EUROPEAN CENTRAL BANK

EUROSYSTEM

Asset prices, collateral and bank lending

The case of Covid-19 and Real Estate

August 29th, 2023

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Housekeeping

The views expressed are those of the authors and are not necessarily those held by the European Central Bank

We examine how the banking system transmits asset price shocks to credit, via revaluation of collateral and subsequent lending decisions

- We use credit registry data for the euro area (AnaCredit) which provides loan-level data on euro area bank lending to firms (NFCs) but also collateral-level data, including almost 5 million pieces of real estate collateral

- We examine banks' treatment of real estate collateral during the Covid-19 crisis and then examine how the use of real estate collateral and its revaluation affects banks' lending behaviour during this crisis

- We make three key contributions to the literature:
    1. We examine how banks' revaluation behaviour contributes to the financial accelerator for the first time and find evidence of significant frictions in the transmission of asset price dynamics to collateral values
    2. We confirm an economically significant link between real estate price shocks and lending behaviour – confirming the significance of the collateral channel
    3. We do this having fully addressed endogeneity problems which remained unresolved in the pre-existing literature
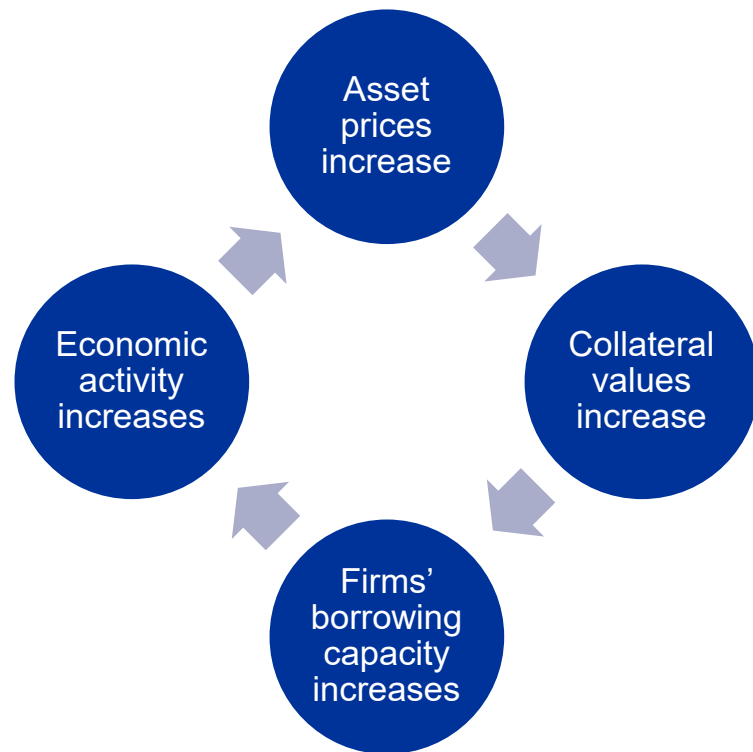
Overview

1. Motivation

2. Literature

3. Data

4. Collateral revaluations during Covid-19

5. Did banks avoid lending to real estate collateral reliant firms during Covid-19?

6. How did revaluations affect lending behaviour?

Overview

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Why do we care about collateral values?

Collateral plays a central role in our understanding of how financial cycles work

e.g. Bernanke and Gertler (1989) "financial accelerator"

Also central role in transmission of monetary policy via "collateral channel"

Asset prices increase → Collateral values increase → Firms' borrowing capacity increases → Economic activity increases →

Covid-19 was a large, exogenous shock to real estate markets and real estate is widely used as collateral on NFC lending

- Pandemic had negative impact on Retail and Office markets while Residential real estate price growth accelerated

- Approximately 37% of euro area NFC loans are collateralized by real estate - collateral channel suggests that shocks to real estate prices could have implications for credit to real estate markets (amplify initial shock) and wider NFC credit conditions (amplify wider financial cycle)

REIT price dynamics during Covid-19
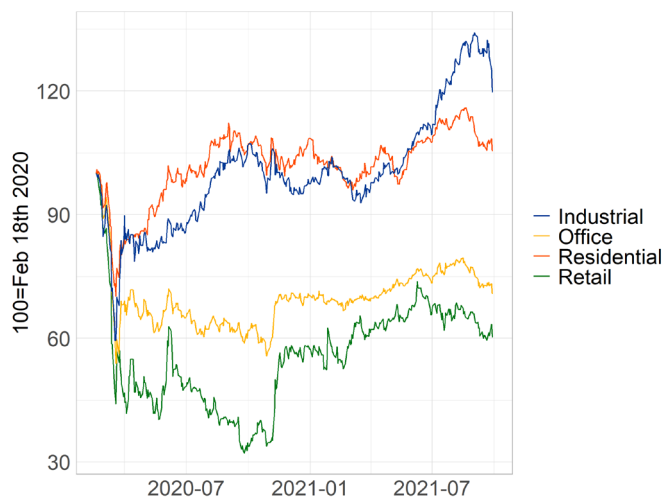
Real Estate is widely used as collateral – including on lending for non-real-estate-purposed lending
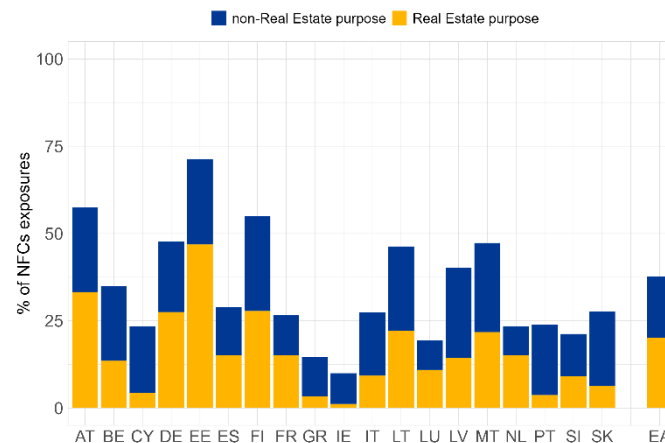
Overview

Existing literature

- *Collateral channel of financial/business cycles*
  - **Bernanke and Gertler (1989), Kiyotaki and Moore (1997)** - Fluctuations in asset prices can create fluctuations in real economic activity when these assets are used as collateral and so their rising prices loosen firms' borrowing constraints

  - **Lian and Ma (QJE; 2021), Greenwald (2019) and Drechsel (2022)** – Examine covenants in US corporate loans and argue that actually earnings based constraints are more common than collateral based constraints – **argue that traditional collateral channel plays only a minor role – our results support the economically significant role of the collateral channel (in euro area, during crisis)**

- *Real estate and the collateral channel – empirical analysis*
  - *Chaney at al (AER; 2012)* – rising real estate prices in the US raises firm investment,
  - *Gan (JFE; 2007)* - negative real estate price shock in Japan in the 1990s reduced firm investment rate,

Granularity of our data allows us to address endogeneity problem present in existing literature on collateral constraints

- Critical source of endogeneity that these papers cannot fully address – the decision to hold real estate and firms' investment opportunities are likely highly correlated
    - Chaney et al (2012) suggest that real estate owning firms may be more exposed to local economic shocks

"We do not have a proper set of instruments to deal with [this] source of endogeneity. We make two attempts at gauging the severity of the bias it may cause" Chaney at al (AER: 2012)

- We carry out most of our analysis at the bank-borrower-level. This allows us to follow method laid out **Khwaja and Mian (2008)** which compares outcomes across a given borrowers' banking relationships
    - Implement via borrower or time-borrower fixed effects with data at bank-borrower-level
    - **This means we fully control for the role of firm characteristics in driving our results**
    - Double check using industry-location-size FE laid out in **Degryse et al (2019)**

Revaluation behaviour is a crucial but unstudied component of the financial accelerator mechanism

- Our data set allows us to track the value of individual pieces of collateral over time (during a crisis caused by a large exogenous shock)

- To our knowledge ours is the first paper to examine actual revaluation behaviour by the banking system

- By studying this behaviour and then examining its relationship with lending we provide novel insights into a crucial but previously unstudied component of the financial accelerator mechanism
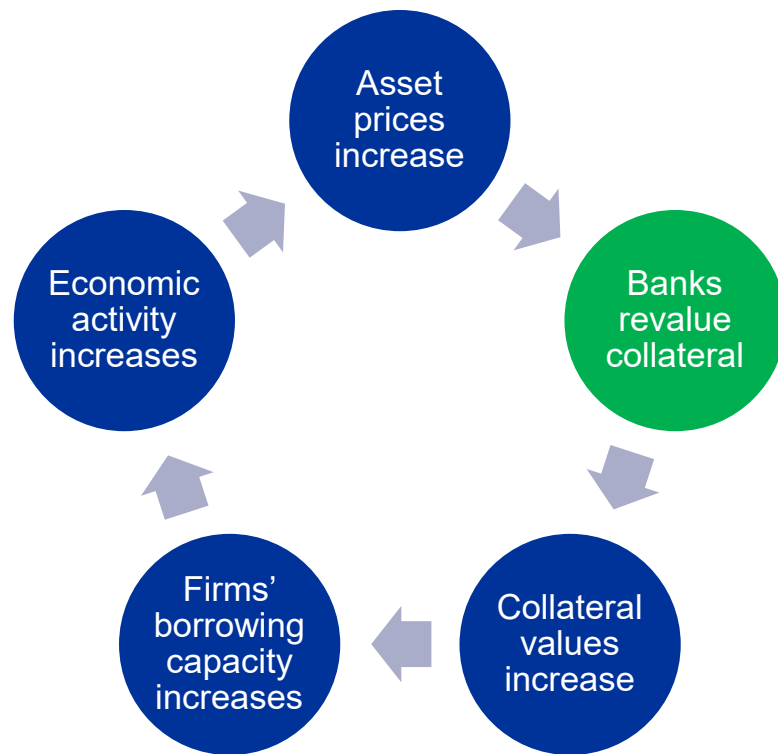
Asset prices increase

Banks revalue collateral

Collateral values increase

Firms' borrowing capacity increases

Economic activity increases

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AnaCredit

- AnaCredit is an analytical credit register containing information on all commercial bank lending in the euro area above €25,000

- Data is both loan and collateral level - provides details including valuations, revaluation dates, debtor information, and asset types.

Real Estate Collateral Item
1. Commercial Real Estate (CRE) used for *income generating purposes*
2. Commercial Real Estate (CRE) used for a *firm's own commercial activities,* i.e. offices and commercial premises
3. *Residential* Real Estate (RRE) owned by NFCs

- *Data coverage:* January 2019 – December 2021
  - Non-Financial Corporations loans
  - Longer term loan types (no overdrafts, credit card debt)
  - Collateral value of at least €10,000

NFC exposure by types of real estate collateral

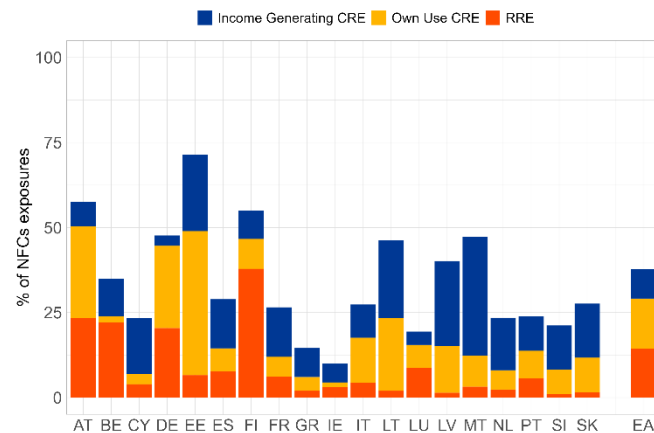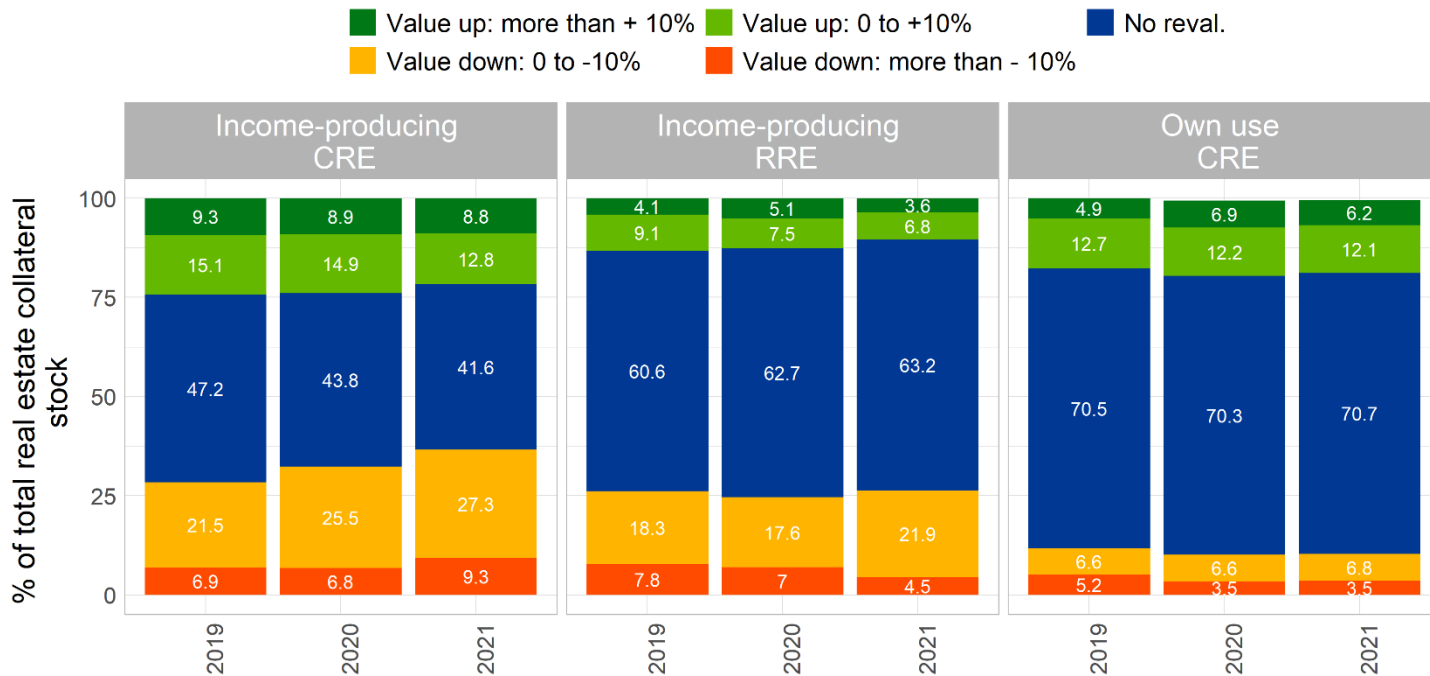Source: ECB calculations based on AnaCredit. Data as of end December 2021.

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Covid-19 pandemic appears to have had limited impact on banks' revaluation behaviour

Stock of euro area banks' Real Estate collateral by size of annual revaluation

Legend:
- Value up: more than + 10%
- Value up: 0 to +10%
- No reval.
- Value down: 0 to -10%
- Value down: more than - 10%

Income-producing CRE

	2019	2020	2021
Value up: more than +10%	9.3	8.9	8.8
Value up: 0 to +10%	15.1	14.9	12.8
No reval.	47.2	43.8	41.6
Value down: 0 to -10%	21.5	25.5	27.3
Value down: more than -10%	6.9	6.8	9.3

Income-producing RRE

	2019	2020	2021
Value up: more than +10%	4.1	5.1	3.6
Value up: 0 to +10%	9.1	7.5	6.8
No reval.	60.6	62.7	63.2
Value down: 0 to -10%	18.3	17.6	21.9
Value down: more than -10%	7.8	7	4.5

Own use CRE

	2019	2020	2021
Value up: more than +10%	4.9	6.9	6.2
Value up: 0 to +10%	12.7	12.2	12.1
No reval.	70.5	70.3	70.7
Value down: 0 to -10%	6.6	6.6	6.8
Value down: more than -10%	5.2	3.5	3.5

% of total real estate collateral stock

Source: ECB calculations based on AnaCredit.
Note: Revaluation size is based on change in value of each piece of collateral over the year. Collateral items appearing in at least 8 months are included. Own use CRE refers to collateral which is the borrower's own offices or commercial premises (typ_prtctn = 9)

Negative shock to CRE prices was not reflected in largescale downward revaluation following the pandemic onset

Monthly Real Estate revaluations by over % of collateral stock and average revaluation size

Legend:
- Value up: more than + 10%
- Value up: 0 to +10%
- Value down: more than - 10%
- Value down: 0 to -10%

Y-axis (left): % of total real estate collateral value
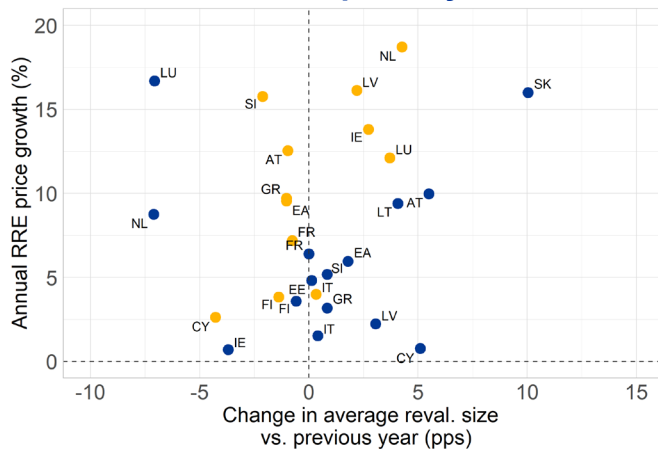Y-axis (right): Average Revaluation Size (%)
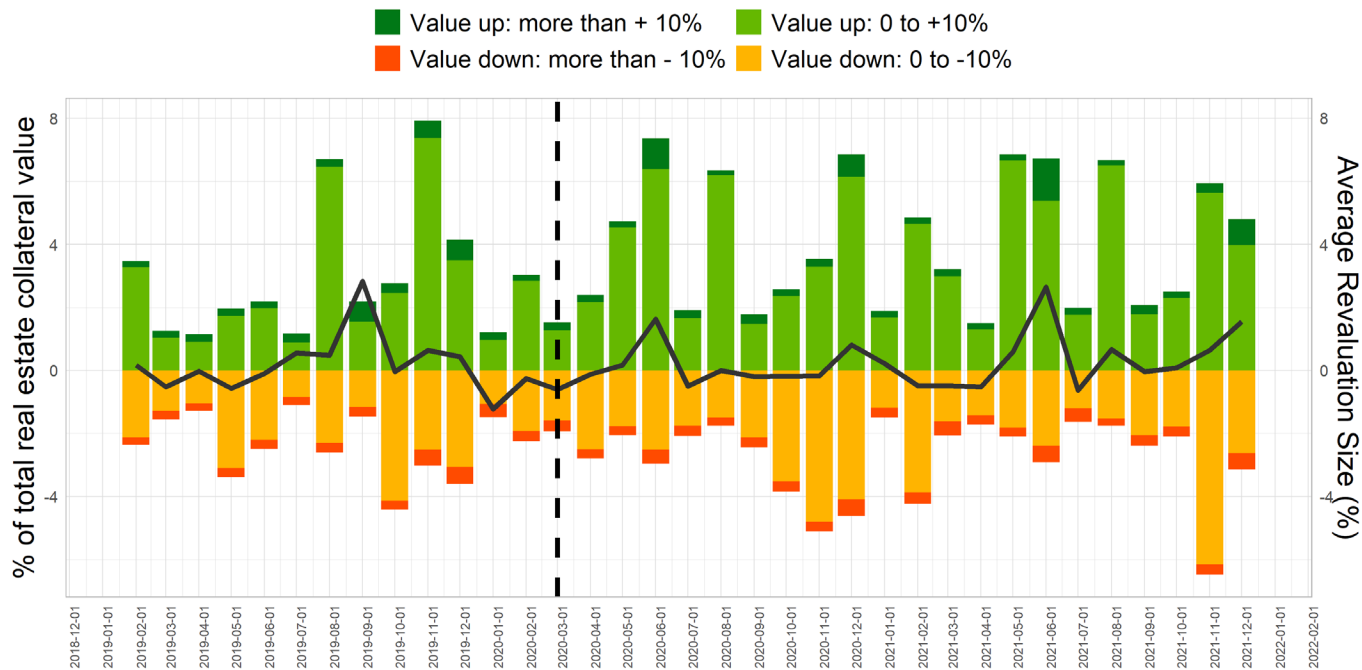
Source: ECB calculations based on AnaCredit.
Note: Revaluation size is based on change in value of each piece of collateral in that month. Average revaluation size is weighted by the value of the collateral item.

Country-level data show limited Covid-19 impact but also clear national differences in frequency of revaluations

- Country-level dynamics show no clear relationship between changes in price indices and revaluations (RRE only) or a clear trend for more negative revaluations in pandemic years
- The share of collateral being revalued varies substantially at country-level – same shock could have different effects on national banking systems

Revaluations do not seem to have a clear correlation to price dynamics

In many countries a very low share of collateral is revalued at all (2020 data)
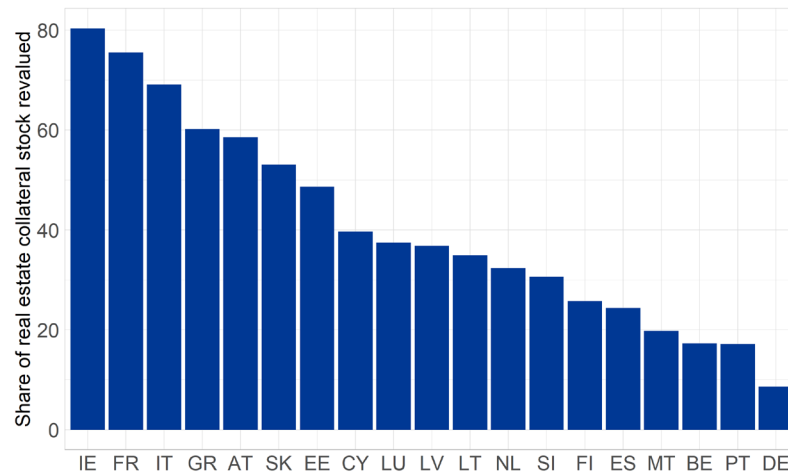
Source: ECB calculations based on AnaCredit.
Note: Revaluation size is based on change in value of each piece of collateral over the year. Collateral items appearing in at least 8 months are included. Countries with less than 20% of collateral revalued are excluded from scatter chart.

Overview

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Were firms which relied on real estate collateral granted less credit following the stress in real estate markets?

$$new\ loans_{i,j} = \beta_0 + \alpha_i + \textcolor{red}{\beta_1} * Pre\ Covid\ real\ est.\ collateral\ depend_{i,j} + \Gamma * X_{i,j} + \Phi * Z_j + \varepsilon$$

- α_i - borrower fixed-effects

- $X_{i,j}$ - bank-borrower control variables

- Z_j - bank control variables

- Standard errors clustered for banks and borrowers

Conservative specification aims to isolate effect of real estate collateral reliance on credit availability to remove endogeneity and credit demand effects

New loans to firms which relied on real estate collateral pre-2020 as % of total quarterly new loans

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We use borrower fixed effects in the diff-in-diff model to see that banks avoided lending to firms who were reliant on real estate collateral

- β_1 - the mean difference in ratio of new lending in the first 6 months of pandemic to pre-pandemic stock of loans between the group of CRE-reliant (treated) and non-CRE-reliant (control group) companies

- Carefully control for an overlap between owning an using CRE collateral, and relying on income stream from CRE

Dependent Variable: Model: Borrower fixed-effects, without gov-guaranteed loans	New loans to pre-covid stock of loans				
	(All borrowers) (All CRE) ()	(All borrowers) (CRE subsectors) ()	(All borrowers) (All CRE) (CRE-prps control)	(No CRE-prps) (All CRE) ()	(No RE-sectors) (All CRE) ()
Variables					
CRE reliance dummy	-0.0355*** (0.0057)		-0.0317*** (0.0056)	-0.0486*** (0.0100)	-0.0461*** (0.0073)
CRE inc. gen. reliance dummy		-0.0448*** (0.0074)			
RRE reliance dummy		-0.0398*** (0.0059)			
CRE own use reliance dummy		-0.0389*** (0.0056)			
Borrower LTV	-5.06×10^{-5} (4.62×10^{-5})	-5.34×10^{-5} (4.62×10^{-5})	-5.13×10^{-5} (4.63×10^{-5})	-6.06×10^{-5} (5.1×10^{-5})	-5.04×10^{-5} (4.8×10^{-5})
Cross-border dummy	-0.0272** (0.0117)	-0.0283** (0.0117)	-0.0284** (0.0117)	-0.0279 (0.0193)	-0.0344** (0.0164)
Bank NPL ratio	0.0743 (0.0726)	0.0715 (0.0722)	0.0753 (0.0743)	0.0556 (0.0713)	0.0801 (0.0766)
Bank CET1 ratio	-0.0114 (0.0398)	-0.0138 (0.0398)	-0.0079 (0.0408)	0.0113 (0.0508)	-0.0181 (0.0559)
Moratorium dummy	-0.0385*** (0.0100)	-0.0379*** (0.0100)	-0.0385*** (0.0102)	-0.0536*** (0.0131)	-0.0442*** (0.0118)
CRE purpose share dummy			-0.0210*** (0.0059)		
Fixed-effects					
dbtr_id	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,727,594	1,727,594	1,727,594	1,231,899	1,087,219
R^2	0.79557	0.79565	0.79564	0.81029	0.77760
Within R^2	0.00269	0.00309	0.00305	0.00369	0.00326

Two-way (crdtr_id & dbtr_id) standard-errors in parentheses
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

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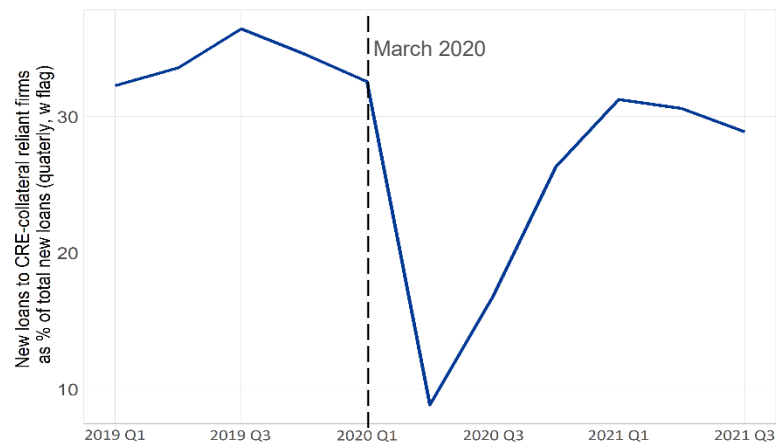
6. **How did revaluations affect lending behaviour?**

How did revaluations affect bank lending decisions?

$$new\ loan_{i,j,t} = \beta_0 + \alpha_i + \beta_1 coll.reval.occurred_{i,j,t} + \beta_2 coll.reval.nature_{i,j,t}$$
$$+ \beta_3 coll.reval.nature_{i,j,t} * high\ LTV_{i,j,pre-Covid} +$$
$$\Gamma * X_{i,j,t} + \Phi * Z_{j,pre-Covid} + \varepsilon$$

Link revaluations at bank-borrower-level to contemporaneous new lending

- Real Estate collateralized loans only, monthly Feb 2020-Aug. 2021
- **Extensive margin:** Probits examine effect of revaluation on probability a loan is made
- **Intensive margin:** OLS examines effect of revaluation on loan size, maturity and interest rate

Very conservative specification aims to really isolate effect of revaluation on credit availability

- α_i - borrower fixed-effects – removes endogeneity and credit demand effects
- $X_{i,j,t}$ - bank-borrower control variables – new collateral posted, number of loans pre-Covid, average interest rate etc.
- Z_j - bank control variables – pre-Covid NPL and CET1 ratios
- Control for revaluation occurring at all – aims to capture procedural relationship between revaluation and lending

Revaluations and the likelihood of a new loan being made

- Borrowers receiving a negative revaluation were less likely to get a new loan (aprox – 18%)

- Effect concentrated among highly leveraged borrowers (aprox – 36%)

- Leverage plays lesser role for upward revaluations

- Size of revaluation also matters

Dependent Variable:	Loan made			
Model:	(1)	(2)	(3)	(4)
Variables				
Reval. dummy	0.2160***	0.2175***	0.1104***	0.1615***
	(0.0288)	(0.0288)	(0.0304)	(0.0217)
Neg. reval. dummy	-0.1051***	-0.0635		
	(0.0402)	(0.0448)		
New coll. posted dummy	2.391***	2.391***	2.392***	2.392***
	(0.0222)	(0.0222)	(0.0222)	(0.0222)
Avg. num new loans 2 years pre-Covid	0.0260***	0.0261***	0.0261***	0.0260***
	(0.0075)	(0.0075)	(0.0075)	(0.0075)
Num. pre-Covid loans	0.0019*	0.0019*	0.0019*	0.0019*
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Bank CET1 ratio (pre-Covid)	0.0728	0.0669	0.0690	0.0750
	(0.1088)	(0.1092)	(0.1094)	(0.1090)
Bank NPL ratio (pre-Covid)	0.3591	0.3680	0.3594	0.3785
	(0.4496)	(0.4495)	(0.4499)	(0.4500)
LTV > 75% dummy		0.0374*	0.0295	
		(0.0193)	(0.0193)	
Neg. reval. dummy $\times$ LTV > 75% dummy		-0.1693***		
		(0.0639)		
Pos. reval. dummy			0.0995**	
			(0.0435)	
Pos. reval. dummy $\times$ LTV > 75% dummy			0.0276	
			(0.0659)	
Reval. size (%)				0.3575**
				(0.1648)
Fixed-effects				
Borrower	Yes	Yes	Yes	Yes
Fit statistics				
Observations	267,701	267,701	267,701	267,701
Squared Correlation	0.28652	0.28658	0.28662	0.28651
Pseudo R^2	0.34263	0.34273	0.34266	0.34262
BIC	142,531.7	142,547.3	142,554.1	142,533.0

Clustered (Bank-borrower) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

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	(0.0222)	(0.0222)	(0.0222)	(0.0222)
Avg. num new loans 2 years pre-Covid	0.0260***	0.0261***	0.0261***	0.0260***
	(0.0075)	(0.0075)	(0.0075)	(0.0075)
Num. pre-Covid loans	0.0019*	0.0019*	0.0019*	0.0019*
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Bank CET1 ratio (pre-Covid)	0.0728	0.0669	0.0690	0.0750
	(0.1088)	(0.1092)	(0.1094)	(0.1090)
Bank NPL ratio (pre-Covid)	0.3591	0.3680	0.3594	0.3785
	(0.4496)	(0.4495)	(0.4499)	(0.4500)
LTV > 75% dummy		0.0374*	0.0295	
		(0.0193)	(0.0193)	
Neg. reval. dummy × LTV > 75% dummy		-0.1693***		
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Revaluations and the characteristics of new loans

With firm fixed effects:
Revaluations also affect loan size but not interest rate or maturity

Without firm fixed effects - i.e. allowing for endogeneity:
Borrowers with downward revaluations got shorter maturity, smaller, more expensive loans

Dependent Variables:	Loan size (% pre-Covid stock)		New loan maturity		New loan interest rate	
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Reval. dummy	0.1419	-0.0646	14.43	128.3	0.0002	8.97×10^{-5}
	(0.2971)	(0.1230)	(182.8)	(117.3)	(0.0003)	(0.0001)
Neg. reval. dummy	-0.9095**	-0.4332***	279.0	-302.1*	0.0002	0.0005*
	(0.4630)	(0.1609)	(275.7)	(176.8)	(0.0005)	(0.0003)
LTV > 75% dummy	0.0481	-0.9431***	-165.3	132.7	0.0006	4.3×10^{-6}
	(0.6390)	(0.1104)	(261.3)	(88.79)	(0.0004)	(0.0001)
New collateral dummy	0.2861	0.4342***	214.9*	802.8***	3.07×10^{-5}	-0.0008***
	(0.3971)	(0.0997)	(110.3)	(60.67)	(0.0002)	(0.0001)
Avg. size new loans 3 years pre-Covid	-6.34×10^{-7}*	-2.54×10^{-7}				
	(3.36×10^{-7})	(2.92×10^{-7})				
Bank CET1 ratio (pre-Covid)	1.043	-0.3291	-1,589.1	299.8	0.0029	0.0141***
	(4.232)	(0.4182)	(1,716.1)	(520.8)	(0.0029)	(0.0007)
Bank NPL ratio (pre-Covid)	-33.29	-1.843*	-2,729.3	-2,900.0***	-0.0155	0.0486***
	(37.93)	(1.119)	(6,393.1)	(1,069.0)	(0.0192)	(0.0042)
Neg. reval. dummy × LTV > 75% dummy	1.132	0.1737	-418.4	2.983	-0.0009	-0.0016***
	(0.8427)	(0.1952)	(422.4)	(280.3)	(0.0008)	(0.0004)
(Intercept)		2.319***		777.3***		0.0080***
		(0.1260)		(145.0)		(0.0004)
Avg. initial maturity all pre-Covid loans			0.3104***	0.6721***		
			(0.0882)	(0.0212)		
Avg. rate all pre-Covid loans					0.1841***	0.4713***
					(0.0407)	(0.0135)
New loan maturity					-2.14×10^{-7}***	-7.01×10^{-7}***
					(7.69×10^{-8})	(2.39×10^{-8})
Fixed-effects						
Borrower	Yes		Yes		Yes	
Fit statistics						
Observations	8,510	23,754	10,566	10,566	10,007	30,278
R^2	0.72536	0.00470	0.80358	0.34967	0.91275	0.37928
Within R^2	0.00274		0.03265		0.04550	

Clustered (Bank-borrower) standard-errors in parentheses
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	(0.3971)	(0.0997)	(110.3)	(60.67)	(0.0002)	(0.0001)
Avg. size new loans 3 years pre-Covid	-6.34×10^{-7}*	-2.54×10^{-7}				
	(3.36×10^{-7})	(2.92×10^{-7})				
Bank CET1 ratio (pre-Covid)	1.043	-0.3291	-1,589.1	299.8	0.0029	0.0141***
	(4.232)	(0.4182)	(1,716.1)	(520.8)	(0.0029)	(0.0007)
Bank NPL ratio (pre-Covid)	-33.29	-1.843*	-2,729.3	-2,900.0***	-0.0155	0.0486***
	(37.93)	(1.119)	(6,393.1)	(1,069.0)	(0.0192)	(0.0042)
Neg. reval. dummy × LTV > 75% dummy	1.132	0.1737	-418.4	2.983	-0.0009	-0.0016***
	(0.8427)	(0.1952)	(422.4)	(280.3)	(0.0008)	(0.0004)
(Intercept)		2.319***		777.3***		0.0080***
		(0.1260)		(145.0)		(0.0004)
Avg. initial maturity all pre-Covid loans			0.3104***	0.6721***		
			(0.0882)	(0.0212)		
Avg. rate all pre-Covid loans					0.1841***	0.4713***
					(0.0407)	(0.0135)
New loan maturity					-2.14×10^{-7}***	-7.01×10^{-7}***
					(7.69×10^{-8})	(2.39×10^{-8})
Fixed-effects						
Borrower	Yes		Yes		Yes	
Fit statistics						
Observations	8,510	23,754	10,566	10,566	10,007	30,278
R^2	0.72536	0.00470	0.80358	0.34967	0.91275	0.37928
Within R^2	0.00274		0.03265		0.04550	

Clustered (Bank-borrower) standard-errors in parentheses
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Our findings

1   **Real estate is an important form of collateral for euro area banks' NFC lending**
- Price shock from Covid-19 may impact resilience of loan portfolios
- Price shock may also affect lending via the collateral channel/ financial accelerator

2   **Revaluation behaviour more complex than economic theory would imply**
- Limited downward revaluations of commercial real estate collateral despite market correction
- Clear national differences in revaluation behaviour

3   **However, we do find evidence of implications of the shock for firms' access to credit during Covid**
- Banks appeared to avoid lending to real estate collateral reliant firms during the pandemic
- For collateral that has been revalued – downward revaluations are associated with lower credit provision

Wider implications and areas for further research

1. **Implications for monetary policy** – particularly national patterns in revaluations.

2. Despite market shock - pandemic did not result in an immediate and large scale downward revaluation of CRE collateral values – **weak collateral channel or just wait-and-see approach?**

3. Does finding regarding sharp drop in lending to real-estate-collateral-reliant-borrowers suggest there is also an "uncertainty" shock happening? Even though no ultimate downward revaluations?

   - **"Revaluation collateral channel"** – revise beliefs about value of collateral and change lending accordingly

   - **"Uncertainty collateral channel"** – drop in lending against collateral but no revision about beliefs regarding value (i.e. revaluation)

Appendix

What would we expect to see?

Commercial real estate:

- Overall Covid-19 a large negative shock (except logistics)

- At least expect revaluations to be worse than in 2019 and probably more negative than positive revaluations once pandemic hits

- Unfortunately, cannot identify retail vs. office in Anacredit
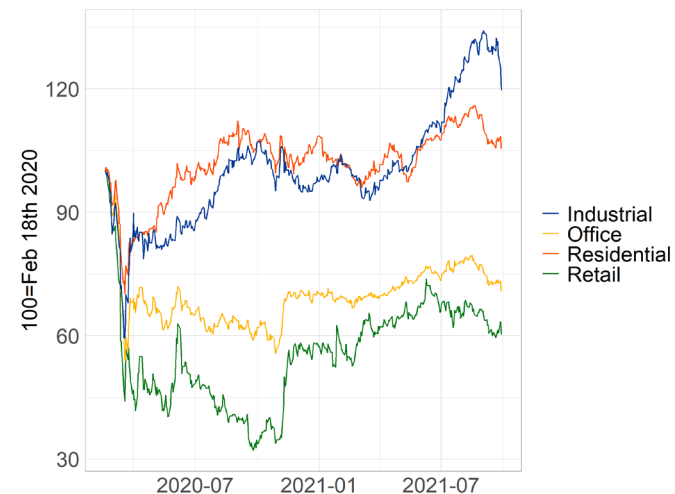
Residential real estate:

- Price growth has accelerated during pandemic – more upward revaluations in 2020 and 2021 than 2019

Revaluation frequency:

CRR Art 208 requires banks to

- *"Monitor"* value at least once a year for commercial and once every three years for residential properties or when market conditions change

- Independent *"valuation review"* when market conditions change and for loans > EUR 3 million every 3 years
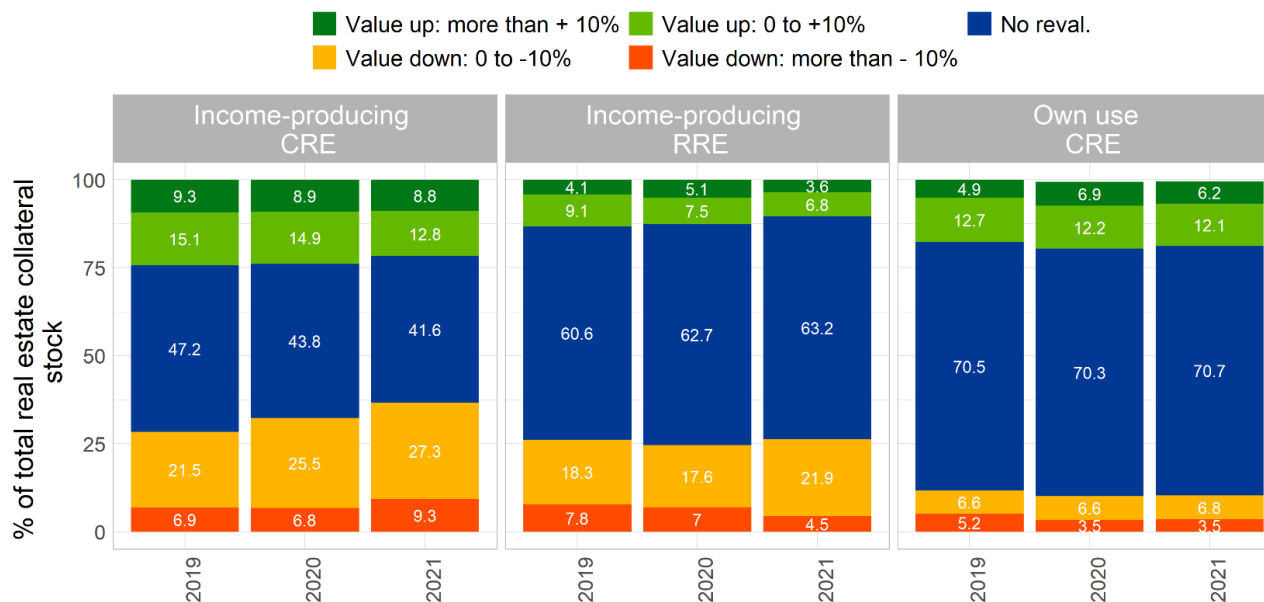
Commercial and Residential markets diverged sharply during Covid

Covid-19 pandemic appears to have had limited impact on banks' revaluation behaviour
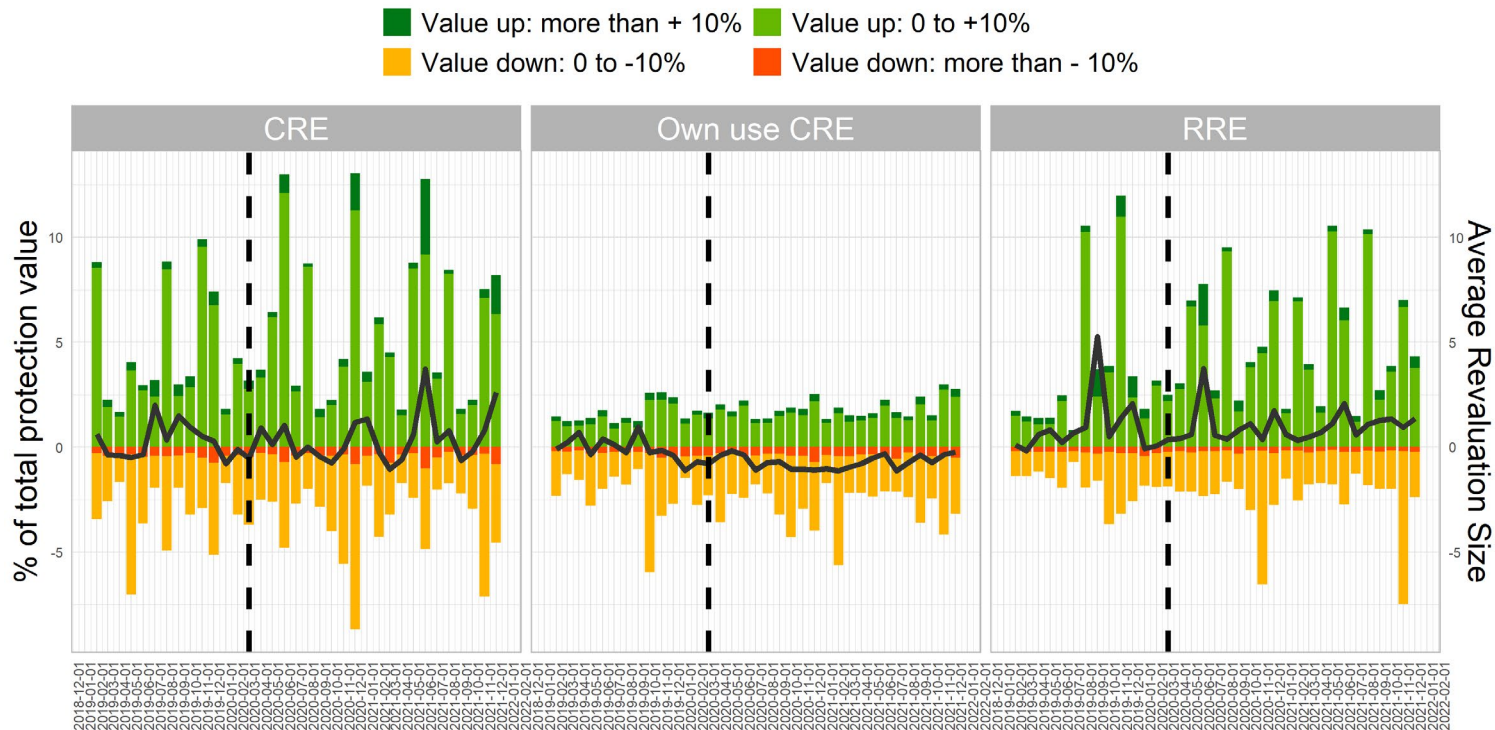
- Negative shock to CRE prices was not reflected in largescale downward revaluation following the pandemic onset – no significant change seen at the monthly level

Stock of euro area banks' Real Estate collateral by size of annual revaluation

Legend:
- Value up: more than + 10%
- Value up: 0 to +10%
- No reval.
- Value down: 0 to -10%
- Value down: more than - 10%

Monthly Revaluations by Asset Type

Monthly Real Estate revaluations by over % of collateral stock and average revaluation size

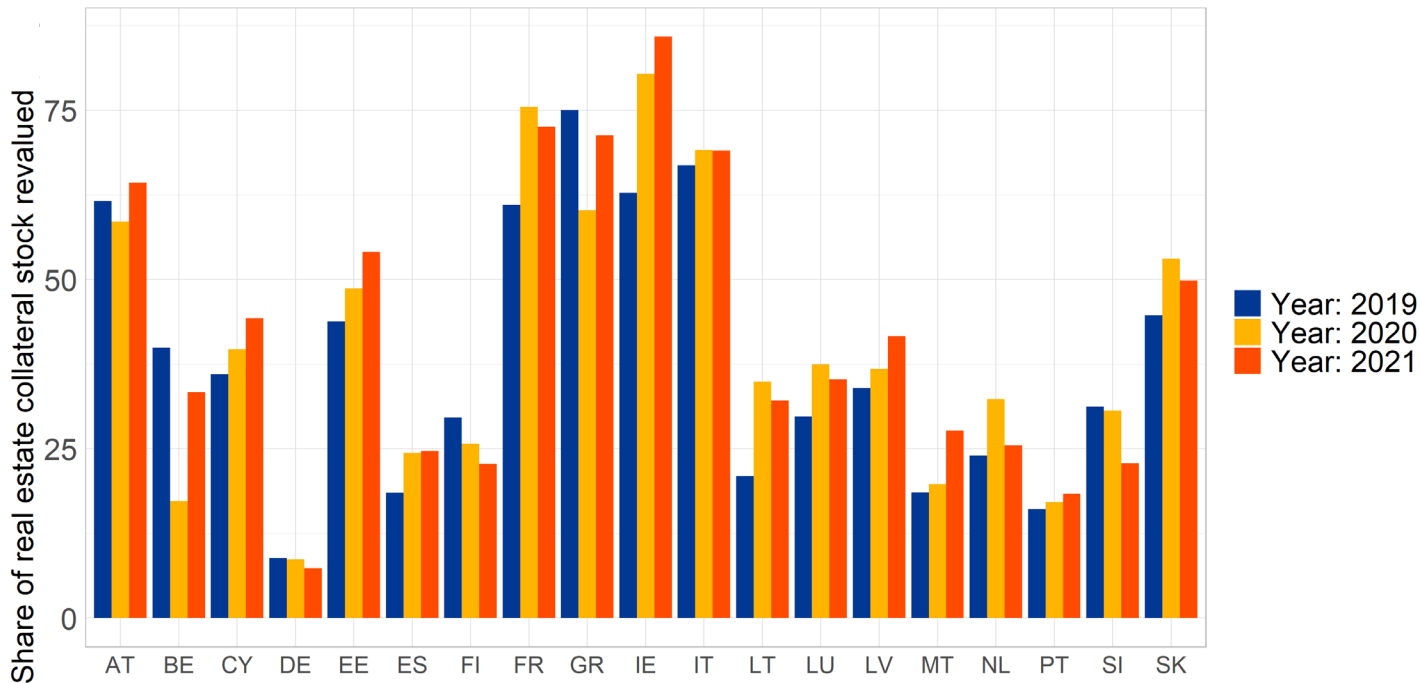# Total Revaluations per Country by Year

Total stock of euro area banks' Real Estate collateral revalued per year

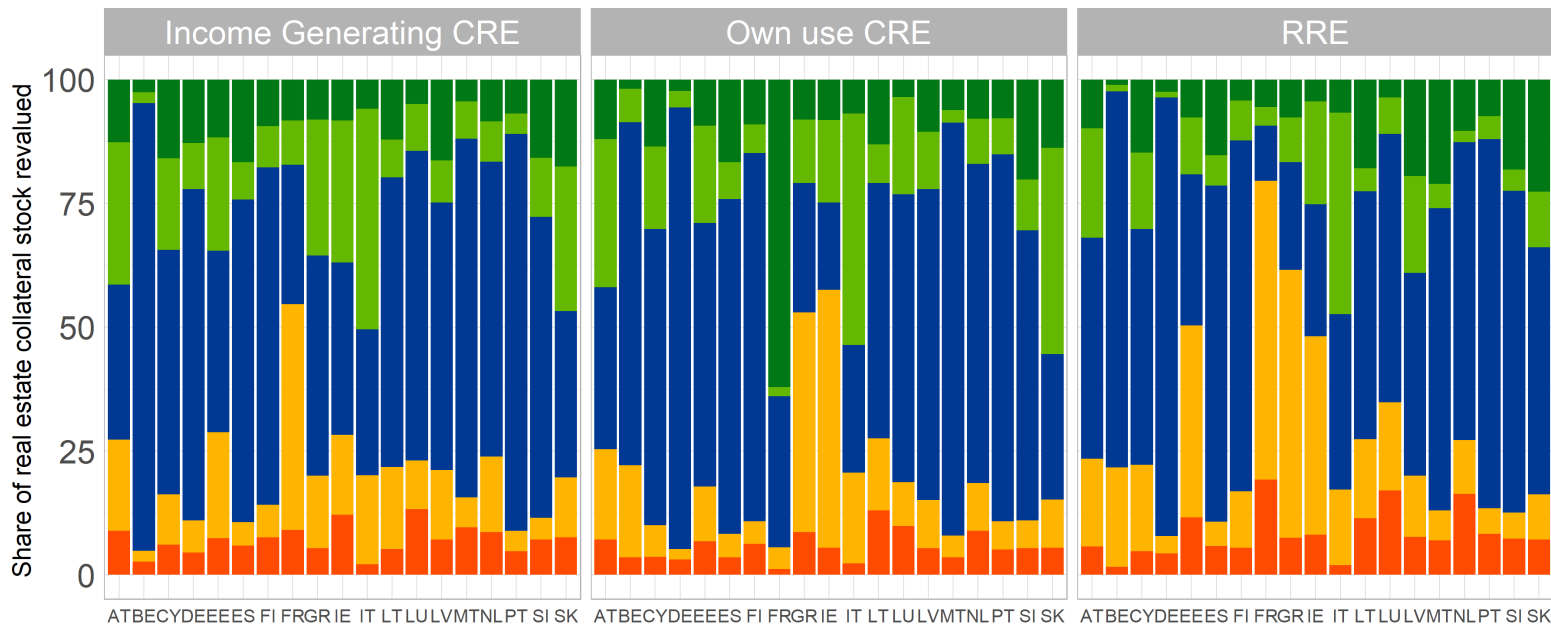# Revaluations per Country by Year

Share of euro area banks' Real Estate collateral revalued in 2020 by asset type

Legend:
- Value up: more than + 10%
- Value up: 0 to +10%
- No reval.
- Value down: 0 to -10%
- Value down: more than - 10%

Panels: Income Generating CRE | Own use CRE | RRE

Y-axis: Share of real estate collateral stock revalued (0, 25, 50, 75, 100)

X-axis (each panel): AT BE CY DE EE ES FI FR GR IE IT LT LU LV MT NL PT SI SK

Establishing treatment and control groups

Treated = borrower relied 100% on real estate collateral with a given bank, pre-pandemic
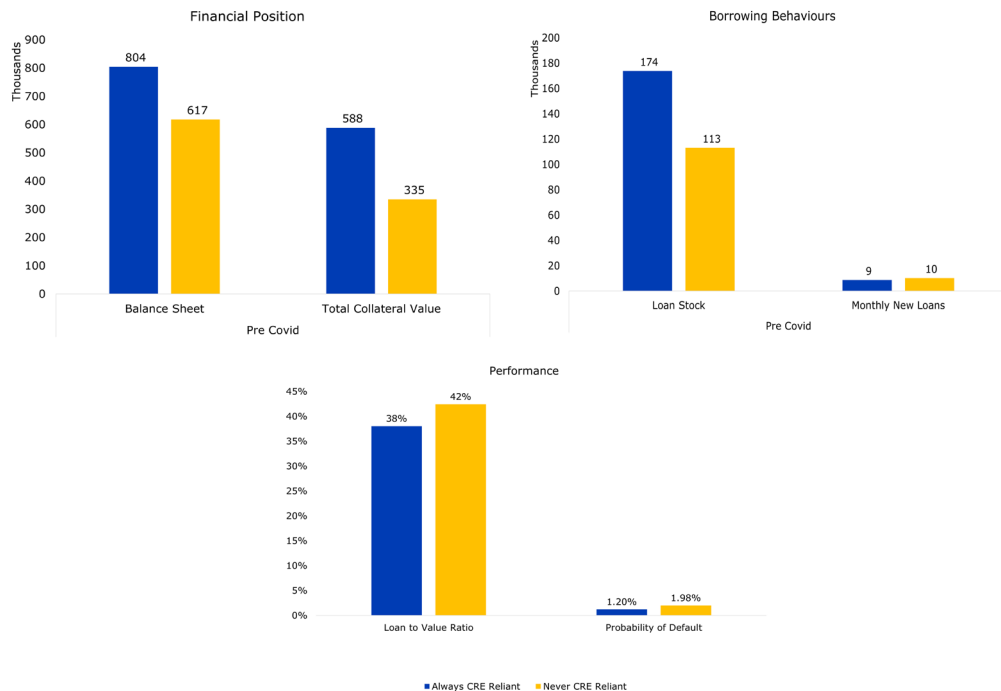- This is equivalent to 75th percentile value for share of collateral made up of real estate
- *19%* of sample were fully reliant on real estate in all lending relationships

What to these firms look like?
- Real estate reliant borrowers seem to be larger than non real estate reliant borrowers (higher balance sheet, collateral value, stock of loans)

- Real estate reliant borrowers seem to be more highly leveraged (higher LTVs) but had lower PDs

Note: *100% Real Estate Collateral reliance was chosen as the binary flag as this was the 75th percentile of Real Estate Collateral reliance.*

Borrower Comparison – Real Estate Collateral Reliance

Financial Position

	Always CRE Reliant	Never CRE Reliant
Balance Sheet	804	617
Total Collateral Value	588	335

Pre Covid

Borrowing Behaviours

	Always CRE Reliant	Never CRE Reliant
Loan Stock	174	113
Monthly New Loans	9	10

Pre Covid

Performance

	Always CRE Reliant	Never CRE Reliant
Loan to Value Ratio	38%	42%
Probability of Default	1.20%	1.98%

■ Always CRE Reliant ■ Never CRE Reliant

How did lending dynamics to these two groups evolve during the pandemic?

1) During the pandemic banks avoided lending to firms reliant on real estate collateral

New loans to firms which used real estate collateral pre-2020 as % of total quarterly new loans
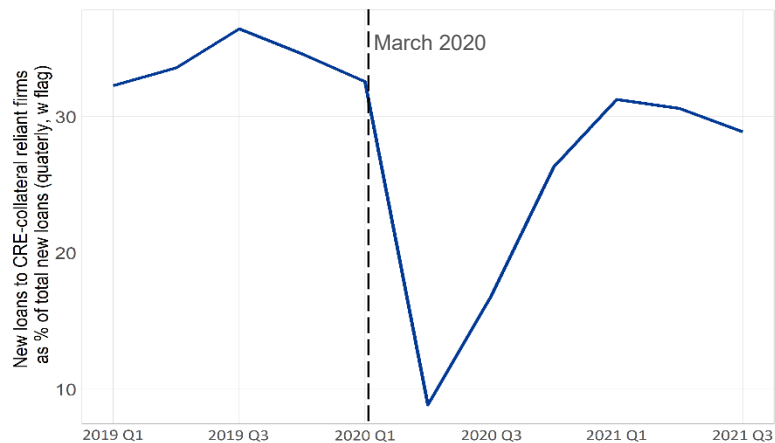
Note: Finding is confirmed in diff-in-diff analysis with controls for borrower LTV, cross-border lending, bank NPL ratio, bank cet1 ratio, use of moratoria and loan purpose. Borrower fixed effects are included. Approx 2 million observations. Only loans to pre-existing bank-borrower relationships are considered.

2) Average new loans to real estate reliant firms were lower than for other borrowers post-pandemic

Mean new lending values in Pre and Post Covid
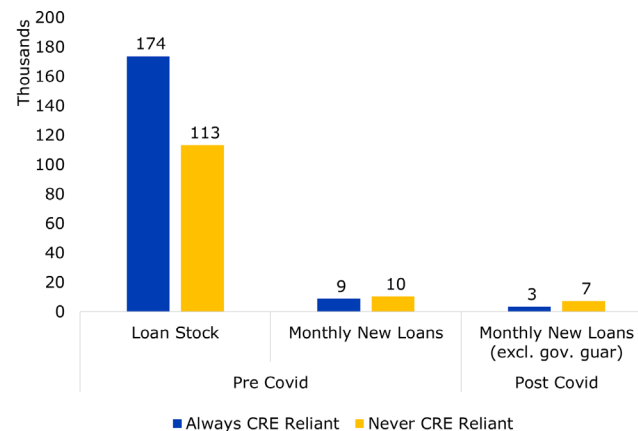
Note: Loan Stock is median value, while New Loans are mean value. Borrowers who are sometimes reliant on CRE in some banking relationships and not reliant on CRE in others are excluded.

Source: ECB calculations based on AnaCredit.

We use a diff-in-diffs model with ISL fixed effects to see that banks avoided lending to firms who were reliant on real estate collateral

- β_1 - the mean difference in ratio of new lending in the first 6 months of pandemic to pre-pandemic stock of loans between the group of CRE-reliant (treated) and non-CRE-reliant (control group) companies

- Carefully control for an overlap between owning an using CRE collateral, and relying on income stream from CRE

Dependent Variable: Model: ISL fixed-effects, without gov-guaranteed loans	New loans to pre-covid stock of loans				
	(All borrowers) (All CRE) ()	(All borrowers) (CRE subsectors) ()	(All borrowers) (All CRE) (CRE-prps control)	(No CRE-prps) (All CRE) ()	(No RE-sectors) (All CRE) ()
Variables					
CRE reliance dummy	-0.0305*** (0.0076)		-0.0268*** (0.0069)	-0.0434*** (0.0128)	-0.0538*** (0.0132)
CRE inc. gen. reliance dummy		-0.0336*** (0.0087)			
RRE reliance dummy		-0.0385*** (0.0093)			
CRE own use reliance dummy		-0.0390*** (0.0077)			
Borrower LTV	-4.65×10^{-5} (3.3×10^{-5})	-4.81×10^{-5} (3.34×10^{-5})	-4.69×10^{-5} (3.28×10^{-5})	-6.7×10^{-5} (5.21×10^{-5})	-8.32×10^{-5} (7.44×10^{-5})
Cross-border dummy	-0.0258*** (0.0093)	-0.0266*** (0.0094)	-0.0255*** (0.0094)	-0.0314* (0.0163)	-0.0332** (0.0162)
Bank NPL ratio	0.0717 (0.1006)	0.0671 (0.1004)	0.0726 (0.1017)	0.0621 (0.1200)	0.0856 (0.1226)
Bank CET1 ratio	-0.0176 (0.0346)	-0.0196 (0.0349)	-0.0163 (0.0353)	-0.0088 (0.0484)	-0.0209 (0.0705)
Moratorium dummy	-0.0169*** (0.0055)	-0.0162*** (0.0055)	-0.0175*** (0.0057)	-0.0286*** (0.0087)	-0.0254*** (0.0095)
CRE purpose share dummy			-0.0233*** (0.0074)		
Fixed-effects					
ISL_fe	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,727,594	1,727,594	1,727,594	1,231,899	1,087,219
R²	0.56484	0.56506	0.56521	0.60774	0.59924
Within R²	0.00297	0.00348	0.00383	0.00420	0.00455

Two-way (crdtr_id & dbtr_id) standard-errors in parentheses
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Revaluations and the likelihood of a new loan being made

- Borrowers receiving a negative revaluation were less likely to get a new loan (aprox – 21%)

- Effect concentrated among highly leveraged borrowers (aprox – 42%)

- Leverage plays lesser role for upward revaluations

- Size of revaluation also matters

Dependent Variable:	Loan made			
Model:	(1)	(2)	(3)	(4)
Variables				
Reval. dummy	0.2160***	0.2175***	0.1104***	0.1615***
	(0.0288)	(0.0288)	(0.0304)	(0.0217)
Neg. reval. dummy	-0.1051***	-0.0635		
	(0.0402)	(0.0448)		
New coll. posted dummy	2.391***	2.391***	2.392***	2.392***
	(0.0222)	(0.0222)	(0.0222)	(0.0222)
Avg. num new loans 2 years pre-Covid	0.0260***	0.0261***	0.0261***	0.0260***
	(0.0075)	(0.0075)	(0.0075)	(0.0075)
Num. pre-Covid loans	0.0019*	0.0019*	0.0019*	0.0019*
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
CET1 ratio (pre-Covid)	0.0728	0.0669	0.0690	0.0750
	(0.1088)	(0.1092)	(0.1094)	(0.1090)
NPL ratio (pre-Covid)	0.3591	0.3680	0.3594	0.3785
	(0.4496)	(0.4495)	(0.4499)	(0.4500)
LTV > 75% dummy		0.0374*	0.0295	
		(0.0193)	(0.0193)	
Neg. reval. dummy × LTV > 75% dummy		-0.1693***		
		(0.0639)		
Pos. reval. dummy			0.0995**	
			(0.0435)	
Pos. reval. dummy × LTV > 75% dummy			0.0276	
			(0.0659)	
Reval. size (%)				0.3575**
				(0.1648)
Fixed-effects				
Borrower	Yes	Yes	Yes	Yes
Fit statistics				
Observations	267,701	267,701	267,701	267,701
Squared Correlation	0.28652	0.28658	0.28662	0.28651
Pseudo R^2	0.34263	0.34273	0.34266	0.34262
BIC	142,531.7	142,547.3	142,554.1	142,533.0

Clustered (Bank-borrower) standard-errors in parentheses
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Revaluations and the characteristics of new loans

With firm fixed effects:
Revaluations also affect loan size but not interest rate or maturity

Without firm fixed effects - i.e. allowing for endogeneity:
Borrowers with downward revaluations got shorter maturity, smaller, more expensive loans

Dependent Variables:	Loan size (% pre-Covid stock)		New loan maturity		New loan interest rate	
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Reval. dummy	0.1419	-0.0646	14.43	128.3	0.0002	8.97×10^{-5}
	(0.2971)	(0.1230)	(182.8)	(117.3)	(0.0003)	(0.0001)
Neg. reval. dummy	-0.9095**	-0.4332**	279.0	-302.1*	0.0002	0.0005*
	(0.4630)	(0.1609)	(275.7)	(176.8)	(0.0005)	(0.0003)
LTV > 75% dummy	0.0481	-0.9431**	-165.3	132.7	0.0006	4.3×10^{-6}
	(0.6390)	(0.1104)	(261.3)	(88.79)	(0.0004)	(0.0001)
New collateral dummy	0.2861	0.4342***	214.9*	802.8***	3.07×10^{-5}	-0.0008***
	(0.3971)	(0.0997)	(110.3)	(60.67)	(0.0002)	(0.0001)
Avg. size new loans 3 years pre-Covid	-6.34×10^{-7}*	-2.54×10^{-7}				
	(3.36×10^{-7})	(2.92×10^{-7})				
CET1 ratio (pre-Covid)	1.043	-0.3291	-1,589.1	299.8	0.0029	0.0141***
	(4.232)	(0.4182)	(1,716.1)	(520.8)	(0.0029)	(0.0007)
NPL ratio (pre-Covid)	-33.29	-1.843*	-2,729.3	-2,900.0***	-0.0155	0.0486***
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	(0.8427)	(0.1952)	(422.4)	(280.3)	(0.0008)	(0.0004)
(Intercept)		2.319***		777.3***		0.0080***
		(0.1260)		(145.0)		(0.0004)
Avg. initial maturity all pre-Covid loans			0.3104***	0.6721***		
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Fixed-effects						
Borrower	Yes		Yes		Yes	
Fit statistics						
Observations	8,510	23,754	10,566	10,566	10,007	30,278
R^2	0.72536	0.00470	0.80358	0.34967	0.91275	0.37928
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	(0.8427)	(0.1952)	(422.4)	(280.3)	(0.0008)	(0.0004)
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		(0.1260)		(145.0)		(0.0004)
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Clustered (Bank-borrower) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Probit model specification - How do banks choose which CRE collateral items to revalue?

- Panel Probit model with country and time fixed effects. Binary dependent variable of whether revaluation took place in quarter, and in subsequent specifications, if it was revalued up or down.

$$\text{revalued}_{i,t} = \beta_0 + \sum \beta_k(V_k) + \varepsilon$$

$$= \beta_0 + \beta_1 * ltv\ borrower_i + \beta_2 * npl\ protection_i + \beta_3 * moratoria\ protection_i + \beta_4 * borrower\ size_i + \beta_5 * protection\ type_i + \beta_6 * time\ since\ revaluation_{i,t} + \beta_7 * pre\ Covid\ CET1\ ratio_i + \beta_8 * pre\ Covid\ NPL\ ratio_i + \beta_1 * bank\ revaluation\ type_i + \beta_1 * bank\ size_i + \beta_1 * sector_i + \varepsilon$$

- Explanatory variables considered:

  - **Protection characteristics:** type of CRE, linked to an NPL loan, linked to a loan which was under moratoria, time since last revaluation

  - **Borrower characteristics:** LTV, sector of borrower, size of borrower

  - **Lender characteristics:** CET1 ratio (from SUP), lender in high/medium/ low revaluation country, lender is high/medium/ low revaluation bank, size, NPL ratio

Country and asset type heterogeneity limited stable findings in how banks choose assets for revaluation

- Banks selection of which collateral to revalue could have pro-cyclical effects - e.g. revaluing high LTV collateral could have bigger pro-cyclical impact on credit

- Econometric analysis shows that collateral associated with NPLs is revalued more regularly

- Other relationships vary at subsample level – e.g. different across countries. National specificities may play a major role and these relationship may be quite complex.

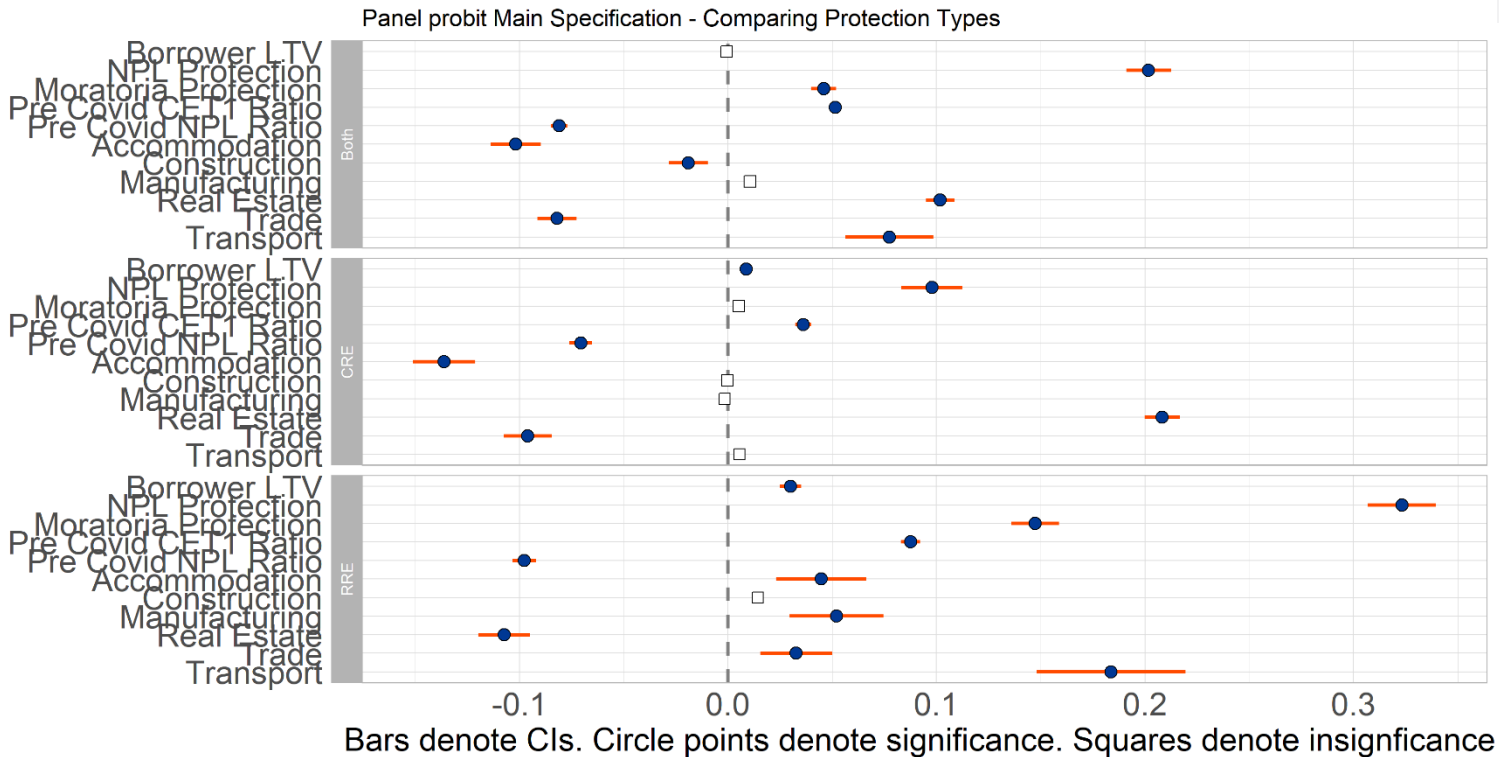- Review of collateral value is also associated with new lending

(Ordered) Panel Probit Coefficients
LHS variable equals 1 if collateral revalued in a given month
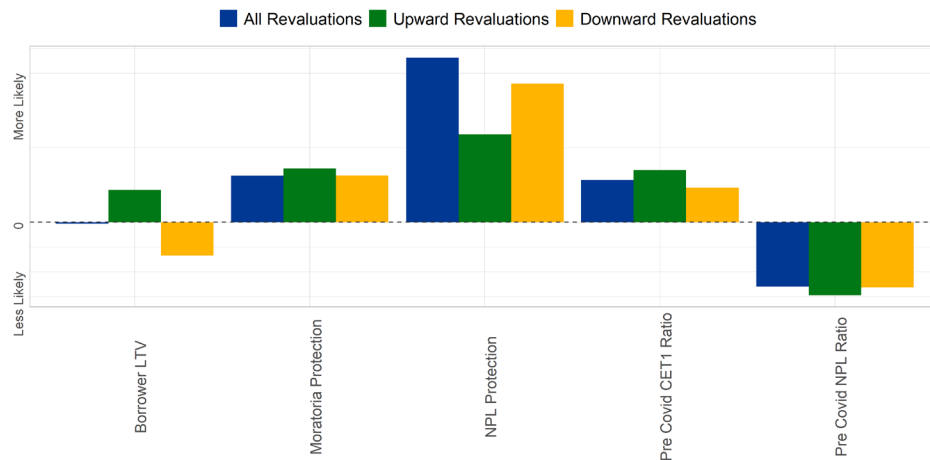
Controls not in table: *Borrower size (relative to size of bank), protection type (Income Generating CRE, Own use CRE, Income Generating RRE), Bank revaluation category (high, medium or low compared to EA average), bank size (log), time since last revaluation.*

Probit model outcomes

Panel probit Main Specification - Comparing Protection Types

Bars denote CIs. Circle points denote significance. Squares denote insignficance

What type of firms use real estate as collateral? Focus on those with multiple bank relationships

- A very conservative specification including borrower fixed effects instead of ISL fixed effects implies that the coefficient of interest in the diff-in-diffs regression (β_1) would be effectively estimated on borrowers with multiple bank relationships:
  - 14% of borrowers have multiple bank relationships
  - 3% were reliant on real estate in some lending relationships, but other asset types in others

- Unsurprisingly, borrowers who have multiple banking relationships tend to be much larger and have larger lending volumes than those with single banking relationships

Borrower Comparison – Banking Relationships
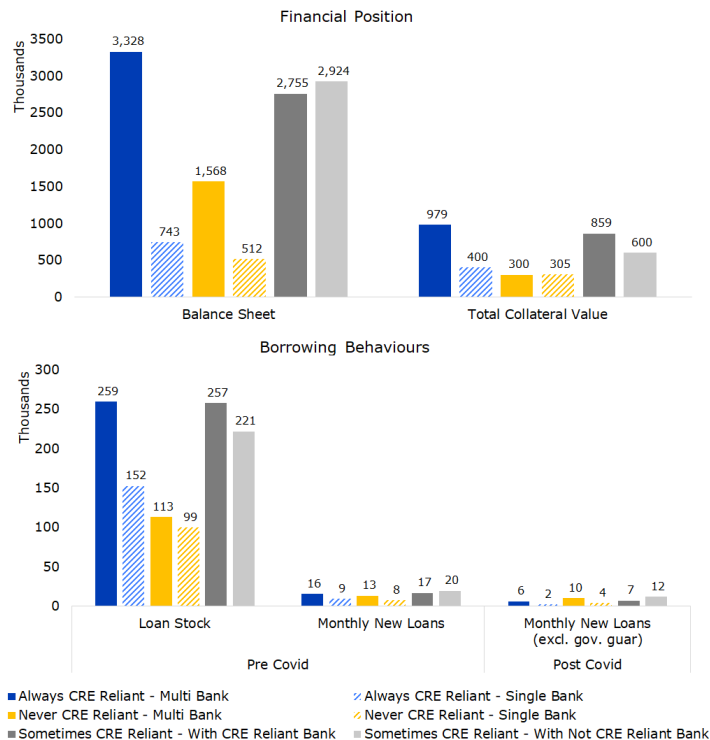
Note: All figures are median values except new loans which are mean value.

What type of firms use real estate as collateral and have multiple banking relationships?
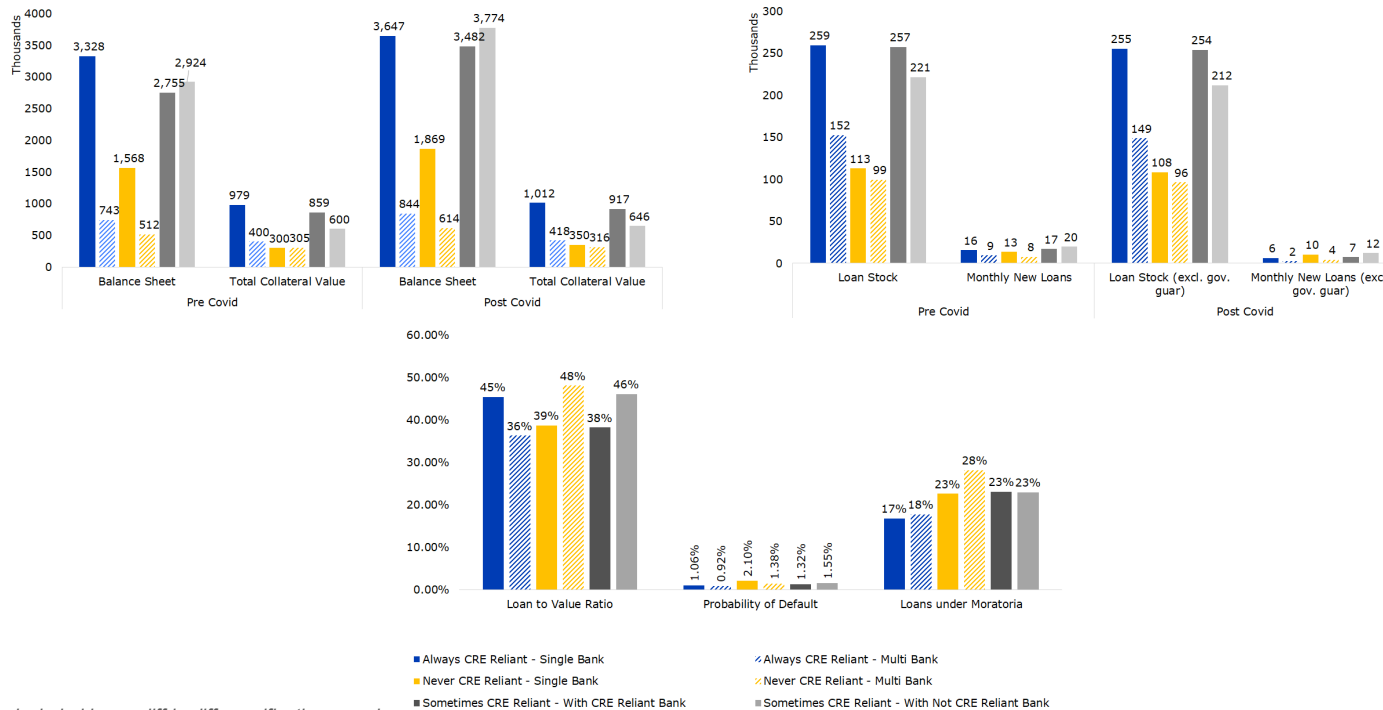
Maybe this is all driven by bank-level behaviour?

Missing variable problem? Bank revises real estate market view -> downward revaluations and less real estate collateralized lending

For loan creation both bank and bank-borrower level revaluations matter

Spillover effect: Downward revaluation of one borrowers' collateral reduces likelihood of loans being made to other borrowers

Dependent Variables:	Loan made	Loan size	Loan maturity	Loan interest rate
Model:	(1)	(2)	(3)	(4)
	Probit	OLS	OLS	OLS
Variables				
Reval. dummy	0.2132***	0.2162	-52.40	0.0001
	(0.0288)	(0.2985)	(47.98)	(0.0001)
Neg. reval. dummy	-0.0960**	-1.077**	-275.9***	0.0004
	(0.0405)	(0.5301)	(73.77)	(0.0003)
Neg. bank-level reval. dummy	-0.0283**	0.5193	-19.18	0.0003**
	(0.0130)	(0.4539)	(31.16)	(0.0001)
Fixed-effects				
Borrower	Yes			
Borrower		Yes		
Fit statistics				
Observations	267,701	8,510	32,423	30,278
Squared Correlation	0.28650	0.72559	0.34045	0.37942
Pseudo R^2	0.34268	0.17451	0.02203	-0.07462
BIC	142,539.4	91,311.2	599,143.6	-207,923.6

Clustered (Bank-borrower) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Note: Control variables from previous specifications also included

This analysis shows that real estate reliant borrowers received less lending post-Covid and those who had their collateral revalued received even less

$$\Delta\ln(loan_{i,j,t}) = \beta_0 + \color{red}{\beta_1} * CRE\ depend_{i,t-1} + \color{red}{\beta_2} * Collateral\ Change_{i,t} + \Gamma * X_{i,j} + \Phi * Z_j + \varepsilon$$

- Relationship between changes in collateral values and lending outcomes as suggested in the literature on the collateral channel

- This analysis does not differentiate between revaluations of existing collateral assets and the posting of new collateral assets - Collateral assessment by banks is likely a stage in the process of receiving most new loans

Dependent Variable:	New loans to pre-covid stock of loans, Borrower fe				
Model: Borrower fixed-effects, without gov-guaranteed loans	(All borrowers) (All CRE) ()	(All borrowers) (CRE subsectors) ()	(All borrowers) (All CRE) (CRE-prps control)	(No CRE-prps) (All CRE) ()	(No RE-sectors) (All CRE) ()
Variables					
CRE reliance dummy	-0.0506***		-0.0473***	-0.0569***	-0.0571***
	(0.0079)		(0.0080)	(0.0134)	(0.0100)
CRE income generating reliance dummy		-0.0498***			
		(0.0087)			
RRE reliance dummy		-0.0509***			
		(0.0082)			
CRE own use reliance dummy		-0.0405***			
		(0.0068)			
CRE purpose share dummy			-0.0184***		
			(0.0053)		
Borrower LTV	-4.22×10^{-5}	-4.14×10^{-5}	-4.33×10^{-5}	-4.55×10^{-5}	-4.82×10^{-5}
	(2.94×10^{-5})	(2.88×10^{-5})	(3.03×10^{-5})	(3.15×10^{-5})	(3.5×10^{-5})
Cross-border dummy	-0.0080	-0.0075	-0.0086	-0.0180	0.0015
	(0.0146)	(0.0146)	(0.0147)	(0.0215)	(0.0223)
Bank NPL ratio	-0.1157	-0.1175	-0.1133	-0.1593	-0.1246
	(0.1447)	(0.1448)	(0.1486)	(0.1601)	(0.1507)
Bank CET1 ratio	-0.0652	-0.0651	-0.0649	-0.0745	-0.0893
	(0.0481)	(0.0483)	(0.0488)	(0.0619)	(0.0651)
Moratorium dummy	-0.0231***	-0.0231***	-0.0228***	-0.0306***	-0.0266***
	(0.0067)	(0.0067)	(0.0068)	(0.0081)	(0.0070)
Collateral increased	0.0321***	0.0302***	0.0332***	0.0273***	0.0251***
	(0.0050)	(0.0050)	(0.0050)	(0.0085)	(0.0069)
Collateral decreased	-0.0070*	-0.0104***	-0.0043	-0.0109	-0.0094*
	(0.0038)	(0.0036)	(0.0038)	(0.0073)	(0.0056)
Fixed-effects					
Borrower_fe	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	1,193,941	1,193,941	1,193,941	851,525	769,535
R^2	0.61308	0.61300	0.61323	0.66008	0.64606
Within R^2	0.00209	0.00188	0.00249	0.00237	0.00329

Two-way (crdtr_id & dbtr_id) standard-errors in parentheses.
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1