Local Property Tax Incentives for Wind Farm Development: Evidence from Finland

Cristina Bratu[a] Marita Laukkanen[a,b] Teemu Lyytikäinen[a]
Sander Ramboer[a,c]

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Extended Abstract

Local governments are pivotal gatekeepers in the energy transition because they control zoning and permitting for renewable energy infrastructure. Yet their incentives to host projects are often weak: the benefits of wind power—climate mitigation and energy security—are diffuse, while the costs—visual intrusion, noise, and potential impacts on recreation, nature protection, and nearby property values—are locally concentrated. This mismatch creates a classic externality problem in which locally optimal permitting decisions may fall short of socially optimal renewable energy deployment. We study whether strengthening municipal fiscal incentives can shift local permitting behavior and stimulate wind farm development.

Our setting is Finland, where municipalities decide whether to approve wind farm zoning and permits. In 2018, Finland implemented a reform to the local property tax system that reclassified wind turbines from the "general real estate" category to the "power station" category. This reclassification increased the maximum allowable property tax rate on turbines from 2% to 3.1% and—crucially—enabled municipalities to raise the turbine-specific (power station) rate without simultaneously raising the general property tax rate applied to other business property. The reform was intended to compensate host municipalities for local disamenities and to strengthen incentives to permit wind farm development.

We ask two main questions. First and foremost, did the 2018 reform lead municipalities with larger fiscal gains to permit and host more wind turbine construction? Second, we ask whether municipalities actively exploit the new turbine-specific tax instrument created by the reform and how they use the resulting fiscal capacity. In particular, we test whether municipalities shift their local tax mix toward the turbine tax base and whether the additional revenues benefit residents through lower resident taxes (income and residential property taxation) and/or expanded local public spending.

[a] VATT Institute for Economic Research; [b] Tampere University; [c] University of Turku; Emails: cristina.bratu@vatt.fi, marita.laukkanen@vatt.fi, teemu.lyytikainen@vatt.fi, sander.ramboer@vatt.fi

A key challenge is that the reform's fiscal incentive is only economically meaningful where wind development is physically and legally feasible. Beyond wind resources, feasibility is shaped by land availability, environmental and conservation protections, grid connection costs, and binding aviation and defence-related restrictions that determine whether developers can realistically propose projects. Municipalities with no feasible sites lie outside the policy's domain: the higher tax ceiling cannot induce additional turbine construction where development is impossible. We therefore construct a high-resolution measure of wind farm suitability that approximates the developer's feasible choice set and identifies where wind development is plausible. This measure is central for quantifying municipal exposure to the reform—that is, the potential turbine tax base to which the higher tax ceiling could apply—and for interpreting cross-municipal differences in incentives as differences in expected fiscal gains rather than differences in whether wind development is possible at all.

Measuring wind farm feasibility with high-resolution spatial predictions

We construct a national 500m $\times$ 500m grid covering Finland (roughly 1.4 million cells) and delineate the feasible land area by masking grid cells that are effectively unavailable for wind development due to legal, environmental, or land-use constraints. The masking excludes, among other layers, protected and conservation areas (e.g. Natura 2000 and national parks), aviation and restricted zones, and cells dominated by incompatible land uses such as dense urban fabric and water bodies. This procedure is designed to mirror the developer's early-stage screening process and to approximate the set of locations where projects could plausibly be proposed.

On the remaining candidate cells, we predict turbine siting probabilities using a stacked machine-learning model that combines four learners—standard logit, lasso-regularized logit, random forest, and gradient-boosted trees—with weights chosen by non-negative least squares. Predictors include wind resources, topography, distances to relevant features (e.g. sea, residential land use, high-voltage transmission), land-use composition in a neighborhood around each cell, and proximity to protected and prohibited areas. Because turbines are extremely rare at the cell level, we address class imbalance by retaining all turbine cells and drawing stratified samples of non-turbine cells within each municipality. We then aggregate predicted grid-cell probabilities to the municipality level, producing a suitability measure interpretable as an expected number of feasible turbine sites, see Figure 1.

Constructing a municipality-specific fiscal incentive (shift–share structure)

The reform increased the maximum tax rate applicable to wind turbines, raising potential annual revenue per turbine. Because turbine taxable value is based on replacement value net of depreciation and detailed project-level construction costs are not available, we infer a representative per-turbine taxable value from municipality-level variation in turbine stock and total taxable value. This yields an estimated taxable value of roughly 0.9 million per turbine. Combined with the typical difference between pre- and post-reform applicable rates, this implies an increase in annual property tax revenue of approximately 14,000 per turbine. How meaningful this revenue increase is for residents depends on the population size of a given municipality, as Figure 2 demonstrates.

We combine predicted municipal suitability (the expected number of feasible turbine sites) with the reform-induced change in revenue per turbine to form a per-capita fiscal incentive measure. Intuitively, this measure captures the expected change in annual turbine-related property tax revenue per resident if the municipality allows wind farm development. The measure varies across municipalities both because siting feasibility differs across space and because the per-capita value of a given turbine is larger in smaller municipalities, as shown in Figure 3.

This structure admits a shift–share representation: the common policy-induced "shift" is the increase in the revenue potential per turbine, and the municipality-specific "exposure" is the predicted number of feasible sites per capita.

Identification and empirical design

Our primary analysis uses a long-differences design comparing changes from 2017 (pre-reform) to 2023 (post-reform). This approach is well-suited to wind development, which involves long planning and permitting timelines and lumpy investment, and it absorbs time-invariant municipal differences in geography, political preferences, and baseline fiscal conditions. In the first stage, we relate the change in turbine stock to the reform-induced fiscal incentive, controlling for a rich set of pre-reform demographic and economic characteristics (e.g. dependency ratios, employment, net migration, workplace self-sufficiency, and population levels and growth). The identifying assumption is that, conditional on these controls, the reform-induced incentive is orthogonal to unobserved post-reform changes in turbine construction that would have occurred absent the higher tax ceiling.

In the second stage, we examine how wind farm development affects municipal fiscal outcomes. Because turbine construction may respond to unobserved local shocks and political factors, we instrument changes in turbine stock with the reform-induced fiscal incentive. This IV strategy isolates variation in turbine construction driven by differential exposure to the common policy shock and identifies the causal effect of additional turbines on municipal fiscal policy among municipalities whose turbine development responds to the incentive. To complement and validate the main estimates, we additionally implement a matching-based difference-in-differences design for the adoption margin and an event-study analysis of fiscal outcomes around first wind farm adoption.

Results

Our analysis yields two main findings. First, fiscal incentives matter for wind farm adoption: municipalities with stronger reform-induced gains build substantially more turbines after 2018. In long-differences estimates, a one-euro increase in annual reform-induced revenue per capita is associated with roughly one to two additional turbines over 2017–2023, with comparable magnitudes across alternative specifications and suitability models (see Table 1). We find similar estimates when we match municipalities on suitability scores and compare those municipalities with above-median fiscal incentive to those below, see Figure 4. These effects are economically meaningful given the scale of municipal budgets and the discrete nature of wind farm projects, and they are consistent with local governments internalizing turbine-related fiscal gains when evaluating land-use choices.

Second, wind farm adoption induces systematic changes in municipal fiscal policy. Municipalities that expand their turbine stock shift their tax mix in ways consistent with the immobility of turbine capital once installed. In particular, they reduce residential and general property tax rates while increasing the tax rate applied to power stations, and they experience increases in overall tax revenue and local spending (see Table 2). These patterns indicate that turbine revenue relaxes local budget constraints and is used partly to reduce fiscal pressure on other taxpayers and partly to expand public spending.

Contributions and policy implications

This paper contributes to the literature on renewable energy siting, local externalities, and the political economy of the energy transition by providing direct evidence that municipal fiscal incentives implemented through local property taxation can meaningfully stimulate wind farm development. Much existing work emphasizes producer-side subsidies. Our results highlight an alternative channel that preserves local authority: aligning municipal fiscal interests with national clean-energy goals through an own-source revenue stream.

The policy implications are direct. When renewable energy projects generate national benefits but impose local costs, reforms that allow localities to retain a clear and durable revenue stream from hosting infrastructure can increase permitting and accelerate deployment. Property taxation is particularly attractive in this context because the tax base is immobile and the revenue stream is stable once projects are built, while municipalities retain discretion over how to allocate the additional fiscal space across tax reductions and spending.

0.1 Tables and Figures

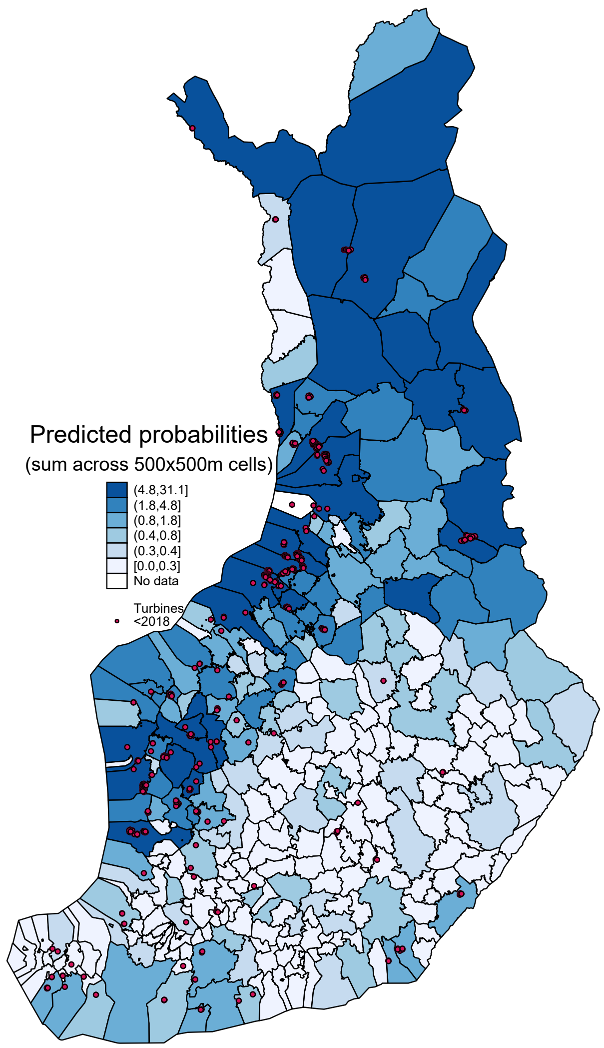


Figure 1: Municipal-level wind farm siting probabilities (stacked ML)

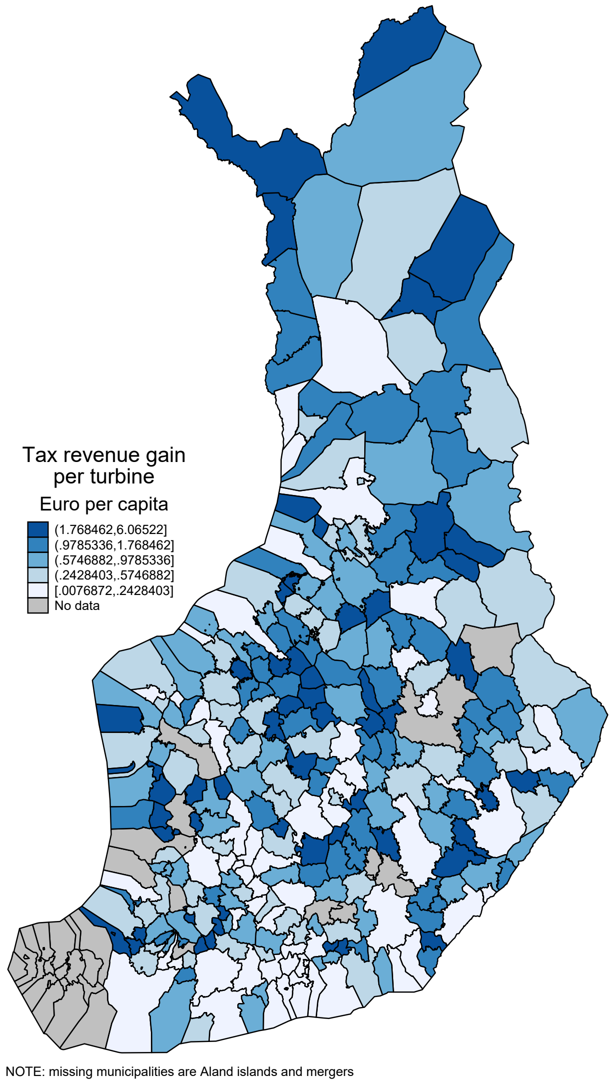
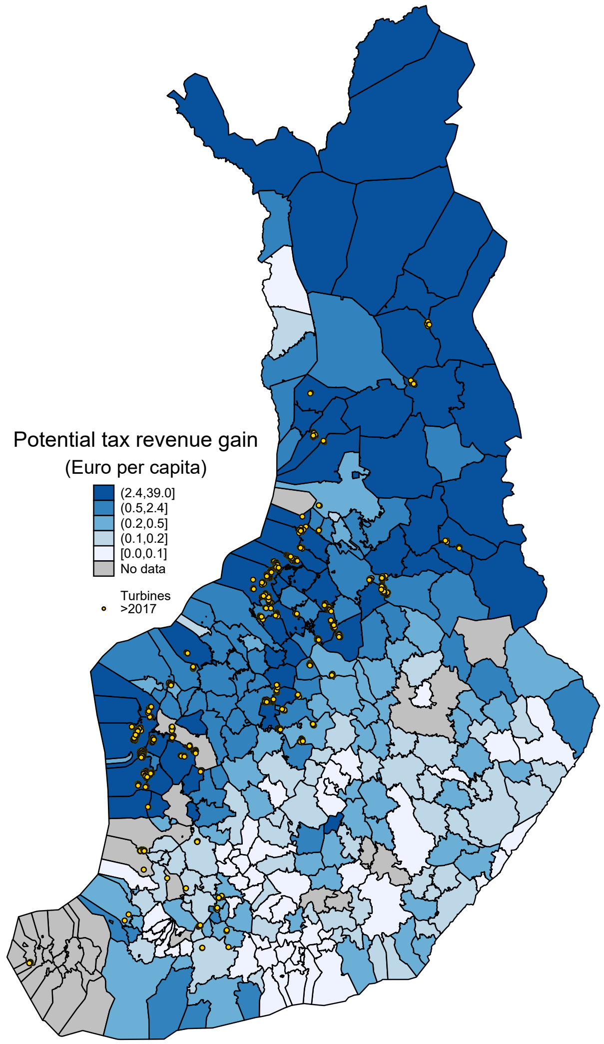


Figure 2: Per-capita revenue gain from a single turbine under the post-reform tax ceiling



NOTE: Potential tax revenue gain= difference between max property tax rate and general property tax rate multiplied by predicted taxable revenue (wind turbine probability x taxable revenue) in elegible areas.

Figure 3: Municipal fiscal incentive FI_m: potential turbine-based revenue gain per capita

Table 1: First Stage Long-Differences (2017–2023)

	Logit		Stacked ML	
	ΔTurbine Stock	ΔTurbine Stock	ΔTurbine Stock	ΔTurbine Stock
ΔFI	1.967***	1.884***	1.522***	1.621***
	(0.629)	(0.654)	(0.510)	(0.521)
Obs.	280	280	280	280
R^2	0.124	0.154	0.202	0.270
Dem. Controls	No	Yes	No	Yes
KP rk LM	10.47	9.20	5.28	5.17
Under-ID p	0.001	0.002	0.022	0.023
CD F	39.40	31.20	70.37	79.16
KP rk F	9.79	8.30	8.92	9.70

Dem. controls: pre-reform average dem. dependency ratio, employment rate, net migration rate, econ. dependency ratio, workplace selfsufficiency, population, population growth

Cluster-robust standard errors (municipal level) in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

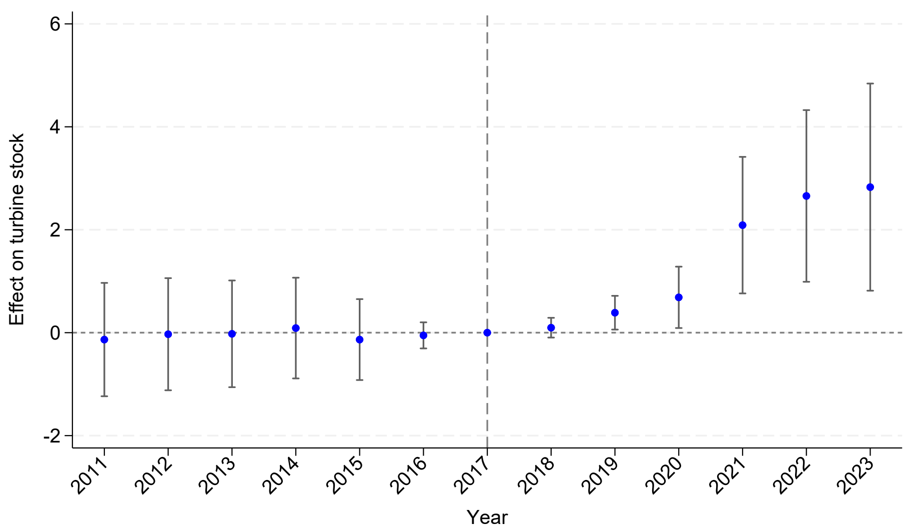


Figure 4: Matching-based estimate of treatment effect

Table 2: Second Stage Long-Differences Results (2017–2023) using stacked ML siting probabilities

	$\ln(\tau^{\text{inc}})$	$\ln(\tau^{\text{res. prop}})$	$\ln(\tau^{\text{gen. prop.}})$	$\ln(\tau^{\text{power plant}})$
ΔStock	0.000	-0.003**	-0.001**	0.014**
	(0.001)	(0.001)	(0.001)	(0.006)
Obs.	280	280	280	280
Controls	Yes	Yes	Yes	Yes

	$\ln(\text{Spend}_{\text{pc}})$	$\ln(\text{TaxRev}_{\text{pc}})$	$\ln(\text{Fees}_{\text{pc}})$	$\ln(\text{Liab}_{\text{pc}})$
ΔStock	0.006**	0.007***	0.010	-0.002
	(0.003)	(0.002)	(0.013)	(0.006)
Obs.	280	280	280	280
Controls	Yes	Yes	Yes	Yes

Note: Cluster-robust standard errors (municipal level) in parentheses. * p<0.1, ** p<0.05, *** p<0.01.