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A simple example for the teaching of demand theory: Aggregate demand estimation for onions in India

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Abstract Managerial economics textbooks rarely include empirical examples of demand estimation of any commodity from real data, perhaps because in reality one must consider coupled demand systems. We suggest that on a national level and over a short time, the price–volume data for onions provide a bona fide example of a single-commodity demand curve. Since the onion has no real substitutes and taste for onions does not fluctuate, the demand curve does not shift over time. Empirical analysis of aggregated national level data yields a demand curve with two regimes: constant consumption at low prices, and constant budget at high prices.

Introduction

The theory of demand and supply is a cornerstone of microeconomics. The idea that the price of a commodity lies at the intersection of its supply and demand curves is central to the teaching of managerial economics (Salvatore & Srivastava, 2008). As per theory, production decisions of a firm are based on the customers' demand curve, which is again dependent on the market structure and the price elasticity of demand for a particular product. But how can we empirically estimate the demand for a certain commodity?

The literature on demand estimation deals with systems of equations that try to include all the variables that might affect the demand for a commodity (Deaton & Muellbauer, 1980). At high levels of aggregation one estimates demand for food vs non-food commodities. When dealing with demand for food items, one accounts for different food categories such as cereals, meat and fish, eggs, dairy, vegetables, fruits and nuts, etc. (Green & Alston, 1990). Such regression models however are too complicated to be introduced to students encountering both economics and statistics for the first time. For example, Chen (1977) has dealt with 23 simultaneous equations in a complicated statistical model. Understanding the implications of such models or replicating their estimation procedure is beyond the scope of the typical introductory managerial economics course.

With this motivation, a teacher of managerial economics might ask, "Is there a straightforward case of demand

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estimation from real data, of a single commodity, that one can use as a classroom example?" In this paper we set out to estimate the aggregate national demand curve for onions. Our interest in onions was spurred by two factors: one was the tremendous rise in onion prices observed from time to time; the second was the fact that onions are a commodity for which there are no close substitutes and therefore they can possibly be studied as a single commodity demand system. The typical features of the onion market have been described in greater detail in a later section.

Demand estimation—theory

Identification problem

In empirically estimating the demand curve for any good, one encounters the well known "identification problem" (Salvatore & Srivastava, 2008), which is briefly described here for completeness. Historical data points on prices and quantities for any commodity represent, in principle, different equilibria where *different pairs* of demand and supply curves intersect, as illustrated in Fig. 1(a).

Observed price quantity combinations (P_1, Q_1), (P_2, Q_2), and (P_3, Q_3) could be the result of the intersection of different demand curves D_1, D_2, and D_3 and different supply curves S_1, S_2, and S_3. Hence the fitted line AB that passes through the observed points E_1, E_2, and E_3 would not represent accurately either a unique underlying demand curve or supply curve (Fig. 1(a)).

In estimation of a demand curve, various exogenous variables that might affect demand need to be included, namely (a) income, (b) prices of substitutes or complements, (c) changes in tastes or preferences, and (d) changes in technology. Each of these variables would cause the demand curve to shift up or down (rather than cause movement along the demand curve). Subsequently, the estimated coefficient for price in the regression model (with all these variables included) gives an indication of the own price elasticity of demand.

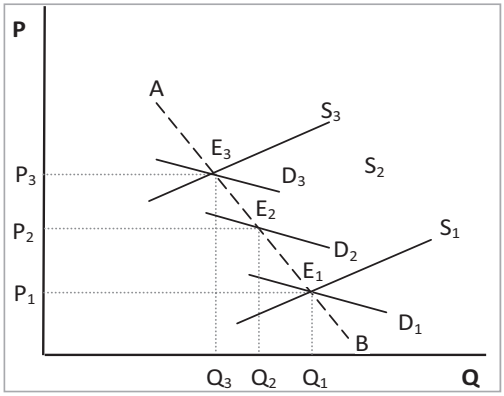
If it can be assumed that there have been no shifts in the demand curve in the period of observation, then the observed price–volume points must lie on *the same* demand curve (see points E_2', E_2 and E_2'' in Fig. 1(b)).

Onions

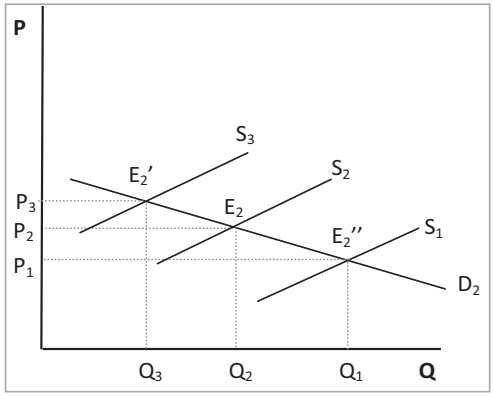
Seeking a simple example for empirical demand estimation, here we consider the demand for onions. Why onions? Onions have received attention from both the popular press as well as academia, mostly because onions prices have risen steeply compared to other food commodities. Prices of onions are believed to have toppled governments (Economist, 2013). Moreover, the four exogenous factors (a) through (d), discussed above, that affect demand of other commodities may not affect onion demand significantly as explained below.

(a) Income: Over a brief interval, the aggregate national income changes little, and onions constitute a relatively small portion of family expenditures in any case; hence changes in income have little effect on demand of onions.
(b) Prices of substitutes: Onions have no real substitutes in Indian cooking (contrast with cereals as a group; pulses; green vegetables; meat, fish and poultry).
(c) Taste: Onions are a popular ingredient in Indian cooking, and the Indian consumer's taste for onions varies little over time.
(d) Technology: Technology does not play an important role (for instance, dried onion powder is not a common substitute for fresh onions in Indian recipes).

All of these factors could in principle lead to a shift in the demand curve (as opposed to movement along the demand curve). Since none of these factors contributes significantly to the demand for onions, it can be assumed that the consumers' aggregate demand curve does not shift up or down (at least in the short run). Hence it would seem to follow that



Both demand and supply curves have shifted over time. Dotted line AB joining the observed price-volume points represents neither the true supply nor the true demand curve.



Only supply curves have shifted over time, and observed price-volume points lie on the true underlying demand curve.

Figure 1 The identification problem. (a): Both demand and supply curves have shifted over time. Dotted line AB joining the observed price–volume points represents neither the true supply nor the true demand curve. (b): Only supply curves have shifted over time, and observed price–volume points lie on the true underlying demand curve.