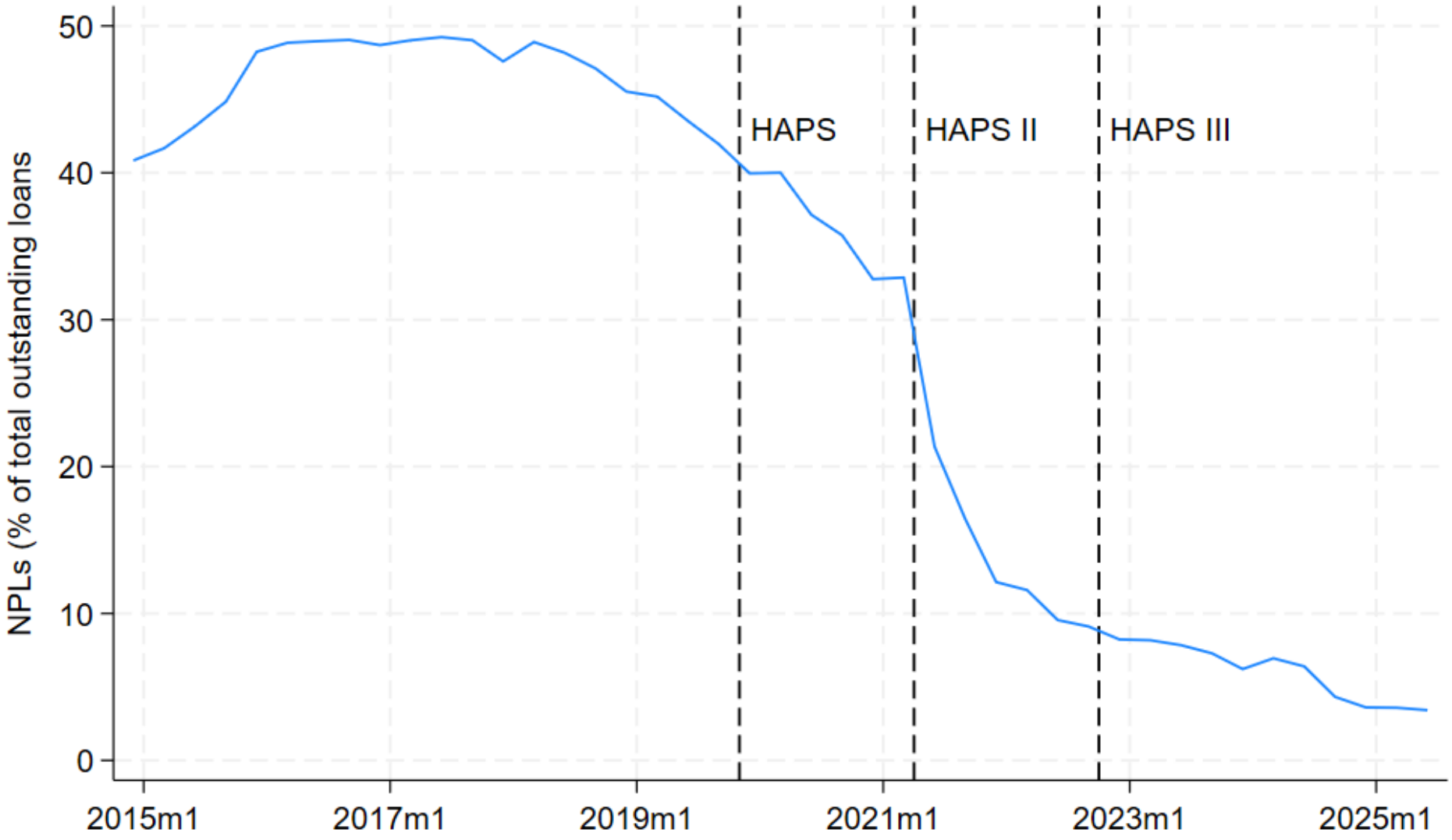
Sample – Loan sales

- Cross-section sample: 151,714 loans, 84,738 firm–bank pairs.
- 48.8% of loans are sold; 31.3% are reported as NPLs.
- 63.7% of loans are to multi-bank firms; 48.9% to corporations.

Table 1: Descriptive statistics of the loan sales sample (N=151,714).

	mean	sd	p1	p25	p50	p75	p99
SOLD	0.488	0.500	0	0	0	1	1
NPL	0.313	0.464	0	0	0	1	1
NPL_AGE	1.819	3.864	0	0	0	1	16.833
RELAS	-0.029	1.065	-1.599	-0.816	-0.193	0.547	3.112
MULTB	0.637	0.481	0	0	1	1	1
CORP	0.489	0.500	0	0	0	1	1
SIZE	0.024	0.060	0	0.002	0.007	0.020	0.383
AGE	2.844	0.702	.693	2.546	2.936	3.272	4.787
INDBT	1.678	6.832	0.012	0.106	0.227	0.580	53.576
LTV	0.758	1.264	0	0.240	0.439	0.991	9.159
INT	0.062	.0290	0	0.047	0.063	0.079	0.138
TENO	0.803	0.744	0	0	1	1	2
EBLS	1.125	0.375	0.281	0.812	1.038	1.584	1.584

HAPS & Loan sales



Empirical identification – Loan sales

Question: What drives the decision to sell a loan vs. keep it on balance sheet?

Key idea:

1. **Continuation value**:
   - Banks retain loans where relationship capital and exposure share generate higher future rents.
   - Measured via `RELAS` and borrower structure (`MULTB`, `CORP`).
2. **Accounting/capital**:
   - Selling triggers loss recognition; DTCs compress the hit to capital.
   - This incentive varied according to the loan's expected loss recognition from sale, defined as the difference between the loan's *Book Value net of Provisions* minus the *Proceeds from the sale*. Accordingly, the expected loss recognized on sale is lower for loans with higher provisions; LGD_i is supervisory Loss Given Default used for loss provisions.
   - Expected Benefit from Loan Sale:

$$EBLS = \frac{DTC}{CET} \times LGD$$

Empirical model (linear probability):

$$\begin{aligned} SOLD_{i,b} = \beta_0 + \beta_1 NPL_{i,b} + \beta_2 RELAS_{j,b} + \beta_3 NPL_{i,b} \times RELAS_{j,b} \\ + \beta_4 EBLS_{i,b} + C_{i,b} + C_{j,b} + f_b + f_{j:NACE} + f_{i:chrt} + \epsilon_{i,b} \end{aligned}$$

- Also estimate within-firm specifications for multi-bank borrowers (firm fixed effects).

Results – Loan sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NPL	0.261***	0.228***	0.240***	0.057***	0.078***			
	(0.004)	(0.005)	(0.005)	(0.011)	(0.011)			
RELAS	-0.078***	-0.089***	-0.071***	-0.065***	-0.057***	-0.227***	-0.213***	-0.143***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.007)
NPL× RELAS			-0.125***		-0.058***			
			(0.005)		(0.006)			
MULTB		0.020***	0.019***				0.021***	
		(0.003)	(0.003)				(0.004)	
CORP		0.038***	0.036***				0.026***	
		(0.003)	(0.003)				(0.003)	
SIZE		0.144***	0.112***				0.183***	
		(0.028)	(0.026)				(0.068)	
AGE		0.006***	0.003				0.024***	
		(0.002)	(0.002)				(0.003)	
INDBT		-0.001**	-0.000				-0.000	
		(0.000)	(0.000)				(0.000)	
LTV		-0.002*	-0.003***	-0.009***	-0.010***		0.002*	-0.001
		(0.001)	(0.001)	(0.001)	(0.001)		(0.001)	(0.001)
NPL_AGE		0.005***	0.006***	-0.001*	-0.002**		-0.014***	-0.013***
		(0.001)	(0.000)	(0.001)	(0.001)		(0.001)	(0.001)
INT		-1.563***	-1.725***	-0.494***	-0.524***		-0.682***	-0.034
		(0.051)	(0.049)	(0.068)	(0.067)		(0.063)	(0.082)
TENO		-0.044***	-0.043***	-0.012***	-0.012***		-0.044***	-0.024***
		(0.002)	(0.002)	(0.003)	(0.003)		(0.003)	(0.005)
EBLS							0.277***	0.152***
							(0.017)	(0.023)
Constant	0.404***	0.486***	0.505***	0.539***	0.537***	0.865***	0.597***	0.812***
	(0.002)	(0.007)	(0.007)	(0.006)	(0.006)	(0.001)	(0.024)	(0.029)
Bank FE	yes	yes	yes	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	no	no	yes	yes	no
Firm FE	no	no	no	yes	yes	no	no	yes
Sample	full	full	full	MULTB	MULTB	NPLs	NPLs	NPLs-MULTB
N	151,663	149,594	149,594	89,380	89,380	47,452	44,036	25,007

Results – Loan sales

- **NPLs are more likely to be sold**:
  - Being an NPL increases sale probability by ≈22.8 pp in the full sample.
- **Relationships mitigate sale**:
  - `RELAS` has a strong negative effect: higher relationship strength ⇒ lower probability of sale by ≈ 7.1 pp.
  - Interaction $NPL \times RELAS$ is negative: relationship capital particularly protects NPLs from sale (lowering an additional ≈ 12.5 pp the probability of sale).
- **Policy-induced incentives matter**:
  - `EBLS` positively predicts sale of NPLs: banks with more DTC capacity and high expected losses are more likely to sell.
- **Borrower structure**:
  - Loans to multi-bank firms and large corporations are more likely to be sold (lower continuation value, more outside options).

Sample – Loan restructures

- Retained NPL-sample restructures: 6,966 loans (4,677 firm–bank pairs).
- 29.7% of retained NPLs are restructured and 34.4% recover.

Table 2: Descriptive statistics of the NPL-b/s sample

	mean	sd	p1	p25	p50	p75	p99
RES	0.297	0.457	0	0	0	1	1
MULTB	0.672	0.469	0	0	1	1	1
CORP	0.536	0.499	0	0	1	1	1
SIZE	0.023	0.060	0	0.002	0.006	0.019	0.400
AGE	3.027	0.587	1.335	2.755	3.114	3.406	4.580
INDBT	3.531	10.543	0.015	0.170	0.444	1.516	59.049
LTV	0.800	1.498	0	0.159	0.370	1	11.013
NPL_AGE	4.605	4.534	0	0.917	3.250	7	16.833
RWBE	0.132	0.436	-1.271	0.000	0.104	0.334	1.005
RECOV	0.344	0.475	0	0	0	1	1

Empirical identification – Loan restructures

Step 1: Selection into sale

- Probit for sale indicator $SOLD_{i,b}$ with `EBLS` as exclusion restriction.
- Construct Inverse Mills Ratio $\widehat{IMR}_{i,b}$ from the sale equation.

Step 2: 2SLS system for restructures and recovery

$$RES_{i,b} = \gamma_0 + \gamma_1 RWBE_{i,b} + \gamma_2 \widehat{IMR}_{i,b} + \gamma_3 C_{i,b} + \gamma_4 C_{j,b} + f_b + f_{j:NACE} + f_{i:chrt} + f_{i:prps} + u_{i,j,b}$$

$$RECOV_{i,b} = \beta_0 + \beta_1 \widehat{RES}_{i,b} + \beta_2 \widehat{IMR}_{i,b} + \beta_3 C_{i,b} + \beta_4 C_{j,b} + f_b + f_{j:NACE} + f_{i:chrt} + f_{i:prps} + \epsilon_{i,j,b}$$

- $DSHARE_{i,b} \in [0,1]$ is the share of loan i's held by bank b over the borrower's total bank debt measured before the restructuring window.
- $RWBE_{i,b} = DSHARE_{i,b} \times RELAS_{i,b}$: Relationship-Weighted Bank Exposure is the **bank-incentive** instrument, combining exposure share to borrower and relationship strength.
- Error terms are (a) are clustered at bank-firm level and (b) boot-strapped to correct for the inclusion of a predicted values $\widehat{IMR}_{i,b}$, $\widehat{RES}_{i,b}$.
- Also estimate reduced-form and OLS versions using observed `RES`.

Empirical identification – Loan restructures

$$EBLS_{i,b} = \frac{DTC_b}{CET1_b} \times EL_i$$

Why *EBLS* is a good exclusion restriction (selection)

- **Relevance:** A higher EBLS makes it *more attractive* for a bank to sell a given loan rather than keep it, so it strongly predicts selection into the retained vs. sold sample.
- **Exclusion:** Conditional on loan characteristics and fixed effects (bank, cohort, sector/firm), EBLS affects restructures and outcomes *only* through the sale/retention decision:
  - It reflects accounting/tax treatment of realized losses, not the economics of working out a retained loan.
  - Under the Greek DTC regime, it is these realized write-off losses that are eligible for conversion into tax credits, rather than the ongoing impairment charges associated with on-book restructurings.

Empirical identification – Loan restructures

$$RWBE_{i,b} = DSHARE_{i,b} \times RELAS_{i,b}$$

Why *Relationship-Weighted Bank Exposure* is a good instrument for restructures

- **Relevance:** Higher *RWBE* values raises the continuation value of the relationship for that bank, making it more likely to invest in a restructuring instead of letting the loan drift.
- **Exogeneity:** Conditional on loan characteristics and fixed effects (bank, cohort, sector/firm), the only channel through which *RWBE* can affect NPL recoveries is by changing the probability that the bank restructures the loan because:
  - *RWBE* is predetermined by the structure of borrower's debt (across banks) and the accumulated relationship,
  - The exposure share $DSHARE_{i,b}$ is purely distributional: reallocating more of the same liabilities to bank b does not change the borrower's future cash-flow capacity, only how much of the upside bank b internalizes if the loan is cured.
  - Finally, relationship strength proxies informational depth and contracting history that lower the bank's *private* cost of designing and monitoring a workout, but does not itself inject any resources to the borrower or relax its financial constraints in the absence of an active restructuring.

Determinants of Loan Restructures

	(1)	(2)	(3)	(4)	(5)	(6)
NPL	0.207***	0.222***	0.163***			
	(0.007)	(0.009)	(0.013)			
RWBE	0.008***	0.015***	0.028***	0.102***	0.095***	0.161***
	(0.001)	(0.002)	(0.005)	(0.014)	(0.016)	(0.036)
IMR	0.016*	-0.011	-0.012	-0.122***	-0.112***	-0.084***
	(0.008)	(0.008)	(0.008)	(0.014)	(0.017)	(0.031)
MULTB		-0.008***			-0.022*	
		(0.002)			(0.013)	
CORP		-0.014***			-0.050***	
		(0.002)			(0.013)	
SIZE		-0.029**			0.308**	
		(0.013)			(0.125)	
AGE		0.005***			0.020*	
		(0.001)			(0.011)	
INDBT		0.000			0.001	
		(0.000)			(0.001)	
LTV		-0.003***	-0.002*		-0.007	-0.002
		(0.001)	(0.001)		(0.004)	(0.005)
NPL_AGE		-0.005***	0.003		-0.003	0.006
		(0.002)	(0.003)		(0.002)	(0.004)
Constant	0.028***	0.017***	0.008**	0.184***	0.181***	0.129***
	(0.004)	(0.004)	(0.004)	(0.014)	(0.040)	(0.038)
Sector FE	yes	yes	no	yes	yes	no
Firm FE	no	no	yes	no	no	yes
N	72532	72532	39792	6324	6324	2619

Determinants of Loan Restructures

- **Being an NPL** raises the probability of restructuring by about 22.2 pp in the full sample.
- **Bank incentives** (*RWBE*) matter:
  - One standard deviation increase in *RWBE* raises restructuring probability by ≈0.81 pp in the full sample (unconditional restructure is 3.7 pp) and by 4.2 pp among NPLs (unconditional restructure is 29.7 pp).
- **Borrower structure**:
  - Loans to multi-bank firms and corporations are *less likely* to be restructured (banks have stronger bargaining power on (single)-bank and non-limited liability borrowers).
- **Collateral and size**:
  - For all loans, higher LTV is associated with less restructures.
  - For NPLs, borrower size is positively related to restructures (priority to larger clients).

Restructures and recovery

	(1) OLS	(2) OLS	(3) IV	(4) OLS	(5) IV
RES	0.486***	0.419***	0.851***	0.426***	0.942***
	(0.018)	(0.019)	(0.234)	(0.019)	(0.277)
MULTB		-0.031**	-0.017	-0.031**	-0.017
		(0.015)	(0.016)	(0.015)	(0.015)
CORP		-0.014	0.010	-0.013	0.014
		(0.015)	(0.019)	(0.015)	(0.020)
SIZE		-0.068	-0.182	-0.051	-0.179
		(0.148)	(0.144)	(0.145)	(0.181)
AGE		0.019	0.004	0.019	0.004
		(0.013)	(0.015)	(0.014)	(0.015)
INDBT		-0.003***	-0.003***	-0.002***	-0.002***
		(0.001)	(0.001)	(0.001)	(0.001)
LTV		-0.021***	-0.018***	-0.021***	-0.017***
		(0.005)	(0.005)	(0.004)	(0.005)
NPL_AGE		-0.020***	-0.019***	-0.020***	-0.021***
		(0.002)	(0.002)	(0.002)	(0.002)
IMR		-0.142***	-0.097***	-0.141***	-0.089***
		(0.017)	(0.028)	(0.017)	(0.032)
Constant	0.232***	0.230***		0.232***	
	(0.006)	(0.046)		(0.046)	
N	8243	5776	5776	5721	5721
rk F			33.559		27.396

Restructures and recovery

- **Cure effects**:
  - OLS estimates: restructuring increases recovery probability by about 41.9 pp (one-year horizon). The effect is 11.9 pp among multibank firms
  - IV estimates: cure effect rises to ≈85.1 pp for the overall NPL sample; No effect on multibank firms
  - Effects remain strong at the two-year horizon (columns 4-5).
- **Borrower incentives**:
  - Single-bank and non-corporate borrowers exhibit higher recovery probability (stronger incentives to preserve the bank relationship).
- **Balance sheet conditions**:
  - Lower indebtedness and higher collateral (LTV) are associated with higher recovery.

Restructures and firm performance

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	IV	OLS	IV
RES	0.038*	0.052***	0.441	0.055***	0.450
	(0.020)	(0.019)	(0.283)	(0.020)	(0.382)
IMR	-0.00	-0.002	0.032	-0.002	0.033
	(0.016)	(0.019)	(0.029)	(0.018)	(0.035)
MULTB		0.151***	0.162***	0.152***	0.162***
		(0.014)	(0.016)	(0.015)	(0.015)
CORP		0.118***	0.138***	0.118***	0.137***
		(0.016)	(0.020)	(0.016)	(0.021)
SIZE		0.299**	0.232	0.283*	0.224
		(0.152)	(0.135)	(0.160)	(0.134)
AGE		-0.011	-0.029	-0.012	-0.027
		(0.014)	(0.019)	(0.014)	(0.019)
INDBT		-0.001	-0.001	-0.001	-0.001
		(0.001)	(0.001)	(0.001)	(0.001)
LTV		-0.005	-0.003	-0.005	-0.002
		(0.005)	(0.005)	(0.005)	(0.005)
NPL_AGE		-0.006***	-0.005**	-0.006***	-0.006***
		(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.173***	0.064		0.065	
	(0.016)	(0.049)		(0.052)	
Bank FE	yes	yes	yes	yes	yes
Cohort FE	yes	yes	yes	yes	yes
Purpose FE	yes	yes	yes	yes	yes
Sector FE	yes	yes	yes	yes	yes
N	4460	4460	4460	4416	4416
rk F			18.552		15.086

Restructures and firm performance

- **Productivity outcomes**:
  - For NPL firms, restructures are associated with an increase of about 5.2-5.5 pp in the probability of productivity gains (PRODG) at one- and two-year horizons (OLS) (columns 2-4).
  - IV estimates are positive but imprecisely estimated due to data limitations on revenues (missing or on several cases not-updated).
- **Who gains more?**
  - Multi-bank and corporate borrowers show higher baseline productivity gains.
  - Larger firms (by employment) also display higher PRODG.
- Overall, evidence suggests that restructures *plausibly help* firms adjust and grow, rather than merely postpone losses.

Policy implications

1. **Target transfer schemes**
   - HAPS/DTC-type schemes can accelerate balance-sheet clean-up when continuation value is low.
   - But safeguards are needed to avoid inefficient disposal of loans with strong relationship value.
2. **Preserve room for disciplined workouts**
   - Where relationship capital and exposure concentration are strong, banks are better placed to restructure credibly.
   - Supervisory frameworks should therefore preserve space for incentive-compatible workouts, while monitoring for zombie lending.
3. **Best resolution framework is an integrated one**
   - Supervisory success should not be measured only by de-recognition speed or lower headline NPL ratios.
   - The key benchmark is whether the framework sorts loans efficiently across a combination of resolution technologies (sale vs workout).
4. **Sold NPLs also need a resolution strategy**
   - Third-party servicers may lack the relationship capital that supported successful bank-led workouts.
   - Their incentives should be linked to long-run cures, borrower engagement, and sector-specific workout capacity.

Thank you!

Questions?