

How to Design Carbon Pricing Under Financial Constraints? Revisiting Pigouvian Taxation when Borrowers are “Too Levered for Pigou”*



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This column summarizes a recent working paper (Döttling and Rola-Janicka, 2023), in which we analyze jointly optimal climate and financial policies in an analytically tractable model with financial constraints. The model shows that carbon taxes may either tighten or relax financial constraints, depending on the magnitude of borrowers' exposure to physical climate risk. Consequently, the optimal carbon tax is below a textbook Pigouvian benchmark if physical risk exposure is not too high, but it may be above this benchmark if borrowers' asset values are sufficiently strongly exposed to climate-related physical risk. We derive necessary conditions under which it is welfare-improving to complement carbon taxes with other policy tools, and evaluate the merit of different climate and financial policies such as cap-and-trade systems, green subsidies, and leverage regulation. The model also provides novel insights on how carbon price hedging markets and socially responsible investors may enable or hinder efficient carbon pricing and emissions reductions in equilibrium.

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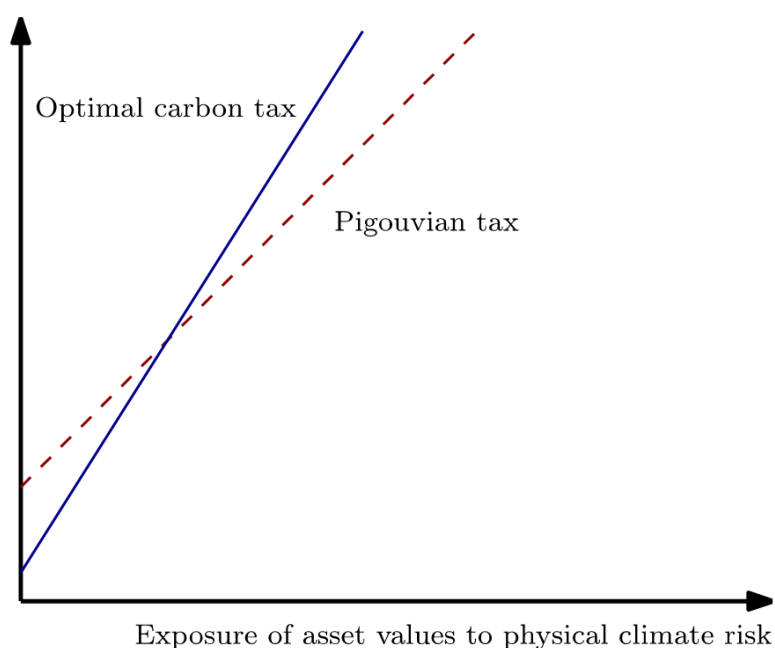
The textbook solution to addressing environmental externalities is an emissions tax equal to the social cost of emissions. This idea goes back to the work by A.C. Pigou (Pigou, 1932), and is the guiding theoretical principle behind a carbon tax. Another well-known result going back to Montgomery (1972) is that a carbon tax is equivalent to cap-and-trade system in which polluters trade a limited amount of pollution permits, such as the EU Emissions Trading System (EU ETS). At the same time, more recent contributions highlight that financial constraints may inhibit efficient emissions pricing, and that optimal emissions taxes generally differ from a standard Pigouvian solution (Hoffmann et al., 2017, Oehmke and Opp, 2023).

In a recent working paper (Döttling and Rola-Janicka, 2023), we revisit the question how to optimally design carbon pricing under financial constraints, and analyze how to best combine carbon pricing with other policy tools such as leverage regulation or green subsidies. To do so, we develop an analytically-tractable model in which financially constrained borrowers with polluting assets can decrease emissions through costly abatement investments or by liquidating assets, but liquidations are inefficient due to liquidation losses. Absent financial frictions, a standard Pigouvian emissions tax equal to the social cost of emissions can implement the first-best allocation because, in this case, an emissions tax can incentivize abatement investments without triggering inefficient liquidations.

By contrast, with binding constraints an environmental regulator needs to trade off the desired emissions-reduction effect of a carbon tax against the unintended side-effect of the tax on financial constraints. Increasing carbon taxes imposes costs, triggering inefficient asset liquidations by constrained borrowers. As a result of this effect, the optimal carbon tax may be set below the benchmark Pigouvian rate because borrowers are “too levered for Pigou”.

A novel insight from our analysis is that physical climate risk gives rise to a collateral externality that can reverse the effect of carbon taxes on financial constraints. Several empirical studies highlight that physical climate risks already affect asset prices today (for an overview, see Giglio et al., 2021). If borrowers’ assets are exposed to such asset pricing effects, then higher carbon taxes that bring down emissions can be good news for borrowers, increase pledgeable income, and ease financial constraints. This collateral externality calls for higher emissions taxes, and may even imply optimal carbon taxes *above* a standard Pigouvian benchmark, as illustrated in Figure 1. More broadly, we show that climate-related collateral externalities call for a “generalized Pigouvian tax” that takes such collateral externalities into account.

Figure 1: Optimal carbon tax as a function of borrowers' assets value exposure to physical climate risk



Another important contribution of our analysis is that we derive necessary conditions under which carbon taxes alone can implement a constrained-efficient allocation in the presence of financial constraints. This is important because there is only a case to complement carbon taxes with other policy tools if the equilibrium allocation is not already constrained efficient. We show that whether the allocation is constrained efficient depends on whether emissions taxes have a *direct* effect on financial constraints. In the textbook Pigouvian solution, emissions taxes are rebated to polluters in a lump-sum fashion, for example in the form of a “carbon dividend”. This creates incentives to reduce emissions, while the rebate avoids a net negative budgetary effect on polluters. However, if tax rebates are not fully pledgeable to outside investors, then carbon taxes have a net negative effect on borrowers’ pledgeable income even if taxes are fully rebated. We show that the equilibrium is constrained efficient only if tax rebates are fully pledgeable, because only in this case there is no net-negative effect of the emissions tax on pledgeable income.

Interestingly, this result implies that, in the presence of financial constraints, a cap-and-trade system is not generally equivalent to a carbon tax. Instead, a cap-and-trade system is equivalent to a carbon tax only if the fraction of freely allocated permits is equal to the fraction of tax rebates that is pledgeable to investors. This implies that a cap-and-trade system which allocates all pollution permits for free can achieve constrained efficiency, rendering it superior to carbon taxes. This is an important policy insight given real-world cap-and-trade systems (including the EU ETS) typically do not allocate 100% of permits for free. For example, the manufacturing industry received 80% of its allowances for free in 2013, but this proportion has been decreased to 30% in 2020 according to the European Commission’s website. We acknowledge that there may be considerations outside our model that motivate these real-life policy choices. For example, it may be difficult for regulators to correctly allocate free permits when polluters have private information, while determining the amount of freely allocated permits by past emissions (a policy referred to as “grandfathering”) may weaken incentives to reduce emissions. While modeling these effects is beyond the scope of our paper, our results highlight that regulators should also weigh the adverse impact of allowance sales on the tightness of financial constraints.

We also show green subsidies may be useful because they constitute a net transfer to constrained agents if financed by taxes raised from unconstrained agents. However, if a subsidy cannot be made contingent on abatement, for instance because regulators may find it difficult to assess which technologies are best suited for a specific borrower, then the subsidy still needs to be combined with a carbon tax in order to provide incentives to reduce emissions. This may explain the combined use of carrots (subsidies) and sticks (carbon pricing) often observed in practice.

Given the central role of financial constraints, and motivated by the recent debate whether financial regulation should include climate-related goals, we also evaluate whether an ex-ante leverage mandate can be beneficial. We consider a policy that fixes a borrower’s ex-ante leverage at a given level. Ex-ante leverage affects financial constraints when borrowers need to pay for abatement investments and emissions taxes down the line. To understand the role of leverage regulation in the model, note that, (i) a borrower’s initial leverage affects emissions because it affects financial constraints and therefore liquidations and abatement activities; and (ii) when emissions pricing cannot implement a constrained-efficient allocation, there remains a wedge between the social and the private cost of emissions even when emissions taxes are set optimally. Together, these two points imply that borrowers make socially inefficient leverage choices, and consequently there is a role for leverage regulation to improve welfare. Interestingly, the socially-optimal leverage is either above or below the level chosen privately by borrowers. On one hand, laxer financial constraints can result in a higher level of abatement, which lowers overall emissions. On the other hand, by loosening financial constraints lower leverage allows for fewer liquidations, which increases emissions. The direction of the total effect of leverage on emissions depends on the underlying emissions and abatement technologies. Only if emissions increase in leverage, the regulator should limit leverage by imposing a minimum equity requirement.

This analysis also implies that there is only a case to implement leverage regulation if the environmental policy cannot implement a constrained-efficient allocation. This suggests a “regulatory pecking order”. First, regulators should combine carbon pricing with redistributive green subsidies that transfer resources from unconstrained to constrained agents. If such transfers are unfeasible, it is best to use policy tools that have no direct effect on financial constraints, such as a cap-and-trade system with freely allocated permits. Only if such policies cannot be implemented optimally, there is a case to complement carbon pricing with leverage regulation.

Finally, we show that carbon price hedging markets can play an important role in enabling an efficient environmental policy. Carbon price hedging can be implemented through carbon price derivatives or climate-linked bonds that write off part of the principal when carbon taxes are high. Such instruments shift resources to bad states of the world where a high social cost of emissions necessitates high carbon taxes and abatement investments. Shifting resources to such states can ease financial constraints and in the best case allow environmental regulators to implement carbon taxes equal to the standard Pigouvian benchmark.

Socially responsible investors can also provide incentives to reduce emissions by demanding a higher financing cost if borrowers fail to reduce emissions. However, our analysis also highlights that, if such investors are driven by value-alignment preferences, they may have a perverse negative effect on abatement by tightening borrowers' financial constraints. This implies that socially responsible investors are an imperfect substitute for a well-designed carbon pricing policy. While much recent literature has focused on socially responsible investing, our results highlight that hedging carbon price risk is an important overlooked role the financial sector can play in the low-carbon transition. ■

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