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RENEWABLE ENERGY AND ITS IMPACT ON THERMAL GENERATION

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Overview

Electricity production from renewable sources generally displaces thermal generation, which leads to lower CO2 emissions in the power sector. However, the intermittent nature of many renewable technologies in combination with less residual demand leads to greater inefficiencies in the operation of existing fossil power plants. This inefficiency translates into higher production costs as well as a higher rate of emissions relative to output. In this paper we focus on Italian power installations. Using panel econometrics, we show that a 10% increase in photovoltaics and wind infeed has reduced yearly CO2 emissions of the average thermal installation by about 3% while the average plants emissions relative to its output have increased by about 0.3% between 2005 and 2014. Given the additional inefficiency caused renewables, our results suggest that the average installation actually only achieves around 90% of the expected reductions.

Method

We apply several specifications of panel data models to pin down the effect of additional renewables in the system on emission factors of thermal plants. We explain those emission factors by two types of variables: system-specific variables and installation-specific variables. The amount of renewable generation in the market and the residual demand left to all thermal installations in the system belong to the former category. These factors vary over time, but not over installation, while the installation variables vary over both dimensions, as, e.g., the commissioning year of the installation or its fuel cost structure.

Results

We show that electricity generation from intermittent renewables has had a measurable positive effect on the efficiency of Italian thermal installations between 2005 and 2014. While the emissions of the average installation have been reduced, the emissions relative to output have increased. Our results show that intermittent renewables lessen the emission reduction by 10% for the average installation.

Conclusions

At the current levels of PV and wind generation in the Italian power system (around 14\% of annual gross electricity production in 2014), the emission factors of base-load installations are less affected than that of peak-load installations. However, when relating the emission factors to the offset emissions both types seem to be equally affected. This may change in the future as the penetration of renewables increases, especially when PV forces base-load plants to ramp down during noon.}

References

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