

How Do Climate Policies Affect Securities Holdings of Green and Brown Firms?

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The views expressed are those of the authors and not necessarily those of the Czech National Bank or the European Central Bank.

Introduction

- Growing interest in understanding the relationship between **environmental policies** and **financial markets**.
- We examine effects of climate policies on **securities holdings of low- and high-carbon firms**.
- **Contribution to the literature:**
 - ▶ Literature analyzing the effects of climate-related policy events on financial sector decisions: *Krueger et al. (2020)*; *Reghezza et al. (2022)*.
 - ▶ Literature showing that financial sector takes into climate risks into account: *Ilhan et al. (2021)*; *Bolton & Kacperczyk (2021)*; *Ramelli et al. (2021)*.
 - ▶ Literature on securities holdings as such: *Bekaert & Breckenfelder (2019)*; *Papoutsis et al. (2021)*.
 - ▶ Literature on ESG performance and access to finance: *Cheng et al. (2014)*; *El Ghouli et al. (2011)*.
 - ▶ Dynamics of the low-carbon transition: *Steg et al. (2014)*; *Geels et al. (2017)*; *Dietz et al. (2016)*; *Campiglio et al. (2018)*, among others.
 - ▶ Theoretical models of climate finance: *Pástor et al. (2021)*.

Main Takeaways

- **Objective:** Examine effects of climate policies and COVID-19 on securities of green vs. brown firms.
- **Key Findings:**
 - ▶ Financial sectors **increase** investments in **green** firms and **decrease** investments in **brown** firms after climate policy events.
 - ▶ Non-financial firms and households do the opposite: **transfer of climate transition risks**.
 - ▶ Governments response aligns more closely with the financial sector.
 - ▶ **COVID-19 pandemic** had similar impact: increase in green firms' securities and decrease in brown firms' securities.
 - ▶ **Regional factors** play a role: home bias; environmental performance of holder and issuer country.
- **Implications:**
 - ▶ **Financial sector leads the transition** towards financing more sustainable industries, with governments playing a supporting role.
 - ▶ Private non-financial sector might be **vulnerable** to climate transition risks.

Hypotheses and Events (1/3)

- We study changes in securities holdings around 5 specific events.
- **Baseline:** two significant climate policy events, Paris Climate Agreement (2015) and UN Climate Action Summit (2019).

Event	Date	Post=1 from	Firms	Exp. sign
Paris Climate Agreement (COP21)	Dec 2015	1Q 2016	green brown	+ -
UN Climate Action Summit (Greta Thunberg's speech)	Sep 2019	3Q 2019	green brown	+ -
COVID-19	Mar 2020	2Q 2020	green brown	+ -
Trump's announcement of withdrawal from COP21	Jun 2017	3Q 2017	US green US brown	+/- +/-
Biden's announcement of rejoining COP21	Jan 2021	1Q 2021	US green US brown	+ -

Hypotheses and Events (2/3)

- 1 Following the COP21 and the 2019 UN Climate Action Summit, **financial institutions** increased securities holdings of green industries and decreased securities holdings of brown industries.
- 2 Following the COP21 and the 2019 UN Climate Action Summit, **the private non-financial sector** increased securities holdings of brown industries, implying a shift of transition risk from the financial sector to the non-financial sector.
- 3 **The COVID-19 pandemic** affected securities holdings of brown industries disproportionately more than those of non-brown (green and other) industries.
 - ▶ Carbon-intensive firms face higher risk premiums (Bolton & Kacperczyk, 2021) and increased tail risk associated with climate policy uncertainty (Ilhan *et al.*, 2021).
 - ▶ After the COP21, European banks reallocated credit away from polluting firms (Reghezza *et al.*, 2022).
 - ▶ During the pandemic, sustainable stocks experienced lower volatility (Shields *et al.*, 2021) and higher resilience (Engelhardt *et al.*, 2021; Albuquerque *et al.*, 2020).

Hypotheses and Events (3/3)

- 4 Financial institutions exhibit a **home bias** in their portfolio allocation decisions between green and brown industries, with a stronger preference for domestic or eurozone securities.
- 5 The shift of securities holdings towards green industries is affected by the **environmental performance** of both the holder's and issuer's countries, with high-performance countries showing a stronger reallocation than low-performance countries.
 - ▶ Strong evidence for home bias in international investment portfolios (Ardalan, 2018).
 - ▶ Existing variation in countries' pro-environmental attitudes and their commitment to climate change mitigation (Hsu & Zomer, 2014).
- 6 Following **Trump's withdrawal from** and **Biden's rejoining of the COP21**, financial institutions in the eurozone changed their allocation of securities holdings toward US green and brown industries.
 - ▶ Ramelli *et al.* (2021) show that carbon-intensive firms' stock prices reacted positively to President Trump's election.

Data (1/2)

We use **two data sources**:

- Securities Holdings Statistics by Sector (SHSS)
- Industry-level carbon emissions by Eurostat
 - ▶ Sensitivity analysis: firm-level emissions by Refinitiv Eikon

1) Securities Holdings Statistics by Sector (SHSS)

- **Security-by-security** confidential data at Q frequency (since 2014).
- Securities held by **euro area resident sectors**.
- Two instruments: **equity** and **debt** securities.
- Our baseline (majority of regressions):
 - ▶ **Holders**: financial sectors (banks, investment funds, IC&PF)
 - ▶ **Issuers**: non-financial firms; all around the world.
- But we examine non-financial sectors as securities holders as well (the risk-shifting hypotheses).

Summary Statistics

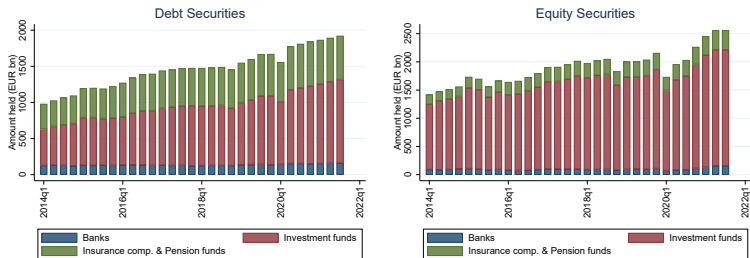
- Securities held by EA FIs issued by NFCs worldwide.
- **Investment funds** hold majority of securities, both equity and debt.
- Banks hold the least.
- Both **EA and US NFCs** constitute a large share of the sample.
 - ▶ EA: 22% of equities, 34% of bonds
 - ▶ US: 27% of equities, 36% of bonds
- **NFCs from countries outside Europe and US** issues about half of all equity securities held by EA FIs

	Equity securities			Debt securities		
	Obs.	Mean	SD	Obs.	Mean	SD
All	4,200,039	13.425	3.249	1,522,531	15.174	2.294
<i>By holder sector</i>						
Banks	721,854	11.064	3.851	221,468	15.047	2.471
Investment funds	2,241,638	14.444	2.783	757,140	15.412	2.233
IC&PF	1,236,547	12.956	2.795	543,923	14.896	2.267
<i>By issuer country</i>						
Euro area firms	921,028	13.933	3.269	524,563	15.520	2.398
EU non-EA firms	206,020	12.901	3.215	74,396	15.241	2.242
US firms	1,127,774	13.449	3.304	547,027	15.004	2.229
Firms from other countries	1,945,217	13.226	3.182	376,545	14.927	2.188

Volume of SH: Financial Sectors

- Debt and equity securities holdings **nearly doubled** from 2014–2021.
- **Investment funds** hold most debt (two-thirds) and equity (90%) securities.

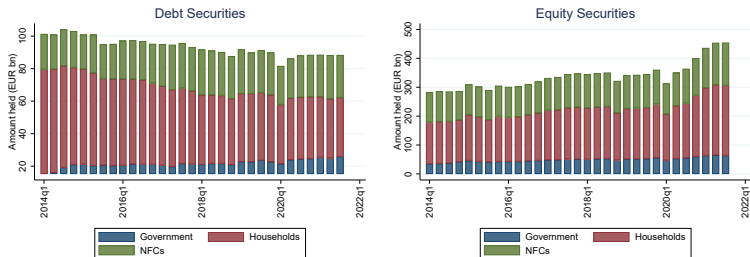
Figure: Volume of Securities Holdings by Financial Sector: Amounts in EUR Billion



Volume of SH: Non-financial Sectors

- Non-financial sector holds **vastly fewer** debt (20x) and equity (6x) securities.
- Household debt securities holdings dropped, but equity securities raised, notably since 2020.

Figure: Volume of Securities Holdings by Non-Financial Sector: Amounts in EUR Billion



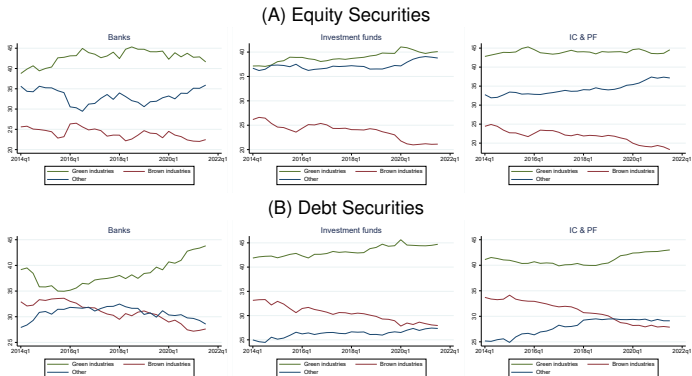
Data (2/2)

2) Carbon emissions

- Proxy for carbon intensity (carbon risk)
 - ▶ Financial markets differentiate firms by their carbon intensity (Ilhan *et al.*, 2021; Bolton & Kacperczyk, 2021)
- Industry-level carbon emissions by Eurostat
- Broken down to 64 industries (NACE classification)
- Used to create a dummy variable for low-carbon (green) and high-carbon (brown) industries
 - ▶ **Baseline:** green (brown) industry = first (last) quartile of the distribution of the emissions per gross value added
 - ▶ **Alternatives:** quintiles; emissions per capita, emissions in absolute amounts

Green vs. Brown Securities: Financial Sectors

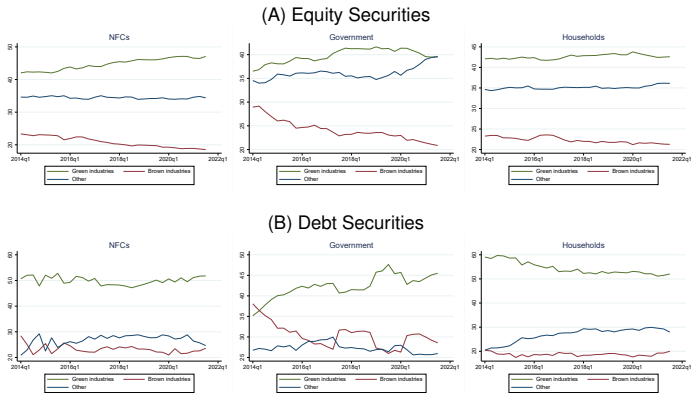
- The shift from brown securities holdings towards green or other securities is evident across most financial sectors.



Note: Y-axis represents the percentage share of green, brown, and other securities in total amount held by a respective sector.

Green vs. Brown Securities: Non-financial Sector

- Decrease in brown and increase in green holdings seems **less pronounced for non-financial sector**.



Methodology

- Firm (issuer) level difference-in-differences regression.
- Parallel trend assumption holds across financial institutions, green/brown firms and events.

$$\log(SH_{i,j,t}) = \beta_1^G Green_{i,t} \times Post_t + \beta_2^G Green_{i,t} + \beta_3^G Post_t + \alpha_i + \alpha_t + \alpha_{j_s} + \alpha_{j_c} + \epsilon_{i,j,t}$$

$$\log(SH_{i,j,t}) = \beta_1^B Brown_{i,t} \times Post_t + \beta_2^B Brown_{i,t} + \beta_3^B Post_t + \alpha_i + \alpha_t + \alpha_{j_s} + \alpha_{j_c} + \epsilon_{i,j,t}$$

- $\log(SH_{i,j,t})$: logarithm of holdings issued by firm i held by financial sector j at quarter t .
- $Green_{i,t}$, $Brown_{i,t}$: dummy variables for low- and high-carbon firms.
- $Post_t$: dummy variable for two years after the event.
- Very tight specification with multiple fixed effects for issuer (α_i), time (α_t), holder sector (α_{j_s}) and holder country (α_{j_c}).
- β_1^G , β_1^B : average percentage change in holdings following each event.

Results: COP21, Green Firms

(A) Equity Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Green	1.127 (0.923)		2.075** (0.871)		-0.013 (0.498)		0.090 (1.113)	
Green * Post	0.054*** (0.015)	0.046*** (0.015)	0.127*** (0.031)	0.111*** (0.033)	0.041** (0.017)	0.024 (0.017)	-0.016 (0.022)	-0.007 (0.022)
Observations	1,522,932	1,522,932	255,955	255,955	816,251	816,250	449,782	449,782
Adjusted R^2	0.622	0.487	0.698	0.594	0.667	0.330	0.591	0.464

(B) Debt Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Green	0.238 (0.291)		0.794 (1.073)		0.171 (0.249)		0.264 (0.363)	
Green * Post	0.062** (0.025)	0.061*** (0.023)	0.028 (0.048)	0.062 (0.047)	0.047* (0.028)	0.054** (0.026)	0.049 (0.032)	0.079** (0.032)
Observations	546,764	546,764	72,231	72,231	271,214	271,214	202,818	202,818
Adjusted R^2	0.404	0.253	0.456	0.361	0.627	0.248	0.559	0.310
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Holder Sector FE	Y	Y	-	-	-	-	-	-
Holder Ctry FE	Y		Y		Y		Y	
Firm's Ind. x Ctry FE		Y		Y		Y		Y

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. SE clustered at the firm level.

Results: COP21, Brown Firms

(A) Equity Securities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All	All	Banks	Banks	IF	IF	IC&PF	IC&PF
Brown	0.039 (0.252)		-0.767 (0.527)		-0.183 (0.376)		0.396* (0.213)	
Brown * Post	-0.046*** (0.017)	-0.026 (0.017)	-0.155*** (0.033)	-0.126*** (0.035)	-0.039* (0.020)	0.001 (0.019)	-0.037 (0.024)	-0.014 (0.025)
Observations	1,522,932	1,522,932	255,955	255,955	816,251	816,249	449,782	449,781
Adjusted R^2	0.622	0.487	0.698	0.593	0.666	0.329	0.591	0.463

(B) Debt Securities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All	All	Banks	Banks	IF	IF	IC&PF	IC&PF
Brown	-0.408 (0.636)		0.050 (0.490)		-0.125 (0.645)		-0.442 (0.727)	
Brown * Post	-0.067*** (0.025)	-0.055** (0.023)	-0.141*** (0.052)	-0.157*** (0.051)	-0.047 (0.029)	-0.005 (0.026)	-0.079** (0.031)	-0.096*** (0.032)
Observations	546,764	546,764	72,231	72,230	271,214	271,214	202,818	202,816
Adjusted R^2	0.404	0.253	0.456	0.357	0.627	0.247	0.559	0.309
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Holder Sector FE	Y	Y	-	-	-	-	-	-
Holder Ctry FE	Y		Y		Y		Y	
Firm's Ind. x Ctry FE		Y		Y		Y		Y

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. SE clustered at the firm level.

Results: UN Summit, Green Firms

(A) Equity Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Green	-0.324 (0.550)		-0.201 (0.518)		-0.381 (0.535)		-0.479 (0.889)	
Green * Post	0.078*** (0.016)	0.056*** (0.015)	0.039 (0.030)	0.066** (0.033)	0.097*** (0.018)	0.050*** (0.017)	0.093*** (0.020)	0.071*** (0.020)
Observations	1,644,529	1,644,529	236,282	236,282	863,966	863,966	542,817	542,816
Adjusted R^2	0.629	0.483	0.726	0.581	0.663	0.331	0.599	0.480

(B) Debt Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Green	0.196 (0.514)		0.300 (1.192)		-0.112 (0.336)		0.091 (0.515)	
Green * Post	0.099*** (0.020)	0.092*** (0.019)	0.043 (0.039)	0.049 (0.039)	0.102*** (0.026)	0.070*** (0.023)	0.100*** (0.025)	0.114*** (0.023)
Observations	670,521	670,521	86,518	86,515	314,581	314,579	268,867	268,865
Adjusted R^2	0.423	0.265	0.494	0.413	0.635	0.237	0.563	0.330
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Holder Sector FE	Y	Y	-	-	-	-	-	-
Holder Ctry FE	Y		Y		Y		Y	
Firm's Ind. x Ctry FE		Y		Y		Y		Y

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. SE clustered at the firm level.

Results: UN Summit, Brown Firms

(A) Equity Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Brown	0.790 (0.590)		0.337 (0.547)		0.889 (0.798)		1.149** (0.492)	
Brown * Post	-0.068*** (0.017)	-0.039** (0.017)	-0.056* (0.033)	-0.044 (0.035)	-0.095*** (0.020)	-0.049** (0.019)	-0.073*** (0.022)	-0.043* (0.022)
Observations	1,644,529	1,644,529	236,282	236,282	863,966	863,966	542,817	542,816
Adjusted R^2	0.629	0.483	0.726	0.581	0.663	0.331	0.599	0.480

(B) Debt Securities

	(1) All	(2) All	(3) Banks	(4) Banks	(5) IF	(6) IF	(7) IC&PF	(8) IC&PF
Brown	0.810 (0.602)		1.627 (1.053)		0.205 (0.652)		0.707 (0.522)	
Brown * Post	-0.092*** (0.020)	-0.070*** (0.019)	-0.008 (0.042)	-0.003 (0.042)	-0.096*** (0.026)	-0.065*** (0.024)	-0.079*** (0.024)	-0.077*** (0.023)
Observations	670,521	670,521	86,518	86,515	314,581	314,579	268,867	268,865
Adjusted R^2	0.423	0.265	0.494	0.413	0.635	0.237	0.563	0.330
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
Holder Sector FE	Y	Y	-	-	-	-	-	-
Holder Ctry FE	Y		Y		Y		Y	
Firm's Ind. x Ctry FE		Y		Y		Y		Y

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. SE clustered at the firm level.

Re-Allocation of Risks Towards NFS

- Same firm-level regression, but with **non-financial sector** as a **holder**.
- **Firms and households increase** equity holdings of **brown** firms and reduces that of green firms following both events.
 - ▶ Increase in equity holdings of brown firms by 8% after COP21 and 12% and the UN Summit.
 - ▶ Decrease in equity holdings of green firms by 3% after COP21 and 5% after the UN summit.
- **Governments** are more “responsible”: reaction more aligned to that of financial sector.
- Results for **debt security holdings** are mostly not significant.

- ⇒ **Transfer of climate-related risks** from financial to non-financial sector.
- ⇒ **Financial sector leading the transition** towards financing more sustainable industries, with governments supporting.

Additional Results: Who Drives Observed Effects?

(1/2)

Home bias

- Is there a bias in favor of domestic securities in international investment portfolios?
- Measured at country-level and EA-level.
- Triple interaction with dummy variable **Home** equal to one if the **holder's country** is the same as the **issuer's country**.
- **Results:**
 - ▶ **Home bias** present in general (irrespective of carbon intensity).
 - ▶ The effects on triple interaction are visible after the **UN summit** and for **equity securities**.
 - ▶ **Brown equity securities:** the effect is driven by the drop in holdings of non-EA firms (-8.9% vs. +2.5% for EA).
 - ▶ **Green equity securities:** equity exposure to EA green firms increases less than that to non-EA (foreign) green firms.

Additional Results: Who Drives Observed Effects? (2/2)

Environmental performance of holder and issuer country

- Triple interaction with **Environmental Performance Index (EPI)** by Hsu & Zomer (2014) to categorize countries (both holders and issuers) into “high” and “low” environmental performers.
- **Results:**
 - ▶ The coefficient on double interaction Green (Brown) * Post remains very similar to baseline results.
 - ★ I.e., environmental performance cannot fully explain changes in holdings of securities.
 - ▶ After the UN summit, increase in green equity holdings is largely **driven by** issuers (firms) and holders (financial institutions) from **high-EPI countries**.
 - ▶ The effects are especially pronounced after the **UN Summit** and for **investment fund**.

Additional Results: More Events

COVID-19 pandemic

- The negative impact on **brown** holdings was stronger than the positive impact on green holdings.
- Primarily driven by **non-banks**.
 - ▶ Drop in brown equity holdings of 9–16%; increase in green equity holdings 3–7%.
 - ▶ Drop in brown debt holdings of 7–13%; increase in green debt holdings 7–11%.
- In line with the literature on carbon risk premiums.

US firms: Trump's withdrawal and Biden's rejoining of COP21

- The effect is statistically significant only for **Trump's withdrawal**.
- EA financial institutions shifted their debt financing **away from green US firms** and **towards brown US firms**.
- Equity financing displayed an opposite trend.

Robustness Exercises

- Different combinations of **fixed effects**.
 - ▶ Differences related to the inclusion of holder country or issuer country fixed effects (hence, we tested regional effects).
- Different **definitions and data sources** to create dummy variables for green and brown firms.
 - ▶ Firm-level emissions from Refinitiv Eikon (similar results with generally higher magnitude of effects, especially for UN summit).
 - ▶ Absolute volume of carbon emissions, carbon emissions per capita, and carbon emissions per gross value added. Quartiles and Quintiles of the distribution.
- Reduced **estimation window** around events to one year.
 - ▶ Qualitatively similar results; weaker after COP21 and stronger after UN summit.
- **New vs. old securities**.
 - ▶ Triple interaction term with a dummy variable equal to one for newly issued securities (those that are no more than one year old).
 - ▶ Not significant results, the age of a security does not significantly impact our results.

Conclusions

- Financial sectors **increase** investments in **green** firms and **decrease** investments in **brown** firms after climate policy events.
 - ▶ Higher **transition risks** for carbon-intensive companies and financial institutions.
 - ▶ Higher **reputation risks** linked to financing of less environmentally-friendly firms.
- **Type of security**: the effect on debt securities seems more pronounced.
- **Sector**: Banks played a significant role after COP21; non-banks (especially investment funds) after the UN Summit.
- **Non-financial firms and households do the opposite**: increase in equity holdings of brown firms and decrease in equity holdings of green firms.
 - ▶ **Transfer of climate transition risks** from financial to non-financial sector.
 - ▶ **Financial sector leading the transition** towards financing more sustainable industries, with governments supporting.
- **Covid-19 pandemic** had similar impact: increase in green firms' securities and decrease in brown firms' securities.
- **Regional factors** play a role: home bias; environmental performance of holder and issuer country.

Thank you for your attention!

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