Green Capital Requirements

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Green Capital Requirements: Motivation

Climate change has become a major topic for financial regulators

- ECB, Bank of England have conducted climate stress tests
- Federal Reserve announced "pilot climate scenario analysis exercise"

The topic remains controversial (in regulatory sphere and more broadly)

Objective: Analyze capital requirements as a tool to address

- Climate-related financial risks
- Emissions (causing externalities)



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- Capital requirements may help facilitate carbon taxes if environmental regulation subject to commitment problem

A single-period model, universal risk-neutrality



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Continuum of cashless, bank-dependent firms

- ullet finite mass π_q of type $q \in \{ oldsymbol{\mathsf{C}} \mathsf{lean}, oldsymbol{\mathsf{D}} \mathsf{irty} \}$
- invest I at t=0, lognormal cash flow X_q at t=1
- ullet D have higher expected CF $\overline{X}_D > \overline{X}_C$ but higher emissions $\phi_D > \phi_C$

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A **regulator** who sets **capital requirements** $\underline{\mathbf{e}} = \{\underline{e}_C, \underline{e}_D\}$

ullet lower deposit insurance put and affect mass of funded firms ω_q

Roadmap

Preliminary analysis:

Banking sector equilibrium with heterogeneous borrowers

Policy analysis:

Ad-hoc green tilts to capital requirements:

- Brown penalizing factor (higher capital requirements for dirty loans)
- Green supporting factor (lower capital requirements for green loans)

Optimal capital requirements:

- Prudential mandate (cares only about <u>financial risks</u>)
- Impact mandate (also cares about externalities)



Demand for bank equity (from funded loans) = **Supply** of bank equity



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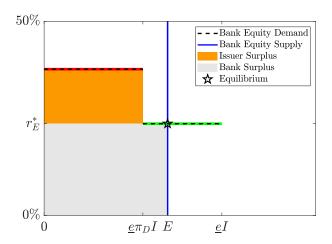
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$$r_q^{max}(\underline{e}_q) = \frac{\mathsf{NPV}_q + \mathsf{PUT}_q}{I\underline{e}_q}$$

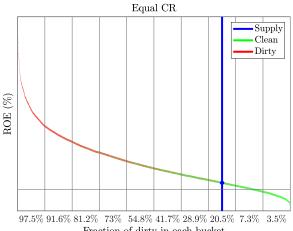
- Numerator: bilateral surplus (cash flows and deposit insurance put)
- Denominator: amount of bank equity taken up by the loan

Equilibrium for Equal Capital Requirements





Many Types



Fraction of dirty in each bucket

Positive Analysis: Green Tilts

Take equal capital requirements as point of departure

- focus on intermediate bank equity case (most interesting)
- given equal capital requirements, dirty loans rank above clean

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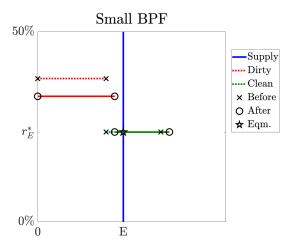
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For now, ad-hoc interventions (but insights relevant for optimal regulation)

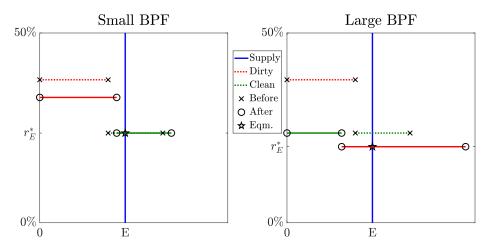
Brown Penalizing Factor



Small BPF may crowd out clean loans



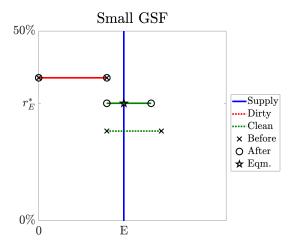
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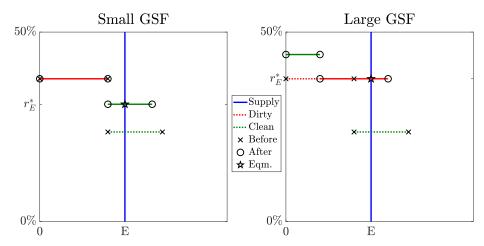
Green Supporting Factor



Small GSF crowds in clean loans



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Positive Analysis: Broader Takeaway

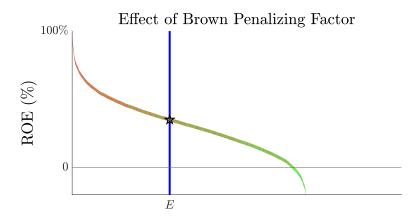
Green tilts to capital requirements have substitution and income effects:

- Substitution effect: relatively cheaper to fund clean loans
- Income effect: Banks can afford to fund more/less of both types
 GSF and BPF have different income effect sign!

Insights also apply with "many types"



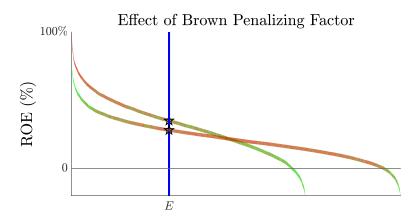
Effect of BPF with Many Types



- Substitution effect: improvement of ranking of clean firms
- Income effect: increase in required equity for dirty loans



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Prudential regulator maximizes

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Rewrite objective as:

$$\max_{\underline{\mathbf{e}}} \Omega_P = E \max_{\underline{\mathbf{e}}} \sum_{\underline{\mathbf{w}}_q} (\underline{\mathbf{e}}) \, \mathsf{PPI}_q(\underline{\mathbf{e}}_q),$$

where $\tilde{\omega}_q$ is fraction of equity allocated to type q and

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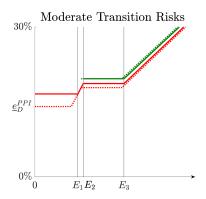
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Climate-related financial risk enters via NPV & deposit insurance put

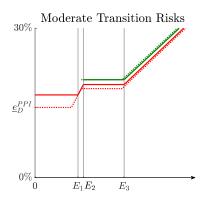
Effect of Increased Financial Risks for Dirty Firms

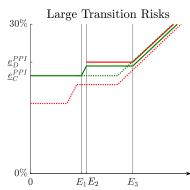


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- size of climate risks matters
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Effect of Increased Financial Risks for Dirty Firms





- optimal to increase dirty capital requirement (BPF)
- size of climate risks matters
 - moderate risks: prudentially optimal to crowd out clean loans
 - ▶ large risks: set large BPF to induce ranking change

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Capital Requirements as a Tool to Lower Emissions?

Consider now regulator with (hypothetical) impact mandate: maximizes

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Interesting case: Large externalities of dirty production \implies social value is negative, but profitable for banks (even at 100% capital requirement).

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The Limits of Green Capital Requirements

- If the banking sector sufficiently well capitalized, capital requirements cannot prevent the funding of dirty loans.
- ② If bank equity capital limited, capital requirements can prevent the funding of dirty loans. However, if dirty loans are sufficiently profitable the regulator has to reduce the capital requirement for clean loans below the prudentially optimal level, thereby sacrificing financial stability.

Implications

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- 1) **Non-bank financing**: Substitution to bond market removes financial risks from banking sector, but does not lower pollution!
- 2) Bank capital scarcity and the cost of raising equity: Lower frictions to raising bank equity make it easier for capital requirements to address financial risks, harder to address externalities
- 3) Dirty firms' abatement incentives: Additional maximization problem to choose optimal technology τ maximizing $r_q^{max} = \max_{\tau} r_{q\tau}^{max}$

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- \Rightarrow effective regardless of financing frictions or substitution

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- stricter capital requirements provide cushion against such losses
- make credible that environmental regulator will increase carbon taxes

NB: specific conditions needed, no blank cheque for intervention



Conclusion

Flexible framework to study **green capital requirements** under varying assumptions about the severity of climate risks and objective functions.

Positive analysis: brown penalizing factor may crowd out clean loans

Normative analysis distinguishes between addressing financial risks and lowering emissions (externalities)

- prudential regulation can deal with climate-related financial risks
- reducing pollution via capital requirements not always possible and may require sacrificing financial stability
 - ⇒ Carbon tax is a more direct tool to address externalities

