Electricity Demand in Wholesale Italian Market

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Estimation of demand price elasticity has been, ever since the foundation of modern economic theory, one of the most popular empirical exercises in applied economics, typically using market prices and quantities for empirical estimation. This means that we observe one realization of the demand curve in every period or state of the world. Thus, the identification of a (stable) demand function through time or across different states of the world can be obtained using appropriate covariates in econometric estimation procedure. The joint variation of other determinants provides the basis to disentangle price effect from other economic effects.

Most popular empirical analyses of electricity markets have assumed an oligopolistic market structure and have used supply quantity and price bids to estimate residual demand elasticity for each market participant.

In this paper, we present a novel approach for estimation of demand price elasticity. We use a large data set of consumer price and quantity hourly bids for electricity in the day-ahead market in the Italian Power Exchange (IPEX) for the period 2010-2011 (there are approximately 40,000 observations per month). In the day-ahead market, every consumer bids price and quantity pairs for 24 hours. We postulate that every consumer expresses a well-defined willingness to pay for each quantity, according to a well-structured behavioral strategy. So in every hour we have not just one

point but an entire vector of the demand curve (a consumer is willing to purchase additional quantities at incrementally lower prices). Surprisingly, these data have never been used before to estimate demand elasticity.

Our research pursues two objectives: (i) is it possible to infer directly from consumer behavior a measure demand elasticity at hourly level? (ii) does electricity demand elasticity depend on structural conditions in the Italian Power Exchange market (IPEX)? In the estimation we take care of the existence of two types of consumers: (i) those who express a quantity bid without corresponding indication of a price, (perfect inelastic behavior), as they are in principle willing to pay any price that would result from market clearing procedure; (ii) those who express a simultaneous quantity and price bid (somehow elastic consumers). We also take care of the problem that agents who submit demand bids are not necessarily final users of electricity, assuming that there exists a principal-agent relationship in the market where electricity consumer is the principal and trader is the agent, who does not behave opportunistically.

Overall, our empirical analysis shows that elasticity of demand can be estimated on average around -0.03 to -0.10 and that it varies according to several market structures: time of the day; day of the week; season of the year; pattern of line congestion; as well as according to the level of equilibrium price. In general, elasticity tends to be higher for goods with close substitutes and that take up a significant proportion of total expenditure.

Our estimation shows that there is more elastic behavior during peak hours, week days, winter periods, in the North when there is relatively more availability of competing substitutes with electricity, i.e. when Italian consumers use electricity for marginal daily operations (peak hours), flexible industrial uses (weekdays), marginal heating (winter). Demand is also more elastic when expenditure is relatively more significant, i.e. when prices are higher.

This is important for competition fostering policies, because more supply competition resulting in a flatter offer curve can yield lower equilibrium prices and proportionately higher quantities, because the offer curve would intersect a flatter, more elastic, portion of the demand curve.