

Pandemic Lending: The Unintended Effects of Model-based Regulation

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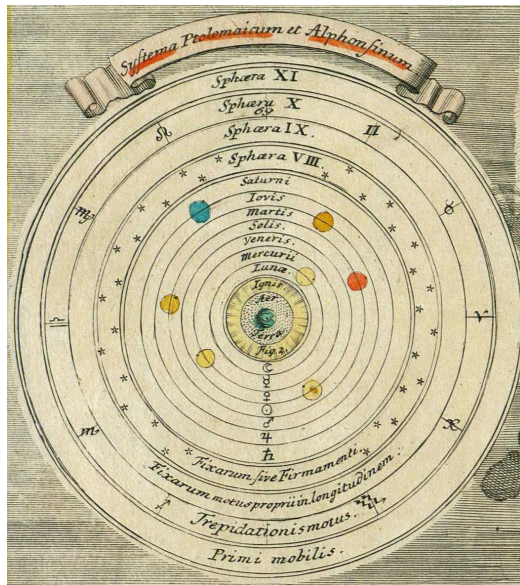
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Motivation

- Bank lending is inherently pro-cyclical (Rajan, 1994)
 - ▶ **Model-based capital regulation** contributes to this

- Basel II was a major change in regulation since it introduced *risk-based capital requirements*. Banks can use:
 - ▶ Standardised Approach (SA): fixed risk-weights
 - ▶ Internal Ratings-Based (IRB) approach: risk-weights calculated by banks

Motivation



(i) Copernican Revolution

Earth → **Sun**

(ii) Kant's Copernican Revolution

Object → **Subject**

Figure 2. Two types of paradigm shift: (i) A new perspective proposed by Copernicus suggests that it is the sun rather than the Earth that is at the center of our solar system. (ii) In philosophy, Immanuel Kant discussed the emphasis to be placed on the subject rather than the object. This resembles the paradigm shift suggested in Copernican Revolution in science.

Motivation

- Issues with Basel II approach
 - ▶ Incentives: The higher the capital the lower the profits
 - ▶ Modelling: What can be modelled?
 - ▶ Cyclicalitity: Exacerbate?
- To smooth cyclicalitity standardization of models and adjustments of through-the-cycle PDs are implemented
- But "such models are useful for measuring the risk of frequent small events but not for systematically important events" (Danielsson et al, 2001)

This paper

Does model-based regulation induce a "credit crunch" at a time of crisis?

Yes, it does.

- **Setting:** Euro Area banks 2019Q2-2020Q3
- **Shock:** Covid-19 Pandemic, exogenous shock, not a financial crisis
- **Data:**
 - ▶ Novel and extensive confidential supervisory dataset
- **Empirical Strategy**
 - ▶ Bank-level
 - ▶ Borrower-level using a global sample of non-financial corporations

- **Lending During Crises**

- ▶ Ivashina and Scharfstein (2010); Puri et al. (2011); De Haas and Van Horen (2013); Popov and Van Horen (2015); Berrospide et al. (2021)
- ▶ Lending during an exogenous shock, not a financial/banking crisis

- **Capital Requirements and Lending**

- ▶ Bridges et al. (2014); Aiyar et al. (2014); De Marco and Wieladek (2015); Mésonnier and Monks (2015); Jiménez et al. (2017); Acharya et al. (2018); Gropp et al. (2019); Cortés et al. (2020); Fraise et al. (2020); De Jonghe et al. (2020)
- ▶ Binding capital constraints not linked to a supervisory decision

● **Model-Based Capital Regulation**

- ▶ Induce cyclicity (Repullo and Suarez (2013))
- ▶ IRB banks report lower credit risk, and less lending, for same borrower (Plosser and Santos (2014); Behn et al. (2016); Bruno et al. (2017))

- ▶ Bank perspective is important: IRB includes credit, market, operational risk and correlations/pools
- ▶ Multiple-lending relationship (Shock to the same borrower)
- ▶ International sample
- ▶ Large exposures

Preview of Results

- IRB banks reduced lending to NFC more than SA banks
- IRB banks reduced lending to the same borrower more than SA banks
- Credit was reduced more to borrowers absorbing more capital
- Credit was reduced more to borrowers in sectors more affected by the pandemic

● Bank-level Data

- ▶ Supervisory data from the European Central Bank
- ▶ Ultimate Parents and Stand Alone banks with assets over 1 billion euros
- ▶ Banks are classified as IRB or SA according to the approach used for corporate credit risk

▶ Sample

▶ Summary Statistics

● Borrower-level Data

- ▶ Supervisory data from the European Central Bank
- ▶ Large Exposures data (\geq €300 million or \geq 10% eligible capital)
- ▶ Wide dataset of global borrowers

Bank-level

Difference-in-Differences regression using **bank-level data**:

$$\Delta \text{Log}(Y)_t = \beta_1 \text{IRB}_i \times \text{Post}_t + \beta_2 \text{Size}_{i,t-1} \times \text{Post}_t + \beta_3 \text{Capital}_{i,t-1} \times \text{Post}_t + \beta_4 X_{i,t} + \text{Bank}_i + \text{Country}_j \times \text{Time}_t + \epsilon_{i,t} \quad (1)$$

- Outcome variable: quarterly growth rate of the exposures of bank i in quarter t
- $\text{IRB}_i = 1$ for banks using internal models
- $\text{Post}_t = 1$ for for pandemic period
- $X_{i,t}$: Log Assets, Equity Ratio(%), ROA(%), Deposit Ratio(%), RWA Density(%)
- Bank_i are bank fixed effects. $\text{Country}_j \times \text{Time}_t$ are demand fixed effects.
- We verify the parallel trend assumption. [▶ Parallel Trend](#)

Total Credit Origination

- Total Credit Origination = On-Balance + Off-Balance Sheet Exposures

	(1)	(2)	(3)	(4)
	Non-NFC borrowers		NFC borrowers	
$Post_t \times IRB_i$	0.0024 (0.0061)	0.0006 (0.0076)	-0.0164*** (0.0058)	-0.0167*** (0.0059)
$Post_t \times Size_{t-1}$	-0.0047** (0.0022)	-0.0027 (0.0025)	0.0025 (0.0016)	0.0032* (0.0016)
$Post_t \times Capital_{t-1}$	0.0020** (0.0009)	0.0022** (0.0010)	-0.0008 (0.0008)	-0.0004 (0.0008)
Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Total Credit Origination

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	(1)	(2)	(3)	(4)
	Non-NFC borrowers		NFC borrowers	
$Post_t \times IRB_i$	0.0024 (0.0061)	0.0006 (0.0076)	-0.0164*** (0.0058)	-0.0167*** (0.0059)
$Post_t \times Size_{t-1}$	-0.0047** (0.0022)	-0.0027 (0.0025)	0.0025 (0.0016)	0.0032* (0.0016)
$Post_t \times Capital_{t-1}$	0.0020** (0.0009)	0.0022** (0.0010)	-0.0008 (0.0008)	-0.0004 (0.0008)
Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

On-Balance Sheet Exposures

	(1)	(2)	(3)	(4)
	Non-NFC borrowers		NFC borrowers	
$Post_t \times IRB_i$	-0.0028 (0.0058)	-0.0038 (0.0069)	-0.0207*** (0.0058)	-0.0179*** (0.0056)
$Post_t \times Size_{t-1}$	-0.0045** (0.0021)	-0.0032 (0.0023)	0.0001 (0.0017)	0.0009 (0.0018)
$Post_t \times Capital_{t-1}$	0.0018** (0.0009)	0.0017* (0.0009)	-0.0012* (0.0007)	-0.0003 (0.0008)
Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

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$Post_t \times Size_{t-1}$	-0.0045** (0.0021)	-0.0032 (0.0023)	0.0001 (0.0017)	0.0009 (0.0018)
$Post_t \times Capital_{t-1}$	0.0018** (0.0009)	0.0017* (0.0009)	-0.0012* (0.0007)	-0.0003 (0.0008)
Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Loans

	(1)	(2)	(3)	(4)
	Non-NFC borrowers		NFC borrowers	
$Post_t \times IRB_i$	-0.0162 (0.0256)	-0.0267 (0.0292)	-0.0229*** (0.0056)	-0.0189*** (0.0055)
$Post_t \times Size_{t-1}$	0.0140* (0.0075)	0.0160* (0.0093)	0.0006 (0.0018)	0.0010 (0.0020)
$Post_t \times Capital_{t-1}$	-0.0004 (0.0031)	0.0000 (0.0031)	-0.0017** (0.0007)	-0.0010 (0.0007)
Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

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	(1)	(2)	(3)	(4)
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Bank Controls	Yes	Yes	Yes	Yes
N	1500	1500	1500	1500
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Country*Time FE	No	Yes	No	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Borrower-level

Difference-in-Differences regression using **borrower-level data**:

$$\Delta \text{Log}(Y)_{i,t,j} = \beta_1 \text{IRB}_i \times \text{Post}_t + \beta_2 \text{Size}_{i,t-1} \times \text{Post}_t + \beta_3 \text{Capital}_{i,t-1} \times \text{Post}_t + \beta_4 X_{i,t} + \text{Bank}_i + \text{Firm}_j \times \text{Time}_t + \epsilon_{i,t} \quad (2)$$

- Outcome Variable: quarterly growth rate of the exposures of bank i , to firm j at time t .
- $\text{IRB}_i=1$ for banks using internal models for *corporate* credit risk
- $\text{Post}_t = 1$ for pandemic period.
- Bank_i are bank fixed effects; $\text{Firm}_j \times \text{Time}_t$ are borrower fixed effects.
- Identification settings based on multiple-lending relationships:
 - ▶ Multi-bank Firms (at least one SA and one IRB bank)

Reduction in loans to the same borrower

- Do IRB banks reduce lending more than SA banks to the same borrower?

	(1)	(2)	(3)	(4)	(5)	(6)
	Total On Balance Sheet			Loans and Securities		
$Post_t \times IRB_i$	-0.0741** (0.0324)	-0.0816** (0.0388)	-0.0877** (0.0405)	-0.0879** (0.0399)	-0.1013** (0.0424)	-0.1053** (0.0453)
$Post_t \times Size_{t-1}$	0.0119 (0.0075)	0.0196 (0.0125)	0.0217* (0.0122)	0.0101 (0.0084)	0.0217* (0.0125)	0.0225* (0.0123)
$Post_t \times Capital_{t-1}$	0.0019 (0.0040)	0.0042 (0.0040)	0.0043 (0.0038)	0.0001 (0.0048)	0.0037 (0.0047)	0.0038 (0.0046)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1516	1516	1516	1516	1516	1516
Bank FE	Yes	No	Yes	Yes	No	Yes
Firm*Time FE	No	Yes	Yes	No	Yes	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Alternative Identification Strategy

- For identification, we divide the IRB sample in banks with Low and High capital

▶ Parallel Trend

- $LowCap_i=1$ if IRB bank is below the median of CET1 distribution

	(1)	(2)	(3)	(4)	(5)	(6)
	Total On Balance Sheet			Loans and Securities		
$Post_t \times LowCap_i$	-0.0240 (0.0169)	-0.0305* (0.0152)	-0.0353** (0.0154)	-0.0383** (0.0174)	-0.0458** (0.0196)	-0.0529*** (0.0185)
$Post_t \times Size_{t-1}$	-0.0005 (0.0108)	0.0127 (0.0110)	0.0145 (0.0120)	-0.0071 (0.0095)	0.0101 (0.0107)	0.0072 (0.0143)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	5288	5288	5288	5288	5288	5288
Bank FE	Yes	No	Yes	Yes	No	Yes
Firm*Time FE	No	Yes	Yes	No	Yes	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Borrower Selection

1. Do IRB banks reduce lending to borrowers absorbing more capital? **Yes** ▶ Credit Risk Mitigation
2. Do IRB banks reduce lending to borrowers in the most affected sector? **Yes**
3. Do IRB banks reduce lending to foreign borrowers more than to domestic borrowers? **No evidence**

Large Exposures Lending - Borrowers Selection

	(1)	(2)	(3)	(4)	(5)	(6)
	Loans and Securities			Loans Commitments		
<i>Panel A. Credit Risk Mitigation</i>						
$Post_t \times LowCap_i \times CRM_j$	-0.1528** (0.0581)	-0.1362** (0.0522)	-0.1330*** (0.0476)	0.1547 (0.1015)	0.1289 (0.1016)	0.1225 (0.1102)
<i>Panel B. Sectoral Exposures</i>						
$Post_t \times LowCap_i \times Most_Affected_j$	-0.0732*** (0.0187)	-0.0537* (0.0319)	-0.0533** (0.0221)	0.0698* (0.0370)	0.0153 (0.0558)	0.0166 (0.0251)
<i>Panel C. Domestic Borrowers</i>						
$Post_t \times LowCap_i \times Domestic_j$	0.0199 (0.0474)	0.0002 (0.0498)	0.0005 (0.0511)	0.0610 (0.0448)	0.0426 (0.0534)	0.0393 (0.0544)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	6200	6200	6200	5464	5464	5464
Bank FE	Yes	No	Yes	Yes	No	Yes
Firm*Time FE	No	Yes	Yes	No	Yes	Yes

Dependent variables expressed as quarterly growth rates. Clustered Standard Errors at bank-level.

Takeaways

- Empirical evidence that IRB models constrain lending during crisis periods when borrowers need it the most
- IRB banks lend less to the same borrowers during Covid-19
- Supervisory assessment might be exacerbating cyclicality under extreme events
- Provide empirical support for the implementation of a floor for the output from internal models
 - ▶ Basel 3.5 to be fully implemented by 2027 “as a back-stop to reduce excessive variability of risk-weighted assets and to make risk-weighted capital ratios more comparable”

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Background Slides

Sample Composition

Number of banks by country according to the approach used for credit and market risk

Country	Total	Standardised Approach	Internal-Rating Based Approach
Austria	20	17	3
Belgium	7	3	4
Cyprus	3	3	-
Germany	95	78	17
Estonia	3	1	2
Finland	10	6	4
France	14	7	7
Greece	6	5	1
Ireland	4	1	3
Italy	32	23	9
Latvia	4	2	2
Lithuania	3	1	2
Luxembourg	8	5	3
Malta	2	2	-
Netherlands	11	5	6
Portugal	6	5	1
Spain	22	16	6
Total	250	180	70

▶ Back

Summary Statistics

	Standardised Approach				Internal-Rating Based Approach			
	N	Mean	Median	SD	N	Mean	Median	SD
<i>Panel A. Outcome Variables at Bank-level (Growth Rates)</i>								
Total Credit Origination (All Borrowers)	1080	0.0137	0.0090	0.0467	420	0.0060	0.0062	0.0395
Total Credit Origination (Non-NFC Borrowers)	1080	0.0140	0.0083	0.0721	420	0.0051	0.0070	0.0753
Total Credit Origination (NFC Borrowers)	1080	0.0196	0.0115	0.1407	420	0.0054	0.0051	0.0495
Total On-Balance Sheet (All Borrowers)	1080	0.0125	0.0090	0.0474	420	0.0060	0.0049	0.0409
Total On-Balance Sheet (Non-NFC Borrowers)	1080	0.0132	0.0079	0.0719	420	0.0069	0.0072	0.0578
Total On-Balance Sheet (NFC Borrowers)	1080	0.0180	0.0115	0.1466	420	0.0043	0.0047	0.0540
Total Loans (All Borrowers)	1080	0.0106	0.0102	0.0618	420	0.0041	0.0043	0.0372
Total Loans (Other Borrowers)	1080	0.0594	0.0388	0.2269	420	0.0521	0.0392	0.1596
Total Loans (Retail Borrowers)	1080	0.0095	0.0086	0.0631	420	0.0018	0.0079	0.1455
Total Loans (NFC Borrowers)	1080	0.0162	0.0101	0.1328	420	0.0056	0.0066	0.0534
<i>Panel B. Outcome Variables at Loan-level (Growth Rates)</i>								
Total Credit Origination	448	0.0009	0.0000	0.0575	1470	0.0025	0.0062	0.1153
Total On-Balance Sheet	376	-0.0039	-0.0027	0.1038	1140	0.0067	0.0019	0.2328
Total Loans & Securities	376	0.0008	-0.0036	0.1493	1140	0.0146	-0.0017	0.2509
Total Off-Balance Sheet	246	0.0123	0.0000	0.3057	978	0.0147	0.0000	0.1436
Total Loan Commitments	246	0.0046	0.0000	0.5202	978	0.0101	0.0000	0.2258
<i>Panel C. Control Variables</i>								
Total Asset (Log)	1080	22.9946	22.8490	0.8059	420	25.2947	25.1391	1.5677
Equity Ratio (%)	1080	8.9210	8.7510	2.8396	420	7.5925	6.7914	2.8842
ROA (%)	1080	0.5668	0.5577	0.2224	420	0.5172	0.5075	0.1937
Deposit Ratio (%)	1080	86.5448	93.2632	15.3167	420	71.9651	71.0663	16.3200
RWA Density (%)	1080	39.0801	40.4030	9.9258	420	26.7971	25.4464	6.9811

Parallel Trend

The choice of being IRB or SA is not random, but the two types of banks are comparable before the shock

Variable	Time	Obs SA (1)	Obs IRB (2)	Mean SA (3)	Mean IRB (4)	Diff (SA -IRB) (5)
<i>Panel A. Pre-treatment Mean Comparison</i>						
Loans to NFC	2019Q2	180	70	0.0105	0.0145	-0.0040
Loans to NFC	2019Q3	180	70	0.0160	0.0065	0.0035
Loans to NFC	2019Q4	180	70	0.0075	0.0055	0.0020
Loans to NFC	2020Q1	180	70	0.0125	0.0175	-0.0045
<i>Panel B. Post-treatment Mean Comparison</i>						
Loans to NFC	2020Q2	180	70	0.0115	0.0000	0.0115**
Loans to NFC	2020Q3	180	70	0.0100	-0.0145	0.0240***

Note: Loans to NFC is expressed as quarterly growth rate.

[▶ Back](#)

Parallel Trend- Low vs High Capitalized Banks

- $LowCap_i=1$ if IRB bank is below the median of CET1 distribution a sof 2019Q2

	Time	High	Low	Mean High	Mean Low	Diff
<i>Panel A. Pre-treatment Mean Comparison</i>						
Loans to NFC	2019Q2	396	646	-0.0080	-0.0040	-0.0040
Loans to NFC	2019Q3	396	646	-0.0155	0.0040	-0.0190
Loans to NFC	2019Q4	396	646	0.0135	0.0120	0.0015
Loans to NFC	2020Q1	396	646	0.1405	0.2220	-0.0815
<i>Panel B. Post-treatment Mean Comparison</i>						
Loans to NFC	2020Q2	396	646	-0.0615	-0.0545	-0.0065
Loans to NFC	2020Q3	396	646	-0.0225	-0.1285	0.1060**

Note: Loans to NFC is expressed as quarterly growth rate.

[▶ Back](#)

Large Exposures Lending - Credit Risk Mitigation

- Define an indicator of Credit Risk Mitigation:

$$CRM_j = \frac{\textit{Exposure after CRM}}{\textit{Original Exposure}}$$

- ▶ A value close to 1 implies a lower role of CRM techniques (i.e., a riskier exposure, absorbing more capital)
- ▶ Calculated as of 2019Q2 as a proxy for the riskiness of the exposures pre-shock

▶ Back