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Horizontal subcontracting and investment in idle dispatchable power plants

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ABSTRACT

We analyze horizontal subcontracting and show how idle production facilities can reduce contracting costs by credibly protecting against hold-up. Our analysis contributes to understanding competition between power firms that increasingly use intermittent generation sources. Their unilateral incentives to invest in maintaining underused units, such as dispatchable gas-fired plants, are underrated by plant profitability indicators. From a policy perspective, decentralized strategic investment incentives reduce the possible need for centralized security of supply measures. Our welfare analysis indicates that quantity competition can lead to a lower market-clearing price than price competition.

1. Introduction

Horizontal subcontracting refers to the practice where competing firms engage in trade with each other. This paper (i) analyzes firms' investment incentives in idle production facilities and (ii) delivers welfare results by comparing price and quantity competition.

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We phrase our analysis in a power market setting, where the integration of renewable energy sources motivates firms to sign horizontal subcontracts. A typical characteristic of important renewable energy sources, like wind or solar, is their intermittent component. Power generation from these sources only follows from favorable exogenous weather conditions like wind speed or sunlight, which are outside the control of the supplier.

At least two consequences have resulted from the introduction of intermittent power generation. First, it has *increased* the need for flexible back-up facilities to ensure security of supply. As an example, the New York Independent System Operator (2010) estimates that the addition of 1 MW of wind only removes 0.2–0.3 MW of existing dispatchable resources to still meet adequate reserve criteria. Second, intermittent energy sources typically have low to zero marginal generation costs and often enjoy priority of dispatch. As a consequence, they have *reduced* the capacity factor, the ratio of actual over potential generation, of conventional, dispatchable units. For example in Spain, where about 20% of power production comes from an intermittent source like wind, the capacity factor of Combined Cycle Gas Turbine (CCGT) plants dropped from 40% in 2004 to 11% in 2015 (Red Eléctrica de España, 2015).[1] Similarly, in Denmark, another frontrunner in intermittent power, wind farms generated 42% of total electricity consumption during 2015 at the expense of conventional power plants (Energinet, 2016).

The *direct* effect is that residual load profiles of conventional power plants have decreased considerably and therefore diminished profitability at the plant level. Low plant profitability undermines firms' incentives to maintain or install dispatchable units. Accordingly, public interventions, e.g. capacity payments, have been proposed or implemented to guarantee sufficient returns from adequate capacity needed to secure power supply. For instance, National Grid in the UK published capacity auction results of £2.2 per MW per hour, to be delivered in 2018 and beyond (National Grid, 2014). In the Northeast of the United States, the transmission organization PJM's reliability pricing model returned a price of $6.87 per MW of capacity per hour in 2018/2019 (PJM, 2015).

Our analysis uncovers an *indirect* opposite effect that favors investments. Before the introduction of large-scale intermittent power, portfolio diversification followed mainly from a non-strategic tradeoff between fixed costs and variable costs. Our paper shows that, in a world with intermittent power sources, firms have *strategic* incentives to install or maintain dispatchable units. The reasoning is as follows. Since weather conditions are location-specific, not all intermittent units are always available. For instance, one firm can be wind-abundant, while at the same time its rival is windless and needs to rely on its expensive dispatchable units. In such a framework, competing firms can gain from *horizontal* subcontracting. The (prime) *contractor*, instead of activating its expensive gas-fired plants, purchases low-cost power from the rival's intermittent units (the *subcontractor*). If a firm cannot generate power from its intermittent source, and only has access to its dispatchable units, its willingness to pay for outsourcing equals at most its

[1] The Red Eléctrica de España, 2015 data cover market outcomes until November 2015. The 2014 data show a similar capacity factor for CCGT's.