

Drive Down the Cost: Learning by Doing and Government Policy in the Global Electric Vehicle Battery Industry

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Abstract :

The global battery industry has achieved significant cost savings: electric vehicle (EV) battery costs have dropped by more than 90% over the past decade. This study assesses the extent to which this sharp decline in battery prices is attributable to learning-by-doing in battery production and quantifies the impact of two types of government policies (e.g., consumer subsidies and domestic content requirement) on learning, technology diffusion, and industry dynamics.

Our analysis is based on rich data consisting of model-level sales, prices, and attributes of EVs for 13 top EV countries that account for over 90% of global sales and information on battery suppliers and characteristics. We estimate a structural model of the global EV industry, accounting for consumer vehicle choices, EV makers' pricing decisions, and bilateral bargaining between EV manufacturers and battery suppliers over battery prices. We recover the model-implied battery costs and evaluate how battery costs change with the accumulated production experience of battery suppliers. The identification of learning-by-doing in battery production relies on variations in EV subsidies across vehicle models as well as variations in battery supply networks due to domestic content requirements.

Our estimates suggest a learning rate of 18% and that learning-by-doing explained a substantial portion of the observed battery cost reductions. Learning-by-doing greatly magnified the impact of EV consumer subsidies on adoption and created sizeable complementarity between subsidies adopted by different countries. These results suggest that the existing estimates from the literature drastically underestimated the full impact of consumer subsidies. We then conduct simulations to examine the impacts of domestic content requirement, a strategy adopted by China and, more recently, the US, on market share dynamics and global EV adoption. Our results suggest that China's whitelist policy nearly doubled the market share of Chinese battery suppliers, mainly at the expense of South Korean suppliers.