LIMITED INVESTMENTS IN RENEWABLE CAPACITY STRATEGIC SUPPLY REDUCTION, ARROW REPLACEMENT EFFECT, AND UNEXPECTED BUREAUCRATIC DELAYS

Christoph KRETSCHMER[1]

Investments in additional renewable capacity are necessary to fight the global climate crisis. Yet, energy markets are concentrated around some dominant firms with market power, the market design of electricity markets is complex, and multiple regulatory market entry barriers exist. Against this background, I analyze three microeconomic effects by which a firm´s investment decision into additional renewable capacity is influenced. First, I scrutinize the strategic reduction of investment in additional generation units. I show that firms decrease investments in capacity below the socially optimal value to increase prices in subsequent production markets. Second, I point out the importance of the Arrow replacement effect for investments. Incumbents have a decreased incentive to invest in additional capacity compared to entrants because additional capacity cannibalizes the profits of already existing generation units. Both effects reduce total investments in renewables and are economically significant if regulatory market entry barriers exist. Third, I examine the timing of investments and the effect of unanticipated delays in bureaucracy on already-existing investment plans. Put together, this paper gives an overview of some important microeconomic effects that slow down the transformation to a green energy system.

Strategic Supply Reduction in Investment

Strategic supply reduction in energy markets is a well-understood phenomenon. Companies with market power reduce their production of energy to increase market prices. In this paper, I set up a Cournot model encompassing investment and production decisions and show that firms reduce investments strategically. This result remains unchanged even if firms do not curtail their energy production strategically. Assuming market power, the last unit of capacity constructed generates a higher revenue than the total costs. So, any unit wins a positive margin.

At least three reasons render strategic reductions in investment more lucrative for firms compared to reductions in production: First, firms save not only the marginal costs of energy production but also the fixed costs of additional investments. Second, regulatory authorities find it challenging to compel a firm to invest in additional capacity, whereas monitoring and penalizing firms utilizing market power to curtail production below capacity limits is feasible. Third, high initial investments, regulatory necessities, and bureaucratic transaction costs impede market entry. Consequently, supply reductions in investment can be sustained in equilibrium.

Arrow Replacement Effect in Investment

Second, I analyze the Arrow replacement effect for investments in additional capacity. To my knowledge, I am the first to highlight the Arrow replacement effect's importance in energy investments. I assume that entrants and/or incumbents invest in a market with a pre-defined, existing capacity. The number of firms investing, as well as the share of incumbents (and entrants) differ between the scenarios. As before, I model firms` behavior in a Cournot model consisting of an investment and a production decision.

In the first scenario, two incumbents invest in additional capacity. Compared to a model without incumbency, the additional constructed capacity shrinks. Yet, the total capacity and the production of final goods increase. An interpretation of this result is: If a state subsidizes the construction of the first generation facilities of a new technology (as it was done for renewables), the total capacity in the market increases, and the market price of the final good reduces.

In the second scenario, one entrant invests in capacity instead of one of the two incumbents. Besides having no initial capacity, entrant and incumbent are symmetric. In comparison with the first scenario,

[1] Universität Bayreuth, Universitätsstraße 30, RW, 95440 Bayreuth, christoph.kretschmer@uni-bayreuth.de

total investments increase. The entrant invests in more capacity compared to the incumbent that it replaces. The impact of an additional unit of capacity is more pronounced on the profits of an incumbent: Each additional unit of capacity depresses the market price and reduces the profits of all existing capacity, including the older units. To limit the depressing influence of capacity on the market price, the incumbent invests in less additional capacity.

In a variation of the model, I incorporate learning costs for the entrants. Learning costs can be interpreted as bureaucratic costs, costs of getting to know the market design and organization in a specific industry, or any friction that influences market entries. These costs increase the costs of investing for an entrant relative to an incumbent. I show that learning costs render the market entry of entrants sometimes unprofitable. This leads to higher prices for electricity.

Unexpected Bureaucratic Delays

Third, I model the effect of unexpected bureaucratic delays: After firms decide on an investment plan in additional capacity and start to construct new capacity, bureaucracy stops further constructions suddenly due to, for example, lengthy internal processes. So, the firm completed only a fraction of the planned construction. I analyze the incentive of firms to reevaluate their investment plan and to change the targeted capacity. The results differ depending on whether firms optimize their investment activities in time. If they do so, they split up investments in multiple periods. This is reasonable whenever the price of intermediate goods depends positively on the amount of constructed capacity. Renewable energies satisfy this assumption: High-skilled labour is scarce, and necessary materials and machines are hard to acquire. I demonstrate that if firms optimize their investments in time, an unexpected bureaucratic stop postpones the construction of capacity. More importantly, this leads to lower overall capacity investments. The reason is that capacity construction in the later period becomes more expensive because the demand and the price for intermediate goods increase.

Surprisingly, if firms are myopic (they do not optimize in time), bureaucratic halts are positive for society. They force companies to reconsider their investment decision and make them optimize in time. Moreover, a second channel is active: Already constructed capacity is paid. Building additional capacity after the halt increases only the costs of still-to-be-built capacity. Therefore, in total, more capacity is constructed.

Implications for Political Decision-Makers

All three microeconomic effects highlight the significance of market frictions in shaping investment decisions in renewable capacity. Political decision-makers should target two aims: first, to minimize (bureaucratic) market-entry barriers in energy markets, and second, to foster learning and knowledge spillovers, particularly for potential entrants. This can be done by facilitating regulatory standards or by offering programs that teach baseline knowledge to entrants. Moreover, a focus on small-scale suppliers is favorable: Compared to brown energy, renewable energy production has fewer returns to scale. So, a less concentrated energy market is in the interest of welfare. Potentially, political decision-makers can motivate the market entry of new players by buying in the investment in additional resources by themselves and auctioning off its operation. Thereby, the state would take the risk of investment and bureaucratic delay. This remedy is worthwhile if the probability of investing too much is small and if potential entrants are risk-averse or specialized in operating and maintaining generation units (instead of being specialized in constructing energy units).

Altogether, this paper describes three microeconomic effects that slow down investments in renewable capacity: First, energy companies strategically reduce investments in capacity to increase prices in subsequent production markets. Second, the Arrow replacement effect for investments generates an increased incentive to invest in capacity for entrants compared to incumbents. Last, unexpected bureaucratic delays in the build-up of generation facilities reduce the total capacity constructed – if firms optimize their investment decision in time. All in all, bureaucratic procedures that increase market entry barriers exacerbate all three effects.