Resistance and Arbitrage: International Trade in Brown Loans

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Research Question

How do banks respond to increasing pressures regarding their loans to high-emission firms?

Reallocation: shift lending from carbon-intensive to cleaner sectors ("brown" → "green").

Relocation: maintain brown lending but move it across borders (regulatory arbitrage).

How do these choices reshape the **global** allocation of brown credit?

Theoretical Framework

I model portfolio choice over **clean** and **dirty** projects at **home** and **abroad**. Brown lending resistance (preferences or regulation) is summarized by $\theta \in (0, 1]$:

$\theta = 1$: no resistance to brown lending.

smaller θ: stronger resistance (lower effective return from dirty projects).

Consider two countries $\{H, L\}$ where H has higher resistance θ_H.

Define the **carbon sensitivity of lending** as:

$$\underbrace{log(\frac{X_C^j}{X_D^j})}_{\text{relative change}} = \underbrace{log(\frac{\pi_j}{1-\pi_j})}_{\text{relative share}} + (\sigma-1)(\underbrace{logR_C^j - logR_D^j}_{\text{relative return}}) - (\underbrace{\sigma-1}_{>0}) \underbrace{log\theta_H}_{\text{brown lending resist.}}, \quad \text{for } j \in \{H, L\}$$

Predictions

Higher resistance (lower θ) ⇒ cleaner lending at home and abroad.

If regulation is **incomplete** (affecting domestic but not foreign returns), banks may **reduce domestic** brown lending while **relocating** brown lending abroad.

Macro Empirical Strategy

Data: Syndicated Loan Market (2000–2023)

Bilateral sectoral lending from origin country i to destination j in sector K:

$$X_{i,j,t}^K = \exp\left[\alpha + \beta\, EI_{K,t-1} \times \log(GDPpc_{i,t-1}) + \lambda_{ij} + \lambda_{it} + \lambda_{Kjt}\right] + \varepsilon_{ijt},$$

where EI is sector emission intensity and $GDPpc$ proxies for country-level brown lending resistance.

Macro Findings

A faster shift towards greener sectors in ***total*** and ***domestic*** portfolios of more developed countries

1 S.D. ↑ in GDP per capita ⟺ 0.71 (0.99) ↓ in the total (domestic) portfolio weight of a sector that is 1 S.D. higher in emissions intensity, ∼ 10% (14%) of the mean sectoral weight.

A persistent "domestic-foreign wedge" portfolio decarbonization is driven by domestic portfolio changes; signs of cross-border risk transfer

Multiple attributes of higher "brown lending resistance" higher resilience to climate hazards, better business environment to leverage market investment, more pro-environmental preferences

Micro Evidence: Risk Transfers Within Syndicates

Using within-syndicate variation in loan share retention:

$$\text{LoanShare}_{lbt} = \alpha + \beta\, EI_{b,t-1} \times \log(GDPpc_{l,t-1}) + \lambda_{bt} + \lambda_{lt} + \varepsilon_{lbt},$$

with

EIR — Emission intensity based on revenue (Refinitiv Workspace & CDP)

Loan share — reported shares at loan origination

Lenders from higher-resistance countries retain smaller shares in high-emission loans, consistent with **risk transfer** toward less regulated regions and institutions.

More results: various incentives behind what banks choose to do,
e.g., originate-to-distribute/liquidity, supervision pressures, agent role difference, etc.

Policy Shock: ECB Climate Guide (Nov 27, 2020)

Directly treated: **Significant Institutions (SI)** supervised by the ECB (non-climate-related criteria)

Concerns:

⇒ No enforceable rules? Soft supervision = good news?

⇒ Non-SIs=control? or **treated as well, more likely in opposite direction**

Compare using different control groups (2015 - 2023):

1. control = non-SI, within SSM

$$\begin{aligned}\text{Sectoral Exposure}_{lKt} =& \alpha + \gamma_1 EI_{Kt-1} \times SI_{lt} + \gamma_2 EI_{Kt-1} \times SI_{lt} \times Post\ Guide_t \\ &+ \lambda_{lK} + \lambda_{lt} + \lambda_{Kt} + \epsilon_{lKt},\end{aligned}$$

2. control = "unrelated" lenders outside SSM zone

$$\begin{aligned}\text{Sectoral Exposure}_{lKt} =& \alpha + \beta EI_{Kt-1} \times \log(\text{GDP per capita})_{lt-1} \\ &+ \gamma_1 EI_{Kt-1} \times SI_{lt} + \gamma_2 EI_{Kt-1} \times SI_{it} \times Post\ Guide_t \\ &+ \gamma_3 EI_{Kt-1} \times Other\ SSM-related\ Lender_{lt} \\ &+ \gamma_4 EI_{Kt-1} \times Other\ SSM-related\ Lender_{lt} \times Post\ Guide_t \\ &+ \lambda_{lK} + \lambda_{lt} + \lambda_{Kt} + \epsilon_{lKt}.\end{aligned}$$

Evaluation with two different control groups

	Reported sectoral loans					
	(1) Total	(2) Domestic	(3) Foreign	(4) Total	(5) Domestic	(6) Foreign
EI X Log GDP per capita				-1.991***	-5.768***	-0.436
				(0.574)	(1.604)	(1.193)
EI X SI	-0.818	-0.870	-1.100	1.303	1.288	2.169***
	(0.884)	(0.859)	(1.443)	(1.428)	(1.385)	(0.735)
Post Guide X EI X SI	-11.739**	-13.899**	-6.587	4.783***	2.934***	3.142***
	(4.351)	(6.030)	(4.241)	(0.976)	(0.962)	(0.968)
EI X Other SSM-related lender				1.704	2.280	3.047
				(1.884)	(1.387)	(1.787)
Post Guide X EI X Other SSM-related lender				16.075***	14.810**	9.657**
				(4.717)	(6.594)	(4.531)
Constant	24.806***	10.100***	26.273***	34.362***	51.887***	22.725**
	(0.863)	(1.256)	(0.404)	(3.746)	(11.388)	(8.401)
SSM lenders only		Y			N	
N	6477	4063	4063	34483	17409	17409
Adjusted R2	0.147	0.036	0.179	0.184	0.210	0.246
		Control = Non-SIs			Control = unrelated lenders	

Figure 1:ECB Climate Guide evaluation with two control groups (within-SSM vs outside-SSM).

Conclusions

International comparison of loan portfolio decarbonization

1. a structural change in sectoral loan supply: faster shift to green sectors in more developed countries
2. persistent lag in foreign portfolio decarbonization of these countries
3. signs of risk transfers due to different incentives: originate-to-distribute, regulatory arbitrage, specialization advantage.
4. risks may concentrate on lead arrangers as a result of brown loan reduction

Evaluation of the publication of the ECB's climate guide:

1. unintended effects & regulatory leakage
2. Supervisory expectations without credible sanctions can be interpreted oppositely.

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