Banking on the Environment? Financial Frictions and Green Investments

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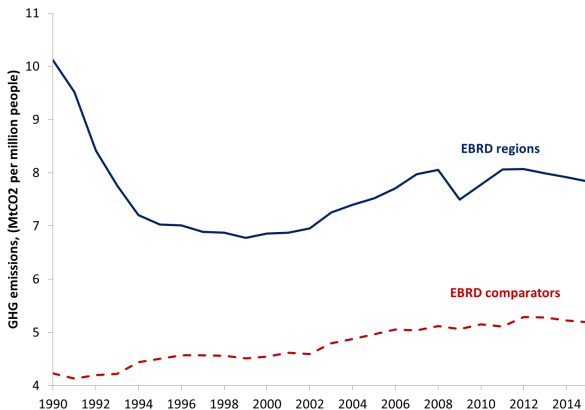[2] Imperial College Business School

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Motivation

Countries in EBRD regions have witnessed substantial reduction in GHG emissions since 1990, but emissions have started to rise again since the early 2000s

Motivation

To increase energy efficiency and to reduce carbon footprint of firms, production structures will need to change significantly

1. Green management practices: clear, measurable, realistic environmental objectives and know-how to deliver environmental and climate-change related targets

2. Green investments: investments in energy efficiency and pollution reduction

Research questions & contribution

1. Do financial and managerial constraints inhibit green investments?
   - To our knowledge, our paper is the first to explicitly show the link between financial and managerial constraints on the one hand and green investments on the other hand

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1. Do financial and managerial constraints inhibit green investments?
   - To our knowledge, our paper is the first to explicitly show the link between financial and managerial constraints on the one hand and green investments on the other hand

2. Do financial constraints thwart firms' efforts to reduce their greenhouse gas (GHG) emissions?
   - Existing papers on the environmental effects of financial crises suggest that short-term effects are positive, but they may be negative in the longer run
   - Our paper: possible channel for the negative impact of financial crises on (GHG) emissions $\implies$ credit constraints preventing the firms from investing in measures that reduce their pollutant emissions

OLS estimation

1. Baseline:

$$Y_{isc} = \beta_0 + \beta_1 \, CreditConstrained_{isc} + \gamma' \mathbf{X_{isc}} + \nu_l + \psi_a + \iota_{tr} + \xi_c + \zeta_s + \epsilon_{isc}$$

2. Controlling for the quality of green management practices:

$$Y_{isc} = \beta_0 + \beta_1 \, CreditConstrained_{isc} + \beta_2 \, GreenManagement_{isc}$$
$$+ \gamma' \mathbf{X_{isc}} + \xi_l + \nu_a + \psi_{tr} + \iota_c + \zeta_s + \epsilon_{isc}$$

i	Firm
s	Sector
c	Country
Y	Investment indicator: fixed assets, green
$CreditConstrained$	Indicator for whether the firm is credit constrained
$GreenManagement$	Green management practices (z-score)
$\mathbf{X}$	Firm-level characteristics matrix
ν_l	Locality size fixed effects
ψ_a	Accuracy of answers fixed effects
ι_{tr}	Truthfulness of answers fixed effects
ξ_c	Country fixed effects
ζ_c	Sector fixed effects

IV estimation

- Credit constraints can be affected by firms' (green) investment decisions

- Supply of bank credit tightened significantly in emerging Europe in the wake of the global financial crisis

- The intensity of deleveraging varied significantly across banks, even within the same country

- Banks' branch networks were predetermined before the crisis; assume that due to agency costs SMEs can only access nearby banks

IV estimation (cont.)

$$CreditConstrained_{isc} = \delta_0 + \delta_1 Wholesale_{5km,isc} + \delta_2 GreenManagement_{isc}$$
$$+ \gamma^{'} \mathbf{X_{isc}} + \nu_l + \psi_a + \iota_{tr} + \xi_c + \zeta_s + \epsilon_{isc}$$

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i	Firm
s	Sector
c	Country
Y	Investment indicator: fixed assets, green
$CreditConstrained$	Indicator for whether the firm is credit constrained
$Wholesale_{5km}$	Average wholesale funding dependence in 2007 across
	all bank branches within a 5 km radius around each firm
$\mathbf{X}$	Firm-level characteristics matrix
ν_l	Locality size fixed effects
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Data sources

1 EBRD-EIB-WB Enterprise Surveys
  - Credit constraints: 1 if needed a loan and were discouraged or rejected; 0 otherwise (including no need for credit or satisfied demand for credit)
  - Green investments
  - Green management practices
  - Firm covariates

2 EBRD Banking Environment and Performance Survey (BEPS II)
  - Geographical coordinates of bank branches

3 Bureau Van Dijk's ORBIS
  - Data on banks' funding structure: pre-crisis reliance on wholesale funding
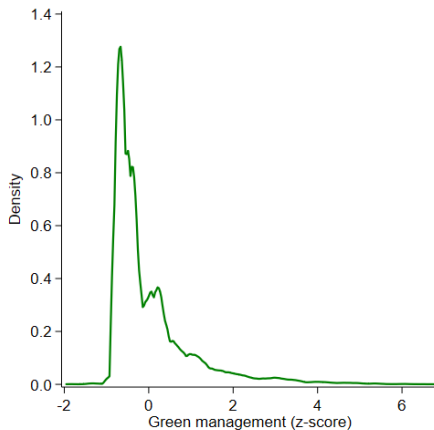
Green investments

- Investment in fixed assets: machinery & equipment, vehicles, land, buildings

- Green investments
  - On-site generation of green energy
  - Energy and water management
  - Waste minimization, recycling and waste management
  - Measures controlling air and other pollution
  - Energy efficiency measures
  - Improvements to heating, cooling and lighting systems
  - Machinery and equipment upgrades
  - Vehicle upgrades

- Investment in non-green fixed assets

- Overlap between investments in fixed assets and green investments is imperfect

Green management practices

Four areas:

- Strategic objectives related to the environment and climate change
- Manager with an explicit mandate to deal with green issues and who they report to
- Clear and attainable environmental targets
- Monitoring of energy and water usage, CO_2 and other pollutant emissions

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Summary statistics

Variable	N	Mean	Median	Std. dev.	Min	Max
Investment in fixed assets	10,648	0.404	0	.491	0	1
Investment in non-green fixed assets	10,648	0.051	0	.220	0	1
Green investment	10,653	0.718	1	.450	0	1
Machinery	10,219	0.452	0	.498	0	1
Vehicle	10,155	0.324	0	.468	0	1
Heat/cool/light	10,653	0.513	1	.500	0	1
Green generation	9,928	0.120	0	.325	0	1
Energy/water management	10,653	0.343	0	.475	0	1
Waste minimization	10,074	0.344	0	.475	0	1
Pollution control	10,653	0.194	0	.396	0	1
Energy efficiency	10,507	0.333	0	.471	0	1
Credit constrained	10,653	0.235	0	.424	0	1
Green management practices	10,507	-0.031	-0.393	.977	-1.852	6.836
Exporter	10,653	0.192	0	.394	0	1
Publicly listed	10,653	0.066	0	.247	0	1
Sole proprietorship	10,653	0.169	0	.374	0	1
Audited	10,653	0.332	0	.471	0	1
Age (log)	10,551	2.690	2.833	.749	0	5.323
Wholesale (5km)	10,653	81.265	81.154	23.986	26.640	226.713

Source: Enterprise Surveys, Banking Environment and Performance Survey II (BEPS II), Bureau Van Dijk's Orbis database and authors' calculations.

OLS estimates

Dependent variable	(1) Investment in fixed assets	(2) Investment in non-green fixed assets	(3) Green investments
Credit constrained	-0.087***	-0.009*	-0.019
	(0.011)	(0.005)	(0.014)
Green management	0.061***	-0.021***	0.099***
	(0.006)	(0.002)	(0.005)
Observations	9,777	9,777	9,777
Clusters	194	194	194

Source: Enterprise Surveys, Banking Environment and Performance Survey II (BEPS II), Bureau Van Dijk's Orbis database and authors' calculations.

Note: The dependent variables are: a dummy indicating whether the firm has invested in fixed assets in the past year (column 1); a dummy indicating whether the firm has invested in assets other than green investment (column 2); and a dummy indicating whether the firm has made at least one type of green investment over the past three years (column 3). Types of green investment are the following: improvements to heating, cooling and lighting systems; machinery and equipment upgrades; vehicle upgrades; energy or water management; waste minimisation, recycling and waste management; on-site generation of green energy; measures controlling air or other pollution; and energy efficiency measures. All regressions include firm-level controls (indicators for exporter status, listed firm, sole proprietorship and audited financial reports, as well as the log of firm age), as well as country, sector, locality size, accuracy and truthfulness fixed effects. Standard errors clustered at four-digit industry level are shown in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1 per cent levels, respectively.
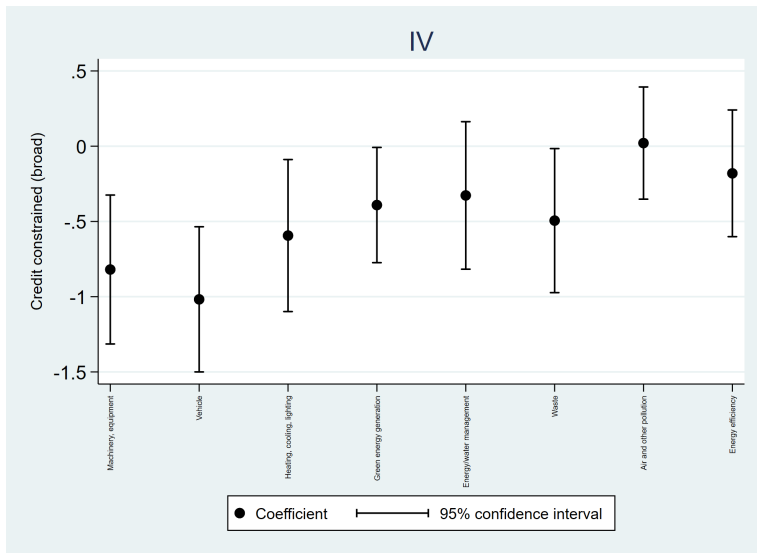
IV estimates

	(1) 1st stage	(2) 2nd stage	(3)	(4)
Dependent variable	Credit constrained	Investment in fixed assets	Investment in non-green fixed assets	Green investment
Bank dependence on wholesale funding (5 km)	0.002*** (0.000)			
Credit constrained		-1.020*** (0.288)	-0.130 (0.130)	-0.497** (0.208)
Green management	0.000 (0.005)	0.062*** (0.006)	-0.021*** (0.002)	0.100*** (0.005)
Observations	9,777	9,777	9,777	9,777
Clusters	194	194	194	194
Kleibergen-Paap F-stat.		25.854	25.854	25.854

Source: Enterprise Surveys, Banking Environment and Performance Survey II (BEPS II), Bureau Van Dijk's Orbis database and authors' calculations.

Note: The first-stage instrument is a branch-weighted measure of average dependence on wholesale funding across all banks within 5 km of the firm. All regressions include firm-level controls (indicators for exporter status, listed firm, sole proprietorship and audited financial reports, as well as the log of firm age), as well as country, sector, locality, accuracy and truthfulness fixed effects. Standard errors clustered at four-digit industry level are shown in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1 per cent levels, respectively.

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Emissions
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Conclusion
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IV estimates: Types of green investment

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Access to credit and greenhouse gas emissions

- Data from the European Pollutant Release and Transfer Register (E-PRTR) for EU-10*, Bulgaria and Romania
- Combined with BvD ORBIS and bank branch network information from BEPS II
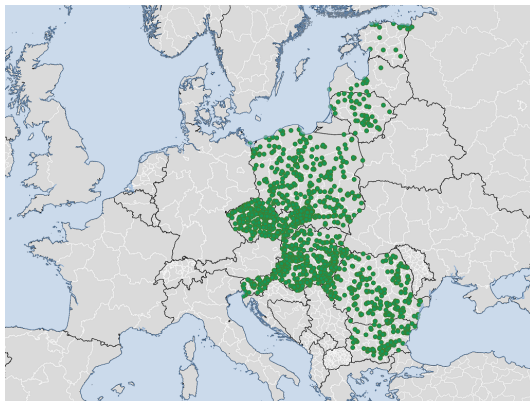
Reduced-form model

$$Emissions_{isct} = \beta_0 + \beta_1 Wholesale_{15km,isct} + \beta_2 Post_{2007}$$
$$+ \beta_3 Wholesale_{isct} \times Post_{2007} + \gamma^{'} \mathbf{O_{isct}} + \xi_c + \zeta_s + \epsilon_{isct},$$

$Emissions$	Total emissions of air pollutants or GHG (log)
$Wholesale_{15km}$	Average wholesale funding dependence in 2007 across
	all bank branches within a 15 km radius around each firm
$\mathbf{O}$	Facility-level characteristics matrix (GPS, GUO fixed effects)
ξ_c	Country fixed effects
ζ_c	Sector fixed effects

Results

Dependent variable	(1)	(2)	(3)	(4)
		Total e	missions	
	Air pollutants		Greenhouse gas	
Bank dependence on	-0.044**	-0.044**	-0.032	-0.033
wholesale funding (15 km)	(0.021)	(0.022)	(0.032)	(0.031)
Post 2007	-1.063***	-1.062***	-2.144***	-2.144***
	(0.292)	(0.309)	(0.715)	(0.729)
Post 2007 * Bank dependence	0.011***	0.011***	0.026***	0.026***
on wholesale funding (15 km)	(0.004)	(0.004)	(0.009)	(0.009)
Ownership controls	No	Yes	No	Yes
Observations	3,638	3,638	3,638	3,638
R-squared	0.428	0.429	0.398	0.398

Source: E-PRTR, BEPS II, Bureau van Dijk's Orbis database and authors' calculations.
Note: Bank dependence on wholesale funding (15 km) measures the average dependence (in 2007) on wholesale funding of all bank branches located in a circle with a 15 km radius around the industrial facility or, in the case of multi-facility firms, the parent company. Post 2007 is a dummy variable that is 1 in 2008 or later years and 0 in the base year 2007. Regressions control for the latitude and longitude of the facility, country and sector fixed effects, and (in columns 2 and 4) for whether the facility is owned by a private corporation, the state, a financial institution/bank, or an individual or family. Standard errors are clustered by parent company and shown in parentheses. *, ** and *** denote statistical significance at the 10, 5 and 1 per cent levels, respectively.

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Impact of local credit shocks on facility-level greenhouse gas emissions, by year
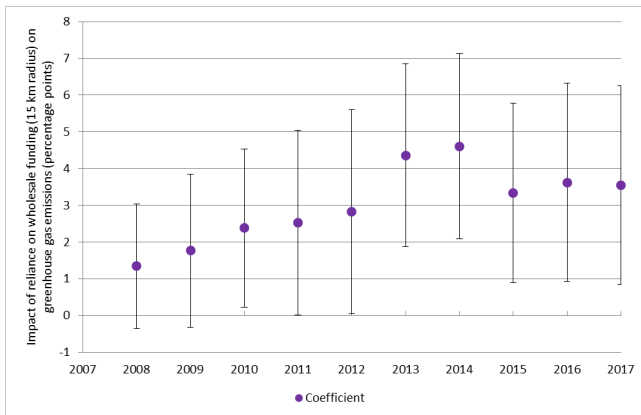
Source: E-PRTR, BEPS II, Bureau Van Dijk's Orbis database and authors' calculations.
Note: These coefficients are estimated by using a difference-in-difference regression to explain the impact that local credit constraints have on the logarithm of greenhouse gas emissions (in kilograms of CO2) in every year after 2007 (the base year). The lines show the 95 per cent confidence interval.

Conclusion

- Credit constraints hamper all investments by firms, including investments with environmental benefits

- Managerial constraints matter more for green than regular investments

- Credit constraints also have a substantial negative impact on GHG emissions

Work in progress

- Updated EBRD-EIB-WB Enterprise Surveys dataset
- Instrument for green management practices
- Impact of credit constraints on firm leverage