Agenda

Advancing economics in business

Helping to analyse consumer decisions: Deaton's AIDS model in market analysis

On 12 October 2015, Angus Deaton was awarded the Nobel Prize in Economic Sciences 'for his analysis of consumption, poverty and welfare'. Deaton's unique contribution lies in his argument that welfare-promoting, poverty-reducing economic policy must begin with individual consumption choices. His Almost Ideal Demand System (AIDS) model, which monitors aggregated consumer behaviour to assess market demand, has influenced both academia and policymakers

Princeton University economist, Angus Deaton, has studied how consumers allocate their spending among goods, and devised a model to estimate the aggregate demand for these goods. This model—and those that have built on it—has been widely adopted, including in many recent competition policy cases.

Deaton's research disclosed the link between income and consumption over time.[1] His focus was on individual spending patterns, which develop over a person's lifetime. His work contributed to the shift in focus towards individual choices in the analysis of aggregate phenomena, an approach now widely adopted in contemporary macroeconomics.

In the last 15 years, Deaton's research has addressed the measurement of welfare and poverty in developing countries. He has highlighted how an understanding of individual consumption in developing countries can reveal the mechanisms influencing economic development. His research has relied on household surveys—a factor that has contributed to the increased use of empirical studies in development economics.[2]

This article focuses on Deaton's research into consumer choices between different goods, and the implications of this work for economic policy, particularly in competition policy.

Estimating consumer demand

Economists are often faced with the challenge of understanding how consumer demand for a product changes, given a change in its price (the 'price elasticity' of a good). This task is straightforward where a single product is concerned and the only choice is about how much of it to buy, given a particular price.

For example, consider the price elasticity of Pepsi in a hypothetical world where it is the only soft drink available. In this scenario, it is relatively straightforward to assess the relationship between the price of Pepsi and the quantity demanded—and the results can be used to estimate the drink's price elasticity.

The real world is of course more complex, and Pepsi is not the only soft drink available. If its price were to increase, some consumers might choose to buy alternative products, such as Coca-Cola, Sprite or Orangina. An economist estimating consumer demand will therefore need to account for the fact that individuals choose among different products. Models of differentiated goods will then consider consumer spending among all of these products, according to consumer preferences and relative prices.

Deaton made important contributions to the understanding of consumer demand for differentiated products, and developed the AIDS model in 1980,[3] which became popular among academics and competition policy practitioners. It allows for the use of market-level data, such as supermarket scanner data, to monitor the behaviour of a typical consumer; the consumers' choices can then be aggregated to identify the market demand for a particular product. As it is a good approximation of any demand model, the AIDS model can be used in a variety of settings. It also satisfies the so-called 'axioms of choice' in standard consumer theory, which allows demand for Pepsi and demand for Coca-Cola to be compared. It recognises that consumer preferences are transitive—for example, if Pepsi is preferred to Coca-Cola and Coca-Cola is preferred to Sprite then Pepsi will be preferred to Sprite. The AIDS model also predicts that consumers will always prefer a bundle with more products, all else being equal (i.e. that more is good).

One of the main drawbacks with the AIDS model is that it is very information-hungry, due to the quantity of data required and the large number of parameters to be estimated. Take the case of a consumer who wants to buy a soft drink in a market where N different soft drinks are available. Applying the AIDS model requires nearly N^2 parameters to be estimated: N equations need to be estimated, each containing N price parameters (one for each soft drink).[4] This might not be feasible in markets where consumers are faced with a large number of options and where limited data is available.

Subsequent applications and extensions of the AIDS model focused on solving this problem. For example, Hausman, Leonard and Zona (1994) split the consumption decisions into three separate steps, thereby reducing the number of parameters to be estimated.[5] Their paper looks at the estimation of the demand for beer. In the first step, their model estimates the overall demand for beer; in the second step, it allocates beer expenditure between three broad categories (premium beer, popular beer and light beer); and in the final step it adopts the AIDS model to allocate expenditure among brands in a certain segment of beer. Hausman et al. then use these results to show how this method can be applied in competition analysis to determine the effect of a merger in the market for beer. This model is illustrated in Figure 1 below.

Deaton and merger control

The model devised by Deaton (and its applications and revisions) soon found practical uses, with competition authorities adopting it to analyse the extent of competition between merging parties.

A notable European example is the 2008 decision on the Friesland Foods/Campina merger case.[6] The case involved the two leading Dutch dairy producers and covered the entire production chain of dairy products, including raw milk, consumer products (milk, cheese, butter and cream), and intermediate products. The European Commission used both scanner data and company data on volumes and prices in the fresh dairy segment to assess the closeness of competition between the parties and to define the relevant market.

To do this, the Commission adopted the Hausman et al. multi-levels approach and specified AIDS models at both the top and bottom levels. The top-level model for basic fresh dairy products included the aggregate segments of milk, yoghurt, buttermilk and vla.[7] At the bottom level, the Commission specified one model for each of the basic fresh dairy products, including brands from the merging parties as well as private-label brands.

The Friesland/Campina merger was cleared subject to extensive remedies. These included a series of divestments and the establishment of a 'Milk Fund', providing the buyers of the divested businesses with drawing rights on raw milk as well as a set of incentives for farmers to leave the merged entity in favour of other buyers.

UK regulators have also recently adopted the AIDS model for demand estimation in merger cases. In the Barr/Britvic merger (2013), the UK Competition Commission (CC, now part of the Competition and Markets Authority) adopted the model as one of the main techniques to assess the extent of competition between the parties.[8] Both parties were manufacturers and suppliers of carbonated and still soft drinks (Britvic brands included Pepsi, 7UP and Gatorade, while Barr brands included IRN-BRU and Orangina).

The CC used the results from the AIDS model to calculate diversion ratios between the parties (i.e. the proportion of customers of company A that would switch to company B if A were unavailable). The model suggested that there was no incentive to increase price for any of the brands considered—a finding that was instrumental in the CC's decision to clear the merger unconditionally.

Figure 1   Estimating the demand for beer
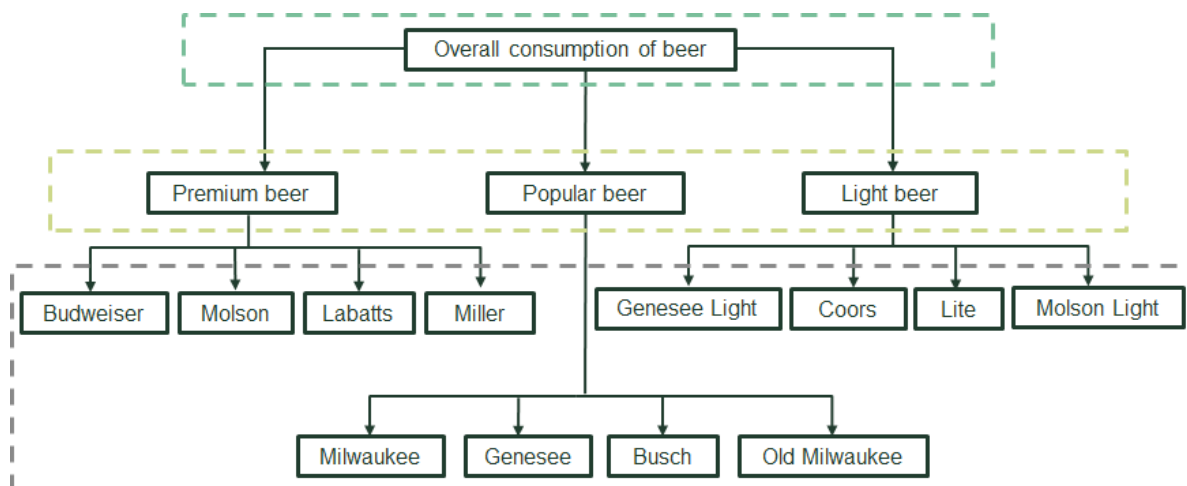
Source: Oxera representation of Hausman et al. (1994).

In a case between Diageo and United Spirits Limited (2014), the UK Office of Fair Trading (OFT, now part of the Competition and Markets Authority) conducted similar empirical analysis to estimate the relationship between the prices and sales of the parties' brands and those of their main competitors in blended Scotch whisky.[9] As in the Barr/Britvic example, the OFT used the results of the AIDS model to calculate diversion ratios. In this case, however, the results indicated close competition between the merging parties, which required the divestment of the entirety of the overlapping brand in order to remedy the substantial lessening of competition identified.

However, care is required in applying these types of model since their results are not always considered sufficiently reliable to inform competition policy decisions. In the acquisition of Dorset Cereals Limited by Associated British Foods plc (2014), the parties presented an AIDS model as supporting evidence of the competitive constraint that would remain after the merger (due to the existence of other parties, particularly private labels).[10] In this case, the Competition and Markets Authority pointed out a number of methodological concerns with the analysis, and chose not to put any weight on the analysis in its final decision to clear the merger.

Concluding thoughts

Deaton's work on consumer decisions led to the development of the AIDS approach, which has been applied to a significant extent in merger assessment. The possibilities offered by powerful computing, and increasingly granular consumer data, make it highly likely that the model will be extended to other applications in future. Further refinements to the AIDS approach are also a possibility, in both academia and applied competition policy.

---

[1] See, for example, Deaton, A. and Paxson, C. (1994), 'Intertemporal Choice and Inequality', *Journal of Political Economy,* **102**:3, pp. 437–67.

[2] See, for example, Deaton, A. (1997), 'The analysis of household surveys: a microeconometric approach to development policy', The World Bank.

[3] Deaton, A. and Muellbauer, J. (1980), 'An almost ideal demand system', *American Economic Review*, **70**:3, pp. 312–26.

[4] An unrestricted AIDS model would estimate (N - 1)*(N + 2) parameters. However, due to the model's mathematical properties, only (N - 1) equations need to be estimated, each of them estimating N parameters for the prices and two additional parameters: a product-specific parameter and a price index.

[5] Hausman, J.A., Leonard G. and Zona, J. (1994), 'Competitive analysis with differentiated products', *Annales d'Economie et de Statistique*, pp. 159–80.

[6] European Commission (2008), 'Commission Decision of 17.12.2008 declaring a concentration to be compatible with the common market and the EEA Agreement (Case No COMP/M.5046 – Friesland Foods/ Campina)', 17 December, http://ec.europa.eu/competition/mergers/cases/decisions/ m5046_20081217_20600_en.pdf.

[7] Vla is a dairy product made from fresh milk and sold in the Dutch market.

[8] Competition Commission (2013), 'AG BARR p.l.c./Britvic plc: a report on the anticipated acquisition by AG BARR p.l.c. of Britvic plc by means of an all-share merger', 9 July, http://webarchive.nationalarchives.gov.uk/20140402141250/http://www.competition-commission.org.uk/assets/ competitioncommission/docs/2013/ag-barr-britvic/130709_final_report.pdf.

[9] Office of Fair Trading (2013), 'Completed acquisition by Diageo plc of United Spirits Limited', ME/6130/13, 25 November, http://webarchive. nationalarchives.gov.uk/20140402142426/http://www.oft.gov.uk/shared_oft/mergers_ea02/2013/Diageo.pdf.

[10] Competition and Markets Authority (2014), 'Anticipated acquisition by Associated British Foods plc of Dorset Cereals Limited', ME/6452/14, 6 October, https://assets.digital.cabinet-office.gov.uk/media/544fa9e3e5274a139000000a/ABF_decision_final.pdf.