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Comments on "The Relationship between Diffusion Rates, Experience Curves, and Demand Elasticities for Consumer Durable Technological Innovations"

The purpose of this paper is to present and estimate a model of the time profile of demand for consumer durables over the early years of the introduction of the product when all demand can be assumed to be first-time purchases. The data for a number of durables suggest that the shape of this profile should be as in figure 1. Let me briefly illustrate the model which Bass (this issue) presents (see fig. 2).

In quadrant 1 we draw a constant elasticity demand function which shifts out over time according to a "contagion" process, which, as specified by Bass, moves the whole demand function out and then in again.

In quadrant 2 we show price declining with time because of economies of scale, learning by doing, or whatever. Quadrant 3 is a 45° line, and combining quadrants 1 and 2 through quadrant 3 gives sales against time in quadrant 4. Drawing this quadrant with sales on the vertical axis shows that the model generates the general shape of the sales curve as required.

This picture does not do full justice to the complexity of Bass's model since at each time he sets price so that marginal revenue from the appropriate demand curve equals marginal cost, but this picture captures the essence. In particular, this picture makes clear that there are two separate areas of discussion which the paper raises. One is the behavior of prices in quadrant 2, the other is the wandering demand function in quadrant 1.

It seems to me that the overlap between marketing and economics is very much greater in quadrant 1 than in quadrant 2, so given the limited time at my disposal and given the purpose of this conference, I intend to confine my remarks to a discussion of the demand process and will simply take it as given that, for whatever reason, over the period of discussion price falls in real terms.

I suppose the first thing an economist must say about Bass's model

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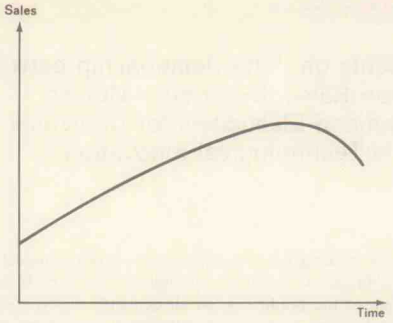

FIG. 1

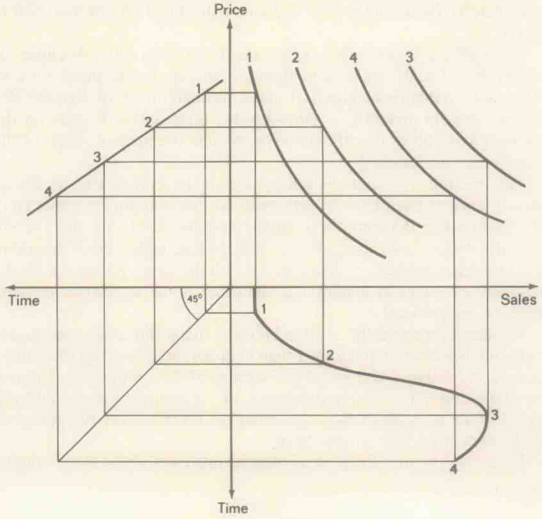

FIG. 2

of demand is that the vocabulary is quite new. "Innovators" and "imitators" who feature prominently in Bass's model have as yet no place in the standard economic lexicon, where all agents are rational men who maximize utility while facing budget constraints.

This is not to say that room could not be found in utility theory for these men. Before rushing out to build a theory of innovators, however, I think we ought to ask if more traditional economics could not also explain the sales curve. If it cannot, we are all in Bass's debt; but if it can, economists, having breathed a sigh of relief, may await more sophisticated tests to distinguish Bass's model from a more traditional model.

I am going to argue that traditional economics can explain the sales curve in a most natural way, but before I do that I want to point to a difficulty which I have with the Bass model.

The problem is that it is not really a model of the individual, and because of that a significant part of the model is without support. I refer to the assumption of a downward-sloping demand curve. Now as price falls, demand grows, even without contagion, but by assumption everyone buys one item. Thus more people are buying later, but no explanation is offered as to why. There is thus no basis in individual behavior for the way in which Bass tries to combine the contagion model with a downward-sloping demand curve. I would much prefer a story which is firmly based on the individual, and because the individual only buys one item, his demand curve is irrelevant. What is relevant is what economists call his "reservation" price or what may better be called the "threshhold" price, that is to say, the price which just triggers a purchase.

Let me assume that individuals belong to groups which are (within a group) identical with regard to threshhold price. As the price comes down we first sell to G1 then to G2 then to G3, and so forth, as in figure 3. The groups are different because the members differ in respect to one or more parameters.

Suppose price falls linearly. The slope of the sales curve now depends on the density of the population in the various groups, which in turn depends on the density of the distribution of the parameter or parameters by which the individual groups G_i differ.

Now in order to generate a sales curve like that in figure 1, we must have a density like that in figure 4. Is there any obvious economic attribute which is distributed across the population from low to high like figure 4 (which is to say, approximately lognormally)?

There is, of course, and that parameter is income (see Aitchison and Brown 1969). Thus, if we make the entirely reasonable straightforward assumption that as the price falls linearly from high to low we sell first to high-income buyers then to low-income buyers, we generate a curve which is a turned-round lognormal curve, truncated at the lowest-

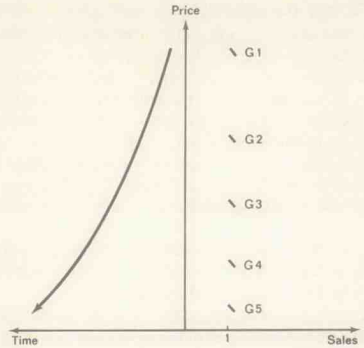

FIG. 3

income group willing to purchase the product at the lowest price. If we experiment with different rates of price fall, we can generate different curves.

Thus it seems to me that traditional economics of a very simple variety can take this problem in its stride. On the other hand, there is the danger that this simple story explains too much. Obviously not all high-income purchasers purchase at exactly the same time, and it may be that within an income group the process of contagion discussed by Bass is at work.

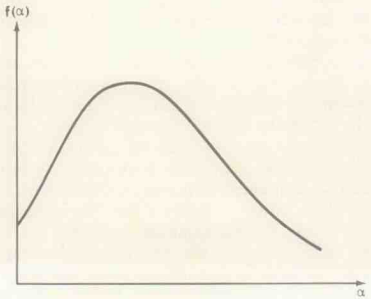

FIG. 4

What we would like to look at ideally is sales data disaggregated by income class. Such data are available in the United Kingdom for black-and-white television sales in Bain (1964). Figure 4B.1 (panel L5) of appendix 4A at page 38 of his book strongly suggests that the income distribution has a strong influence. Moreover, ownership data in Wells (1977) show a similar strong income effect.

I would go so far as to say that if we divide the population into broad income classes, the process of sales over time within an income class may be of secondary importance vis-à-vis the variance of sales across income groups, but this must await more detailed testing.

Conclusion

It seems to me, therefore, that even if Bass's model is correct within income classes, he simply has got to tell us a story somewhere about income.

Let me suggest some tests which would help us to distinguish if the income distribution does have a role in the process. (*a*) The income model predicts that the sales curve will be flatter in countries (for example, Sweden, Norway) in which income is more evenly distributed. Bass's model has no prediction on this. (*b*) The income model predicts that the proportion of sales to the median-income class should fall after the sales peak. Bass's model has no prediction on this.

Obviously the proof of the pudding is in the eating. Bass's model works well enough. Will an income model work better? I would argue that this is a question worth tackling. In particular, since the purpose of this whole exercise is presumably to forecast the sales peak, the income model, if correct, would give firms a very simple message. When a high proportion of sales start going to the median income group, slow down production.

References

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