



Pass-through, profits and the political economy of regulation

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We present a new approach to estimating the impact of regulation on firms' profits. It is based on a new reduced-form model of imperfect competition that unifies existing models using weaker assumptions. We apply the theory to understand the political economy of carbon pricing on US airlines, and quantify its winners and losers.

Government regulation often raises the production cost of regulated firms. In some cases, this is an explicit objective of regulation, for example, when it puts a price on an externality such as carbon emissions or uses an import tariffs to protect domestic producers. In addition to their effects on social welfare, such regulations have an important impact on the profits of the firms being regulated.

This profit impact is critical to understanding the political economy of regulation. On the extensive margin, regulation that substantially lowers an industry's profitability is often unlikely to be introduced. On the intensive margin, firms may lobby the government to influence the equilibrium level of the regulation enacted. The profit impact is also important, for obvious reasons, to the shareholders of any regulated firm. For instance, major central banks are now warning institutional investors about the risks to asset values arising from climate-change policy.

Estimating this firm-level profit impact is, however, not straightforward. Regulation raises the cost of a regulated firm and may also affect, to different degrees, the costs of some or all of its competitors. In general, its profit impact will depend on the firm's own production technology, the structure of demand, and its rivals' responses. The last factor is particularly problematic because modelling it may require information on the identities of all firms, each of their production technologies, the nature of product differentiation, what variables the firms compete on, how competitive or collusive the market is, and so forth. Our aim here is to present an approach that radically simplifies this problem.

The first half of this paper introduces our "generalized linear model" of competition (GLM) which makes much weaker assumptions than typical models. The core assumption is that firm i follows a linear product-market strategy; in standard

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models, this corresponds to a linear supply schedule as implied by its first-order condition. There are no assumptions on the consumer demand system or on the technologies and strategies of firm i 's rivals, and no particular notion of “equilibrium”. Versions of many familiar oligopoly models (e.g., Cournot, Bertrand, Stackelberg, Supply Function Equilibrium) are nested as special cases. We hope that the GLM will also prove useful in other contexts in industrial organization, public economics, international trade, and networks.

We use the GLM to characterize the impact of regulation that raises firm i 's unit cost and affects those of its rivals in an arbitrary way. We show how firm-specific cost pass-through, i.e., the fraction of i 's cost increase that is passed onto i 's price, is a “sufficient statistic” for the profit impact of regulation. That is, *all* relevant information on i 's demand and supply conditions is contained in this single metric. We show that higher pass-through implies a more favourable profit impact; a firm's profit falls with tighter regulation if and only if its pass-through is below 100%.

The second half of the paper illustrates the utility of the theory. We estimate the profit impacts of (future) carbon pricing on the US aviation market. This setting is important in its own right: emissions from airline travel are projected grow well into the 21st century and economic regulation is likely as countries seek to implement internationally-agreed climate targets in a cost-effective manner. At our baseline carbon price of \$50 per ton of carbon dioxide, the annual “value” of US domestic airline emissions exceeds \$8 billion.

Leveraging the GLM, we estimate profit impacts while remaining agnostic about the precise mode of competition across routes. We have quarterly ticket price data for over 600 domestic US routes over the period 2002-15 (yielding over 30,000 observations). We have detailed information on fuel costs at the carrier-route level; we use variation in fuel prices to estimate fuel pass-through, from which we predict carbon cost pass-through. We estimate pass-through rates for each carrier-route, allowing for heterogeneity both between carriers and within the product portfolio of each carrier. We then aggregate up to determine the overall profit impact of regulation for each airline.

Our results show large firm-level heterogeneity in pass-through rates. The large legacy carriers (Alaskan, American, Delta, Hawaiian, United and US Airways) have low pass-through of 55%, on average, across their routes. By contrast, the major low-cost carrier Southwest has a pass-through rate of 148%. Extrapolated to all US domestic routes, at a carbon price of \$50/tCO₂, we predict a profit gain for Southwest of \$0.5 billion and a combined profit loss of \$1.5 billion for legacy carriers. Southwest's gain is driven by higher profit margins plus market-share gains at the expense of less efficient rivals.

We close with a new application to the political economy of regulation; we estimate the political equilibrium (2nd best) carbon tax, which takes into account both imperfect competition and firms lobbying government for their preferred regulation, at \$19/tCO₂ for US airlines (around 60% below the social cost of carbon, SCC).