System Merits and Investment Externalities in Electricity

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Abstract

The value of an investment depends on other investment decisions, generating coordination problems that markets resolve imperfectly. In electricity, the insertion of renewables and storage rapidly changes the value and the risk profile of all the assets in the system. This article develops a unified analysis of interactions between asset values, optimal investment and risk sharing arrangements for electricity. It proposes two sufficient statistics: a vector of system merits gives the marginal social value of assets, and an interaction matrix encodes complementarity and substitutability patterns between assets. System merits guide investment priorities at the margin of a given system, while the interaction matrix describe redistributive effects of sub-optimal investments, which can be large even when capacity deviates little from the optimum. With this analytical framework, we characterize optimal investment under risk-aversion and the consequences of market incompleteness. When risk is not properly shared at the investment stage, investment externalities arise and lead to significant welfare losses. Public support can mitigate this market imperfection, but it should be properly designed not to generate itself investment externalities. Optimal public support trades off the derisking objective against the preservation of investment incentives. Within the class of contracts linear in observable prices, optimal insurance share is lower for assets that generate stronger investment externalities. Technology-neutral auctions provide less derisking but better preserve investment incentives; their optimal perimeter include assets with enough degree of substitutability. Extending the analysis to electricity consumption assets, complementarities with production are large enough to generate multiple equilibria, favoring asset-specific support in joint optimization. A calibration for France using ERAA climate scenarios provides orders of magnitude for optimal mixes and contracts.

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