

Strommarkttreffen, 24 January 2025

# Spillover effects of wind and solar energy on interconnected European electricity markets

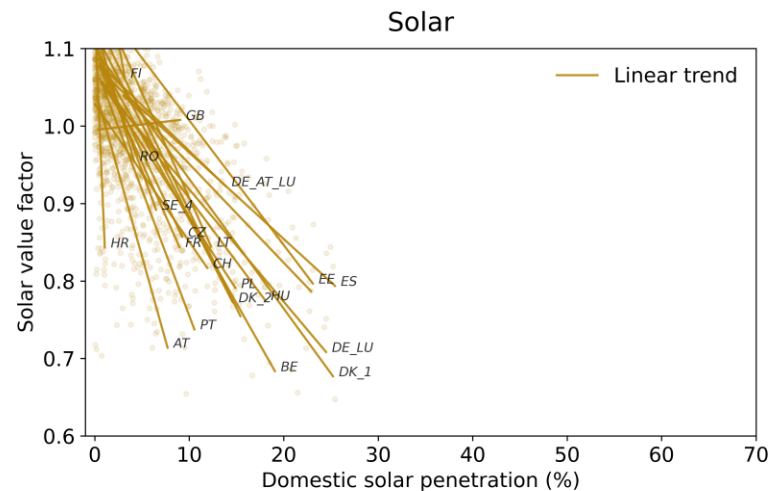
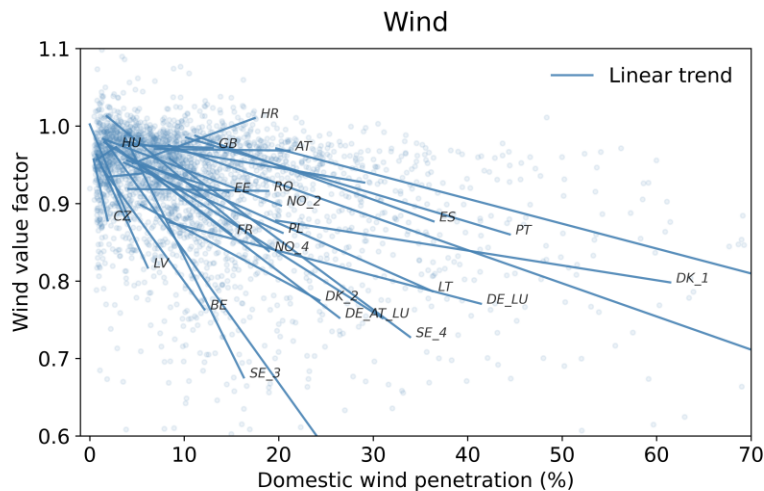
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GEFÖRDERT VOM

# Motivation

- Renewables cannibalize their own market value
- Does cannibalization spill over across interconnected markets?
- Does interconnection mitigate the value drop?
- We estimate cross-border effects on renewable market value across 30 European bidding zones using 2015-2023 data



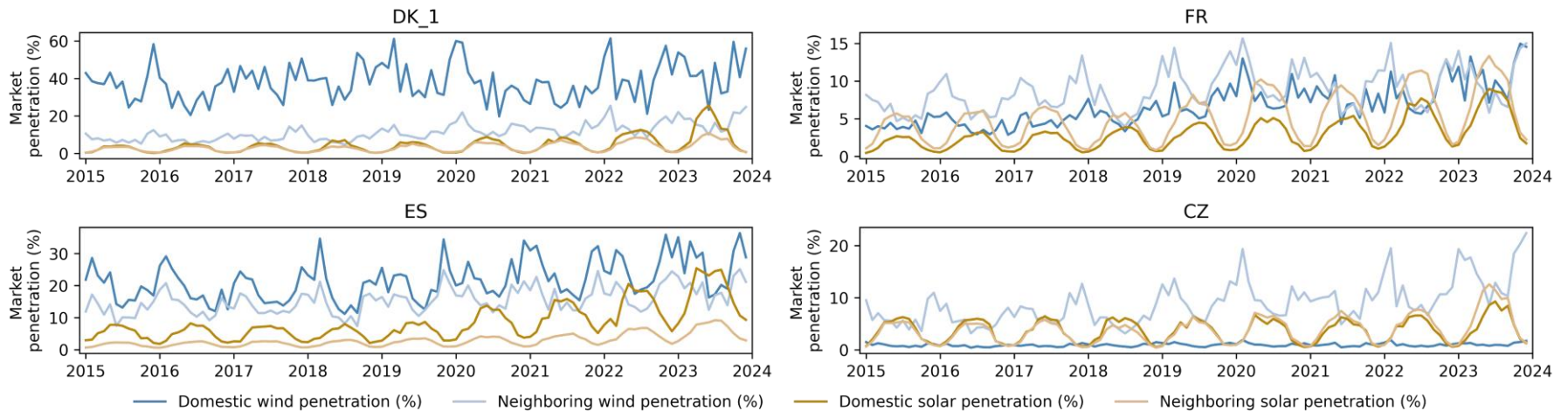
# Model variables and expected effects

	Variables	Expected effects
Dependent	Value factor of wind (solar)	
Independent	Domestic wind (solar) penetration	Negative
	Neighboring wind (solar) penetration	Negative
	Interconnector capacity	Positive / negative
	<i>Controls</i>	
	Reservoir hydro capacity	Positive
	Pumped hydro capacity	Positive
	Coefficient of variation of wind (solar) generation	Negative
	Correlation of wind (solar) generation and system load	Positive
	Clean gas-coal price ratio	Negative

# Modelling spatial effects

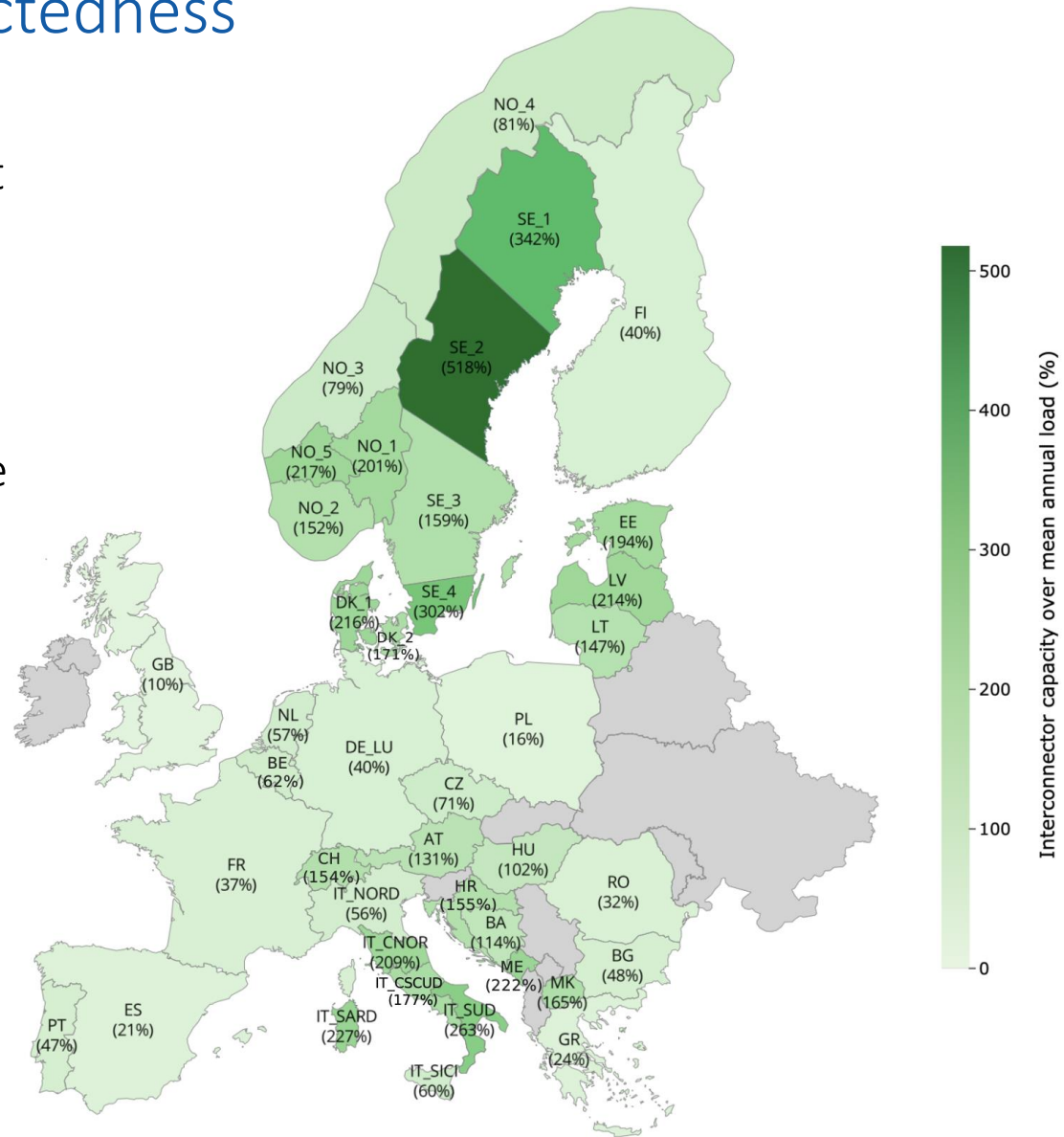
- We model the effect of wind/solar market penetration across a bidding zone's direct neighbors on domestic market value (*spatial lag of X* approach)
- Wind/solar market penetration of bidding zone  $i$ 's neighbor  $j$  is weighted by normalized interconnector capacity between  $i$  and  $j$

Domestic and neighboring wind and solar penetration



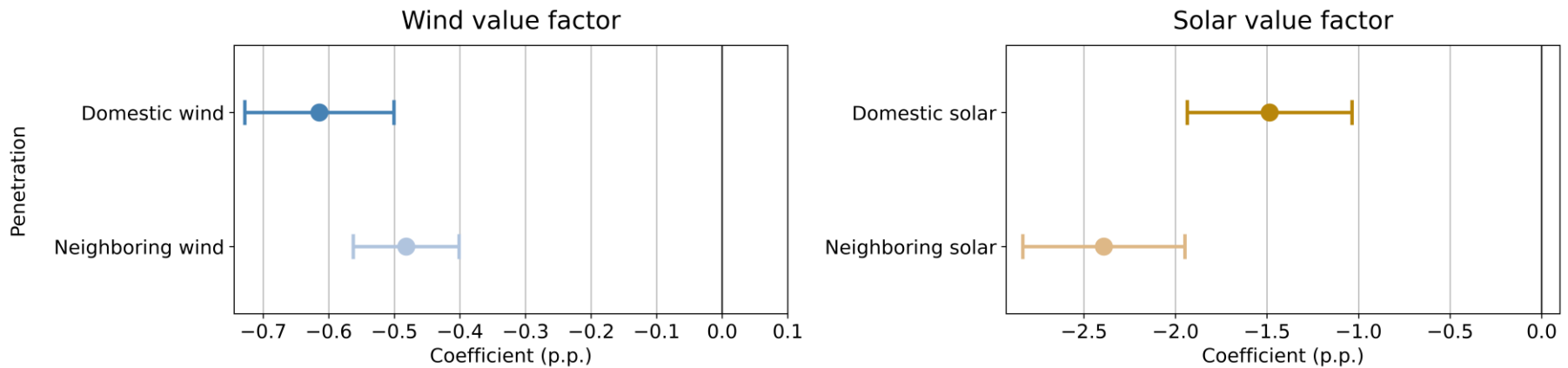
# Measuring interconnectedness

- Interconnector capacity not a fixed parameter in FBMC
- We hence approximate interconnector capacity from largest observed trade flows
- Annual 95% quantile of hourly scheduled commercial exchanges



# Results

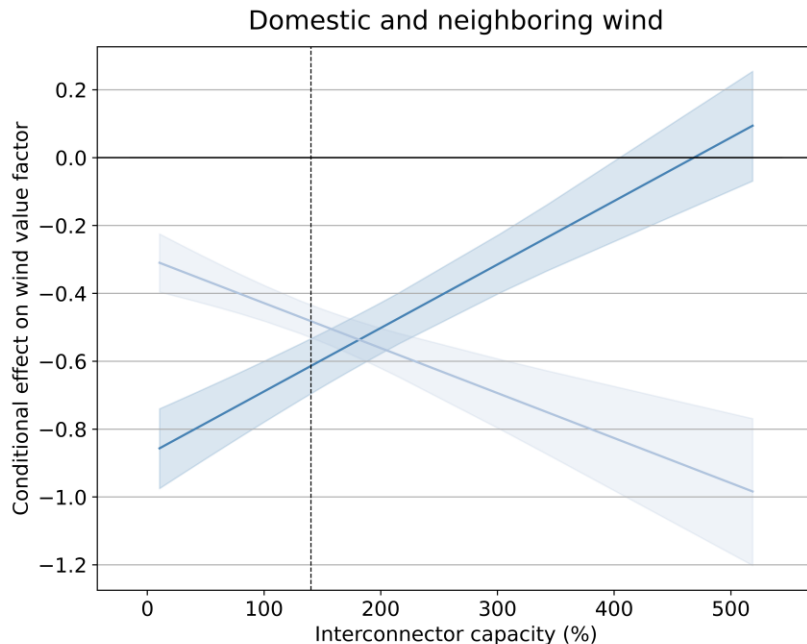
- We find substantial domestic and cross-border effects of market penetration on market value
- Domestic effect of solar is stronger (because of simultaneity)
- Cross-border effect of solar is stronger (because of geographic smoothing of wind)



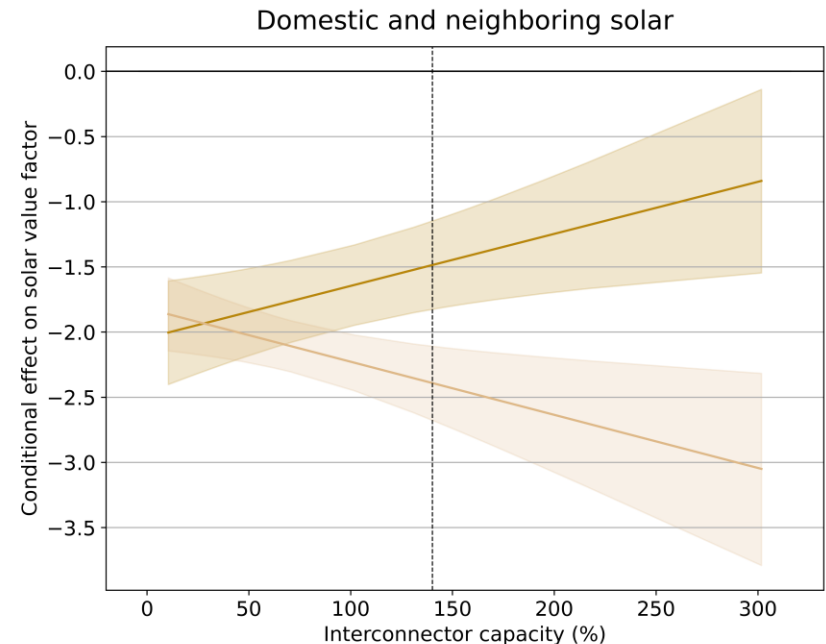
■ Marginal effect incl. 95% confidence interval

# Results

- Interconnection mitigates domestic value drop but exacerbates cross-border spillover
- Aggregate wind effect is smaller for high levels of interconnection



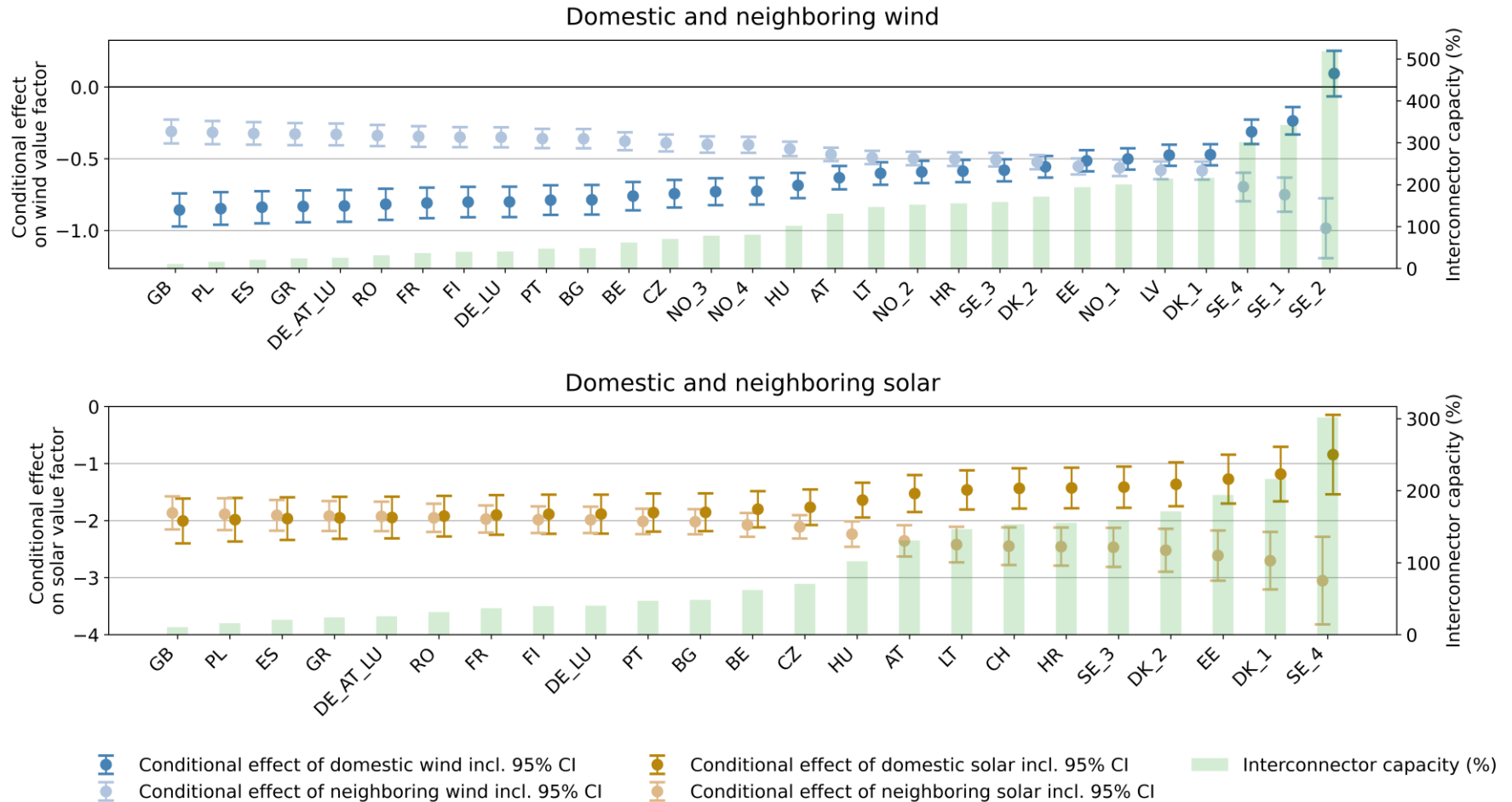
- Conditional effect of domestic wind
- 95% confidence interval
- Conditional effect of neighboring wind
- 95% confidence interval
- - - Interconnector capacity sample average



- Conditional effect of domestic solar
- 95% confidence interval
- Conditional effect of neighboring solar
- 95% confidence interval
- - - Interconnector capacity sample average

# Results

- Effect sizes vary substantially with interconnection levels





# Conclusion

- In addition to domestic cannibalization, we find substantial spatial effects that are stronger for solar
- Interconnection mitigates the domestic value drop but exacerbates spillover effects
- Wind value is stabilized by interconnection while solar value is not

# Thank you!

Working paper: <https://doi.org/10.48550/arXiv.2405.17166>

