

so long as it's black." Could we say, you can have one of these small cars in any color you want so long as it's reflective and fluorescent?

I realize these ideas are unorthodox, and any kind of regulation is in ill repute today. Yet there is an urgent need to think some new and different thoughts and develop strategies that are relatively inexpensive. The forum we're conducting today is bringing together some of the top experts in this field. While we will not cover all the issues, we will make a healthy start on what is an important emerging issue in highway transportation. The Transportation Research Board has the potential to bring to bear the range of expertise needed to address this issue. We hope to identify some of the problems and the corresponding research needs, so that perhaps we can be better prepared to cope with the coming changes.

ECONOMIC CONSIDERATIONS

Dr. Charles Lave, Professor of Economics
University of California

PAT WALLER: Our speaker is Dr. Charles Lave, who is Chairman of the Economics Department at the University of California in Irvine. He's currently on sabbatical at MIT with the Future of the Automobile Research Program. I first came across his work when he edited an issue of "Transportation Research". He's done a great deal of work in the state of the art on models of demand for automobiles. As I recall, I believe that issue was entitled, "Economic Implications of Automobile Choice", and that immediately caught my eye. I thought, "Oh, here's somebody who is really doing something interesting," and it was just this morning that I had the opportunity to meet him in person. I am delighted to have the chance now to hear what he has to say on the question of economic considerations.

DR. CHARLES LAVE: Rather than an abstract discussion of economic considerations, I will focus on a specific mini-car that was recently introduced in Japan. It's not available here yet; and, as you will see, that's fortunate for us. The car is the Honda "City Car," and I want to organize my talk around the theme: if that car were here, what kind of market share would it get? In essence, what I'm doing is market analysis. I think market analysis is probably a good thing to do at this time of the morning. It's certainly more fun than economics or engineering. God knows, it pays better.

Anyway, let's talk about the Honda City Car. The following quotes are from "Automotive News," which is published in Detroit, and is at least somewhat biased toward American cars. Thus the positive comments of their writer are quite significant. The review of the Honda City Car, on December 7, said: "It's styled with plenty of character, has lots of room inside, really lively performance, and it cruises quietly at 70 miles per hour." So we're not going to need bicycle lanes for this car. "It has very good handling, holds four people with reasonable comfort, has sporty looks, and goes 0 to 60 mph in 12 seconds," which is very fast by the standards of U.S. cars. On the Japanese city cycle it gets 45 miles per gallon, and on the highway at 37 miles per hour, it gets 68 miles per gallon. Clearly, this particular mini-car is not going to require much sacrifice of looks, performance, or comfort. And now for the really bad news -- and I've checked this with two

different sources--it seems that the car could be sold in the United States for a mere \$3,500.

Now remember, this is not a dream car. It's a production vehicle, and it's selling extremely well in Japan. Suppose it were available here at something like that price. What market share might it achieve? In particular, since the U.S. cannot produce a similar car at that price, I want to see how much of the auto market would remain for American manufacturers. What would we have left? In the context of talking about sharing, it's worthwhile to remember a remark that Will Rogers once made about marital relations and reciprocal behavior. "Never forget that one good turn, gets all the blanket."

Is Honda going to get all the blanket with this particular car? Let's try a number of alternative forecasting approaches to see what happens. The first task is to set some kind of upper boundary on market share. One characteristic of this car, after all, is its small size. Can we say anything about the possible upper boundary on the market share of small cars? We know, looking at sensitivity to size, that consumers like to have at least one automobile capable of carrying the entire family together. Regardless of the number of special purpose vehicles they may have--a pickup to go hunting and shoot at each other, a tiny little car to transport themselves to work, and so on--they like to have one car which is suitable for the whole family. What does this imply in terms of the market share available to small cars? A few years ago Phil Patterson, sitting in the audience, coughed up a few thousand dollars to support two Irvine anthropologists, Gladwin and Murtaugh, in a study of auto purchase behavior. So instead of doing field work in South America or Africa, they chose to study the fierce tribe of Southern California auto buyers.

These anthropologists began with detailed interviews, and tried to figure out how it was that people chose automobiles: how did they decide what size car to buy? The end result was a series of decision-tree models. They're nice; anyone can look at the models and follow what's going on; you don't have to be a statistician. They show the process by which people progressively narrow down to pick a given car size. Then, last year, the model was applied to known U.S. demographics to produce market share projections, for 1990, of the share of large family cars. What they found is that, essentially irrespective of fuel prices and all kinds of other factors, 30 percent of the market is going to be these large cars in 1990. Well, in one respect that's good news for American manufacturers. It means they can sell to at least 30 percent of the market. But, on the other hand, that other 70 percent is all a potential Japanese share (which is a pretty big piece of the "blanket").

Somebody in the audience mentioned the importance of demographic trends, so let's also look at market shares from a demographic point of view. A few years back, Joan Bradley and I did a model of imported car shares: a simple multiple regression model, not terribly difficult to make sense of. We used both state-average data and household data, and modeled the demographic factors which influence people's willingness to buy imported cars and small cars. Three demographic factors emerged as overwhelmingly important in that decision. The first was family education levels. The second was whether or not it was a multiple-car household, and the third was the age of the head of the household. The education level variable was far and away the

most important. It turned out that the more educated the household, the more likely it was to buy a foreign car or a small car. The multiple-car variable embodies the portfolio notion--the family has a variety of cars to meet a variety of needs. If the family can have only one car, then it must be big enough to meet any conceivable need. But a multiple-car household can "afford" to have a lot of small cars; and, in fact, as cars per household increase, so do small cars per household. Finally, the age variable: we found that 42 years old was a dividing point. Above that, people didn't buy small cars; below that, they did. With some further work, we decided this wasn't simply a senility factor (I'm on the wrong side of the dividing line, after all), but rather it was a kind of historical, cultural factor. People above that age had grown up with big cars and had certain preconceptions of the size car they needed. People below that age had grown up in an era when there were small cars around, and they had different conceptions. The important distinction I'm making here is that it is a value-dimension rather than an age-dimension: hence as that cohort--the people who were over 42 in our sample--moved through the population, then that age shift-point also moves upward. So, in fact, all three major demographic factors are going in the wrong direction for U.S. manufacturers: people are becoming more educated, multiple-car households are increasing, and that pro-domestic cohort is aging itself out of existence.

Now, knowing that I did that research, and distrusting fancy statistics, as you should, you may wonder about the value of those demographic conclusions. So it's worth pointing out that recently Rich Kusmiak did a number of simple cross-tab analyses on the latest National Personal Transportation Survey. No fancy regressions, no multilogit anything; just simple cross tabs. And he confirmed all three of those demographic factors as being important and in roughly the order I gave them to you.

Well, so far we've gotten no comfort from either the upper-bound analysis or from looking at demographic factors; so it's time to bite the bullet and look at multilogit models of auto choice. What do they tell us about consumer sensitivity to various factors? In particular, we know that this mini-car has lower operating costs and lower purchase cost. Let's take these factors one at a time. What will be the effect of lower operating costs (higher miles per gallon) on market share? The particular model I used for this projection is another one of Phil Patterson's bargain basement models. This one was done by Kenneth Train and me; it's a ten-class auto model with about a million variables in it, which purports to explain why people buy the size automobile they buy. The model has three advantages for our current purposes. First, some people actually used it successfully to project 1980 market shares. Remember, this was a 1975 model. They applied it to recent data to predict 1980 market shares and pretty well got them right on the nose. You can see the model was unusually lucky; I won't say it was correct. The second reason is that this particular model has been taken over by Ison, Adler, and Ford, and simplified greatly: they got it down to five car classes: subcompacts, compacts, intermediates, etc.; and they reduced the 25 or 30 odd variables down to just three. So it's an easy model to calculate with. And finally, since it is after all my own model, I know what kinds of secrets are hidden in its bowels, and I know what fudging was in there; so I know how to compensate, I hope.

What I did was the following. I assumed that the five classes of cars had essentially the same characteristics as in 1980, except that the subcompact class was given the 45 miles per gallon efficiency of the Honda City Car. I then ran through the model and reprojected market shares. That one change, the increase in efficiency, produces an 8 percentage point increase in the market share of subcompact automobiles. It says the increase in operating efficiency, alone, will increase subcompact share by 8 points. The other important characteristic of the Honda City is its very low price. What can we say about consumer sensitivity to up-front purchase costs? We know from analyses of the housing market and the appliance market that consumers are extremely sensitive to purchase price, that they will choose the less expensive model of something even when doing so involves much higher operating costs later on.

To project the effect of the City's low price, I reran the simplified Lave/Train model keeping all class characteristics at 1980 values, except that the price of the subcompact class is decreased by 25 percent. This one change, the 25 percent price decrease for subcompacts, increases their market share by a full 14 points. If we both make them 25 percent cheaper and give them 45 miles per gallon, the combined effect is an increase in total market share of 22 points. And finally, if we use that \$3,500 price estimate and combine it with 45 mpg efficiency, we get an increase in market share for subcompacts of a full 30 points. That mini-car is going to be a really serious competitor.

Since I don't want to go on record as saying that they will actually take that hunk of the market, I ought to cover my tracks a bit and qualify the forecast. First, there are all the usual methodological problems. First, we are making a projection which is well outside the calibrated limits of the model. Second, we are basing the whole auto choice decision on just two factors, operating efficiency and purchase price, when we know that there are other factors involved as well; though in this case, since the performance, comfort, noise, and passenger capacity of the City are all equal to or better than existing subcompacts, this is probably an acceptable simplification.

What about the safety issue? One of the things you know, if you were reading the Washington newspapers last week, is that small cars are more dangerous than big cars. To what extent, then, is the safety influence going to limit the market share on this particular automobile? Are people sensitive to safety considerations, and will they be willing to drive a more dangerous car just to save a few thousand dollars?

Well, there are two kinds of evidence that seem relevant. First, we can look at seat belt usage; we know that only 11-14 percent of drivers use them. This suggests that consumers are not terribly concerned with safety. It can be objected that people are not using seat belts because their "operating cost" is too high--the time to put them on and the discomfort of wearing them.

So maybe seat belt evidence isn't relevant. Perhaps, if we gave consumers a chance to purchase a once-and-for-all increase in operating safety, they'd take it. That is to say, even though the daily cost of seat belts is too high, maybe they would be willing to pay an extra two thousand dollars, initially, in order to have a safer car to begin with. Well, I think that's unlikely, if we recall the general proposition that people avoid up-front cost. There is also some specific evidence which is relevant. You may recall that

roughly five years ago, General Motors offered consumers exactly that tradeoff: to spend some extra money and buy an air bag for extra safety. This option was available on the big, luxurious GM cars; and it was very cheap compared to the kind of price differences we have been discussing. Approximately a million cars could have been purchased with that option over the years GM offered it; but, in fact, only ten thousand air bags were sold. That is, only 1 percent of the buyers were willing to spend a little bit more up front in order to purchase extra safety. So I'd conclude that there's no reason, whatsoever, to believe that safety considerations are going to rescue US manufacturers when price and efficiency considerations are not on their side.

Okay, let me sum up and quit. Looking at sensitivity to overall car size, looking at sensitivity to operating costs, looking at sensitivity to purchase costs, looking at demographics, and looking at safety, there's no reason to believe that a mini-car like the Honda City could not substantially enlarge and dominate the small car market. Using the most likely combination of characteristics for the car, I would project a total market share of 60 percent for subcompacts and minis, with minis taking about 40 percent all by themselves. Thus the U.S. industry has plenty to worry about. In terms of the original metaphor, the Honda may not get all the blanket, but it's sure going to leave the rest of us feeling pretty cold.

DISCUSSION

UNIDENTIFIED: I'm wondering if you're using the correct model. From the things I have been reading, the Japanese seem to be more interested in the Third World Market.

DR. CHARLES LAVE: That may or may not be true, but I certainly wouldn't want to be an American manufacturer with that particular car hanging over my head. It is true, as Dan Roos pointed out, that under current import limitations where Japan is limited by number of cars, then there's no reason to export that car--they would rather use up their quota on expensive cars. But we don't know whether that quota will persist. Also, the subject this morning is the possible future of mini-cars; so you can either regard my calculations as being the extent of a particular threat, or as being the potential for a small car in our market.

JIM PLINE: I would assume, Charles, that your prediction is comparable to what happened with the Volkswagen Beetle. It came in and fairly well took over the market.

DR. CHARLES LAVE: Yes, that's exactly the way I see it. The car is sporty, youth-oriented, cheap, and efficient. As far as I can see, it appeals to exactly the class of people who produced the import boom in the first place.

UNIDENTIFIED: You may be correct on the initial sales appeal of that car, but remember that the BMC Mini and the Lada once looked that way in Canada; but then their sales plateaued out at some point, and they did not go on to take over everything.

DR. CHARLES LAVE: My guess about the Canadian experience is that the reputation of those cars eventually caught up with their sales, just as happened with the Renault Dauphine in the U.S. twenty years ago. But my assumption, here, is that

the Honda City is a high quality car, unlike the Mini and the Lada; and remember its comfort, performance, capacity, and features do not mark it out as inferior either.

UNIDENTIFIED: You're right about the quality issue. Also, those cars simply did not hold up to Canadian winters, and they tended to rust out very quickly because of road salt.

DR. CHARLES LAVE: I remember, when I was a kid, we were told that the way to catch a pigeon was to put salt on its tail. Apparently, the Canadians discovered that solution for catching up to these foreign pigeons.

UNIDENTIFIED: The numbers you quoted and the prices, is this before or after the car has been put through the Federal mill here to meet our safety and emission standards?

DR. CHARLES LAVE: Well, what I was told was that the \$3,500 would be the price for a "Federalized" car. Remember, the Japanese have pretty strict smog standards, too.

POTENTIAL USAGE

Kenneth Orski, President, Corporation
for Urban Mobility

PAT WALLER: You make it sound depressingly good. All right, our next speaker is C. Kenneth Orski, who's president of the Corporation for Urban Mobility. It's a public purpose venture to promote public/private cooperation in urban transportation. He's formerly associate administrator of the Urban Mass Transportation Administration, and spent the last four years with the Marshall Fund, where he participated with Dan Roos in the development of the MIT Future of the Automobile program. And he's going to talk to us about the potential use for this small vehicle that we're discussing.

KENNETH ORSKI: As Pat said, my assignment is to talk about the future potential use for minis, and I confess that I run immediately into some problems of definition, because frankly, I'm not sure I know what a mini or a micro is. Certainly the kind of car that Chuck Lave described, the Honda City Car, doesn't sound like a micro car or a mini car. It sounds pretty much like a conventional car, perhaps somewhat smaller in size and certainly cheaper to operate. I don't think that any of us really reached a consensus on what a mini exactly is. Thus, rather than talk about what the potential uses for the minis are, I would like to rephrase the question and ask what are the acceptable minimum performance and design standards for cars that would make them significantly different from the cars that we know today. I have another reason for rephrasing the question. It seems to me it brings up the old philosophical question that we all had to address in our high school essays, and that is, should we let technology dictate our needs, or should we, on the contrary, make our needs influence the technology? In other words, are we to accept the technology of the mini as a given and try to adapt our requirements to it, or should we, on the contrary, define our minimum requirements and then tell the engineers to design a car that we need. Well, from the rhetoric that I've just given to you, I think it is clear that I'm in favor of the latter approach: to ask ourselves what is it