This article re-examines the controversial issue of the usefulness of attitudinal indices as leading indicators of consumer durable expenditures. First a cross-validation is performed using the two most popular indices of consumer sentiment (Survey Research Center and Conference Board). The usefulness of these indices is then tested using a more recent methodology for time-series analysis.

Introduction

The usefulness of consumer attitudes as leading indicators of aggregate consumer expenditures has been the subject of a large controversy yet unresolved. The multitude of studies concluded since the development of these indices in the late 1940's has not resulted in clear-cut answers regarding their usefulness. Actually, in many cases the empirical evidence added more confusion than solutions to the controversy.

With the exception of more recent studies (Curtin 1982; Leone and Kamakura 1983; Vanden Abeele 1983), the published results have been based on the application of linear regressions relating discretionary expenditures to economic and attitudinal variables. This methodology
is known to provide inefficient estimates for time-series analysis, in which autocorrelation is most likely to occur. A more adequate methodology (Multivariate Transfer Functions) is currently available for time-series analysis, which provides an opportunity to re-address the ‘usefulness’ question on a stronger methodological basis. In addition to the autocorrelation issue, the methodology used in this study has another distinction from the one used in previous studies. Whereas most of these studies had tested the attitudinal indices by fitting pre-specified econometric models (or, at most, comparing different formulations), our approach has an exploratory focus, attempting to identify the actual lagged relationship between the attitudinal indices and aggregate expenditures. Details of the methodology will be presented in a latter section, following a brief discussion of previous validation studies. Our validation results will then be presented, following the sequence below:

(a) **Convergent validity across measures** – since two independent sources provide measures with similar purposes, a cross-validation test will be performed to check their convergent validity.

(b) **Identifying lead–lag relationships** – following an exploratory approach (to be discussed in a latter section), the actual lagged relationships between the attitudinal indices and the aggregate expenditures (major appliances, automobiles, houses) will be identified.

(c) **Testing the contribution of attitudinal indices** – given the identified lead–lag relationships, we will then test the contribution of each attitudinal index in explaining variations of consumer expenditures above and beyond the portion already explained by economic predictors.

**Measures of consumer sentiment and buying intentions**

The general theory of psychological economics proposed by George Katona (1951, 1979a, b) specifies that consumer expenditures, in particular discretionary spending, are governed not only by economic factors but also by a cognitive factor reflecting the level of optimism/pessimism regarding the economic conditions. In an attempt to capture this subjective component of consumer demand, several
organizations had started programs for the periodic measurement of consumer attitudes. The Michigan Survey Research Center started its program in 1946 on a quarterly basis (and more recently bimonthly), providing an aggregate Index of Consumer Sentiment (ICS) in addition to other indices specifically related to the purchase of some consumer durables. Similar information is also provided by National Family Opinion Inc. starting in 1967. Results from the application of similar indices had been also reported for the European Economic Community (Praet and Vuchelen 1984) and South Africa (Stuart 1984).

Previous validation studies of attitudinal indices

The analysis and interpretation of these indices has been somewhat controversial since their inception (Burch and Stekler 1969; Shapiro 1973).

One of the first controversies has been the proper test of these indices as predictive tools. One school of authors recommended a cross-sectional application of these indices to compare intentions and subsequent purchase of durable goods at the individual level (Dunkelberg 1973; Tobin 1953). The other school of authors (Mueller 1957, 1963; Adams 1964, 1965; Shapiro 1973) have recommended a time-series approach to predicting changes in trends in consumer expenditures on durable goods.

As Katona points out, however, (Katona 1979a, Katona and Schmiedeskamp 1967), the objective of anticipatory surveys is not to find out which individuals will make a purchase, but to predict trends in the expenditures. Hence, the ultimate test for the predictive ability of attitudes and intentions in forecasting consumer spending should be on a time-series basis.

In one of the earlier time-series studies, Mueller (1960) concluded that the Index of Consumer Sentiment had a significant impact on subsequent expenditures, based on a regression over 12 observations. This conclusion was confirmed in a latter study (Mueller 1963) based on 24 observations. The results from this latter study also showed that Buying Intentions would only anticipate expenditures if the ICS was excluded, thus pointing out the collinearity between these two measures.

The ICS and a composite index of Buying Intentions for cars and houses were used by Adams (1964) in conjunction to Disposable
Income per Capita in a linear regression explaining subsequent durable expenditures. The results indicated that while income accounts for most of the variation in expenditures, ICS still contributes toward explaining that variation. Adams' results also showed that the Composite Buying Intentions index has an impact on expenditures only when the ICS is not included in the regression equation. This is in direct agreement with the results by Mueller (1963).

The problem of autocorrelation of residuals in the linear regressions relating expenditures to attitude was first acknowledged by Maynes (1967). In order to avoid the autocorrelation problem, Maynes transformed the original series by taking first differences. His results lead to the conclusions below:

(1) Both disposable income and ICS are associated with subsequent durable expenditures.
(2) Neither ICS or the Composite Buying Intention index (across products) are significantly related to durable expenditures, when both are included in the model.
(3) Expenditures on new cars and parts are anticipated by the Composite Buying Intention Index when Disposable Income is not in the model.

Burch and Stekler (1969) suggested that the usefulness of attitudinal indices would be better tested through their forecasting accuracy rather than by measuring goodness-of-fit. By estimating linear regressions based on 39 quarterly observations and applying these equations to forecast expenditures on 9 subsequent periods, these authors found that while ICS seems to have some forecasting value, the results were not conclusive.

Juster and Wachtel (1972) suggested that the strong multicollinearity between attitudinal indices and economic predictors might be a reason for the controversial results, since it leads to inefficient regression estimates when both sets of variables are present in the model. Their results suggested that when attitudes are accurately measured, a simple model including only these attitudinal variables would perform as well as a complex model combining both attitudinal and economic predictors.

In order to 'isolate the meaningful changes' in the series, Shapiro (1973) used a filter (based on first differences) on the Index of Consumer Sentiment. Also, similarly to Burch and Stekler (1969), a
hold-out period was used to test the forecasting value of a model based on previous periods. Shapiro's study concluded that the ICS adds no forecasting power to a model which already includes economic predictors.

Based on a regression with correction for autocorrelation in the residuals, Curtin (1982) showed that the ICS improves substantially the degree of fit to the quarterly unit sales of new cars when added to a model with only Real Household Income as a predictor. Curtin's results also showed Buying Intention as a significant predictor, although explaining less variance in car sales.

More recently, these attitudinal indices have also been applied outside the US. Vanden Abeele (1983) presents results from his application in the European Community. These results show that a sizeable portion of variation in Consumer Sentiment can be explained by objective economic variables, thus indicating strong collinearity between them. Furthermore, the part of the ICS not explained by the economic predictors did not contribute significantly for the prediction of consumer discretionary expenditures, thus indicating that the ICS is a poor indicator of changes in expenditures when economic variables are already in the model.

The results summarized above should give an idea of the degree of disagreement in the literature on how useful attitudinal indices are as leading indicators of aggregate discretionary expenditures. A possible source for these contradictory results might be the methodology used to derive them.

Methodology

The application of linear regression techniques to time-series data has been proven to provide misleading results in the face of autocorrelation (Pierce 1977; Granger and Newbold 1974). Pierce (1977) indicates that many econometric analyses have presented misleading results due to the 'spurious regression phenomena' (Granger and Newbold 1974) caused by the unaccounted presence of autocorrelation. Typical misleading results are (Pierce 1977):

(1) Superficially high $t$ and $F$ statistic values required for rejection of the null hypothesis.
(2) Upward bias in $R^2$. 
Thus when autocorrelation goes undetected, the regression coefficients are not efficient and frequently strong but misleading relationships will be found, that do not exist in the real world.

More recent econometric texts (Intriligator 1978) discuss this problem and indicate that generalized least squares is an estimation technique which provides minimum-variance or efficient estimators. The technique of generalized least squares only addresses the problem of autocorrelation which follows a first-order moving average pattern (serial correlation), it does not address autocorrelations which follow an autoregressive pattern. Pierce (1977) has cited several empirical papers (11 in total) where multi-period autocorrelations (high-order) have been found and both types of autocorrelation patterns (autoregressive and moving average) have emerged. There is thus ample evidence to suggest that model estimation techniques which allow for extensive and flexible autocorrelation patterns may be most appropriate for time-series data. The integrated autoregressive-moving average techniques of Box and Jenkins (1970) employed in this study allow for complex and flexible autocorrelation modelling.

The relationship between the attitudinal indices (sentiment and intentions) and actual aggregate expenditures will be tested with the methodology developed by Pierce and Haugh (1977). Let $x_t$ be the predictor time series (i.e., one of the attitudinal measures) and $y_t$ the dependent series (i.e., consumer expenditures). The first step suggested by Pierce and Haugh is the fitting of an Auto-Regressive Integrated Moving Average (ARIMA) model to the predictor series $x_t$ (Box and Jenkins 1970):

$$
\Phi_x(B)x_t = \Theta_x(B)a_t,
$$

where $\Phi_x(B)$ and $\Theta_x(B)$ are polynomials on the lag operator $B$

$$(Bx_t = x_{t-1}).$$

The estimated model is then used to transform the original dependent series $x_t$ into independent residuals $a_t$. This filtering process will sort out any temporal pattern from the original series $x_t$.

The same model is also used to filter the dependent series:

$$
b_t = \Theta_x(B)\Phi_x^{-1}(B)y_t.
$$

(2)
Rather than using the cross-correlations of the original series \( (x_t, \text{ and } y_t) \), Haugh (1976) demonstrated that the true lagged relationship between these two series can be best identified using the cross-correlations of their residuals; \( a_t \) and \( b_t \). The filtering process described above sorts out any common autocorrelation structure which might disguise or distort the true relationship between the two series. For example, two concurrently related series might appear to have a distributed-lag relationship, if either (or both) series have a strong autoregressive pattern. Also, two highly seasonal series will appear to be associated only due to the fact that they follow the same seasonal pattern. This problem commonly occurs when OLS is applied to time series analysis.

Let \( r(a_{t-i}, b_t) \) be the cross-correlation coefficient between the input residuals \( a_t \) (lagged by \( i \) periods) and the output residuals \( b_t \). Then, a significant cross-correlation coefficient for a positive lag \( i \) indicates that the input series \( x_t \) anticipates the output \( y_t \) by \( i \) periods. A significant cross-correlation for a negative lag \( i \) indicates that the input series is actually driven by the output.

In order to account for the eventuality of spuriously significant correlations, Haugh (1976) suggested the cumulative statistic:

\[
Q-\text{ALL} = N \sum_{i=-m}^{m} r^2(a_{t-i}, b_t) - \chi^2(2m),
\]

\((m = \text{number of lags examined}).\)\(^{(3)}\)

This statistic has a chi-square distribution with \( 2m \) degrees of freedom, and can be used as a test of association between the two original series. The hypothesis that the predictor series \( x_t \) anticipates the dependent series \( y_t \) can be tested with the statistic:

\[
Q-\text{LEAD} = N \sum_{i=1}^{m} r^2(a_{t-i}, b_t) - \chi^2(m). \quad (4)
\]

Similarly, the hypothesis that the predictor \( x_t \) is actually driven by the dependent variable \( y_t \) can be tested using,

\[
Q-\text{LAG} = N \sum_{i=-m}^{1} r^2(a_{t-i}, b_t) - \chi^2(m). \quad (5)
\]
These tests had been applied by Pierce (1977) to check the relationships among several monetary and other economic series, and by Haugh (1976) to test the independence between two interest rate series.

In addition to these tests of association, we also tested the marginal contribution of the attitudinal indices in explaining changes in consumer expenditures. These latter tests were attained by fitting multivariate transfer functions to each consumer expenditure series using the attitudinal measures and economic variables as predictors. The methodology for the identification and estimation of transfer functions is extensively discussed elsewhere (see Haugh and Box (1977) for the methodology and Jenkins (1979) for practical applications). Therefore, only a brief description is provided in the appendix.

This approach offers several advantages over the linear regression model for the analysis of time series. First, it provides a flexible, yet parsimonious, formulation for the distributed-lag relationship between each predictor and the dependent variable. Second, it provides an objective criterion for the identification of this relationship. Third, it specifies a general autocorrelation structure for the error term. Finally, this methodology provides useful diagnostic information (through the analysis of residuals) to assure that the causal relationships and the autocorrelation of the disturbances had been properly accounted for. The usefulness of each attitudinal index was tested by first fitting the most appropriate transfer function with only economic variables (income and price), and then measuring the improvement in fit after adding the attitudinal variable. A partial-$F$ test was used to test the statistical significance of this improvement:

$$F = \frac{(SSE_1 - SSE_2)(N - K - 1)}{SSE_2},$$  

where $SSE_1$ is the sum of squared residuals from the transfer function with only economic variables, $SSE_2$ is the sum of squared residuals after adding the attitudinal measure, $N$ is the length of the time series, and $K$ is the total number of variables (including the attitudinal series). This statistic is $F$ distributed with $(1, N - K - 1)$ degrees of freedom.

**Univariate ARIMA models**

Table 1 presents the univariate Auto-Regressive Moving-Average models identified and estimated for each predictor series to be used in
Table 1
Univariate ARIMA models.

<table>
<thead>
<tr>
<th>Model</th>
<th>$\sigma_a$</th>
<th>$Q^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(1 - 0.37B) \nabla INC_t = a_t$</td>
<td>0.043</td>
<td>10.2</td>
</tr>
<tr>
<td>$(1 - 0.77B)CCI_t = a_t$</td>
<td>8.80</td>
<td>13.9</td>
</tr>
<tr>
<td>$(1 - 0.82B)ICS_t = a_t$</td>
<td>5.34</td>
<td>12.8</td>
</tr>
<tr>
<td>$(1 - 0.62B)NFOCAR_t = a_t$</td>
<td>0.81</td>
<td>6.4</td>
</tr>
<tr>
<td>$(1 - 0.73B)SRCAR_t = a_t$</td>
<td>10.4</td>
<td>10.9</td>
</tr>
<tr>
<td>$(1 - 0.34B)MORT_t = a_t$</td>
<td>0.405</td>
<td>10.8</td>
</tr>
<tr>
<td>$\nabla NFOH_t = a_t$</td>
<td>0.403</td>
<td>11.0</td>
</tr>
<tr>
<td>$\nabla SRCH_t = a_t$</td>
<td>15.2</td>
<td>10.2</td>
</tr>
<tr>
<td>$\nabla APPRI_t = (1 + 0.50B)(1 + 0.35B^4)a_t$</td>
<td>1.67</td>
<td>12.9</td>
</tr>
<tr>
<td>$(1 - 0.78B)NFOAP_t = a_t$</td>
<td>2.49</td>
<td>9.7</td>
</tr>
<tr>
<td>$(1 - 0.77B)SRCAP_t = a_t$</td>
<td>9.81</td>
<td>12.8</td>
</tr>
<tr>
<td>$(1 - 0.37B)\nabla CAR_t = a_t$</td>
<td>0.93</td>
<td>10.9</td>
</tr>
<tr>
<td>$\nabla APP_t = a_t$</td>
<td>19.94</td>
<td>7.3</td>
</tr>
<tr>
<td>$\nabla HOM_t = a_t$</td>
<td>62.10</td>
<td>14.3</td>
</tr>
</tbody>
</table>

$Q = N \sum_{t=1}^{T} r_t^2 - \chi^2(12)$.

Note: $\nabla = (1 - B)$.

further analysis. These models were used to filter the expenditures series, for the tests of association between attitudinal measures and expenditures, and for the identification of transfer functions.
The results in table 1 show that we were able to account for most of the temporal pattern in the series (the cumulative tests show no autocorrelation in the residuals) with simple and parsimonious ARIMA models. The description of the series, their sources and abbreviations are presented below.

Data employed in this study

This study examines quarterly consumer expenditures on new cars, major appliances and single family homes for the years 1970 to 1983. There were two sets of variables collected: economic and psychological.

(A) Psychological predictor variables

(A.1) Measures of sentiment

1. $ICS = \text{Index of Consumer Sentiment, by the Survey Research Center.}$
2. $CCI = \text{Consumer Confidence Index, by the Conference Board.}$

(A.2) Measures of buying intentions

3. $NFOCAR = \text{Plans to purchase a car in the next 6 months, by the Conference Board.}$
4. $SRCAR = \text{Buying conditions for new cars, by the Survey Research Center.}$
5. $NFOAP = \text{Plans to purchase major appliances within 6 months, by the Conference Board.}$
6. $SRCAP = \text{Buying conditions for large household goods, by the Survey Research Center.}$
7. $NFOH = \text{Plans to purchase a new home within the next 6 months, by the Conference Board.}$
8. $SRCW = \text{Buying conditions for new homes, by the Survey Research Center.}$

(B) Economic variables

(B.1) Criterion variables

9. $CAR = \text{Retail sales of new cars (seasonally adjusted at annual rate in million units).}$
10. $APP = \text{Retail sales of household appliances, radio and TV stores (seasonally adjusted in $1972 million).}$
(11) \( HOM \) = Sales of single family homes (seasonally adjusted at annual rate, in 1000 units).

(B.2) Predictor variables
(12) \( CARPRI \) = Consumer Price Index for new cars (1967 = 100).
(13) \( INC \) = Per capita disposable income in 1972 dollars.
(14) \( APPRI \) = Consumer Price Index for durables (1967 = 100).
(15) \( MORT \) = Effective mortgage interest rate.

The convergent validity of Consumer Sentiment and Buying Intentions Indices

The fact that consumer sentiment and buying intentions are periodically measured by two independent sources (Survey Research Center and National Family Opinion Inc.) creates an opportunity to test their convergent validity. If these independent measures are designed to measure the same constructs (consumer sentiment and buying plans), they should be strongly correlated, and failure to do so might indicate some problems in the measurement methodology.

Hence, one should expect a strong concurrent correlation between the Consumer Confidence Index (CCI) and the Index of Consumer Sentiment (ICS).

As for buying plans, one should expect a strong association between the two sources (Survey Research Center and National Family Opinion) but not necessarily at the zero lag, since they are intrinsically different. The Survey Research Center asks for the current conditions to make a purchase, while National Family Opinion directly asks for intentions to make the purchase within the next 6 months. Therefore, it is reasonable to expect the Buying Conditions Index (from SRC) to anticipate Buying Intentions (from NFO).

The discussion above leads to the following hypotheses:

\( H_1 \). The Index of Consumer Sentiment and the Consumer Confidence Index are concurrently related.

\( H_2 \). The Buying Condition Index for a given consumer durable anticipates the respective Buying Intentions Index.

The cross-correlations of the residual series computed for quarterly data from 1970 to 1983 are presented on the top of table 2. Based on
Table 2
Cross-correlation coefficients of prewhitened series.

<table>
<thead>
<tr>
<th>Input series</th>
<th>Lag</th>
<th>-4</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Output series</th>
<th>Q-LAG</th>
<th>Q-ALL</th>
<th>Q-LEAD</th>
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</thead>
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<tr>
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<td>-0.03</td>
<td>0.37</td>
<td>0.22</td>
<td>0.03</td>
<td>0.61</td>
<td>*</td>
<td>0.08</td>
<td>-0.24</td>
<td>0.01</td>
<td>0.01</td>
<td>ICS</td>
<td>9.7</td>
<td>32.4</td>
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<td>0.02</td>
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<td>0.25</td>
<td>0.01</td>
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<td>0.03</td>
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<td>-0.01</td>
<td>0.10</td>
<td>CARS</td>
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<td>0.58</td>
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<td>-0.04</td>
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<td>-0.10</td>
<td>HOUSE</td>
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<td>0.08</td>
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<td>0.35</td>
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<td>-0.06</td>
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<td>26.4</td>
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<td>0.04</td>
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<tr>
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<td>0.55</td>
<td>*</td>
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<td>HOUSE</td>
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<td>27.7</td>
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<td>PRICE</td>
<td></td>
<td>0.04</td>
<td>-0.09</td>
<td>0.05</td>
<td>-0.07</td>
<td>-0.34</td>
<td>*</td>
<td>-0.07</td>
<td>0.05</td>
<td>0.14</td>
<td>-0.12</td>
<td>APPL.</td>
<td>0.9</td>
<td>9.05</td>
</tr>
<tr>
<td>INCOME</td>
<td></td>
<td>-0.22</td>
<td>-0.09</td>
<td>0.25</td>
<td>0.09</td>
<td>0.30</td>
<td>0.08</td>
<td>0.13</td>
<td>0.20</td>
<td>0.00</td>
<td>APPL.</td>
<td>6.6</td>
<td>14.6</td>
<td>3.3</td>
</tr>
<tr>
<td>CCI</td>
<td></td>
<td>-0.25</td>
<td>-0.23</td>
<td>0.02</td>
<td>0.27</td>
<td>0.11</td>
<td>0.25</td>
<td>0.06</td>
<td>0.08</td>
<td>0.09</td>
<td>APPL.</td>
<td>9.8</td>
<td>14.6</td>
<td>4.2</td>
</tr>
<tr>
<td>ICS</td>
<td></td>
<td>-0.32</td>
<td>-0.13</td>
<td>-0.25</td>
<td>0.05</td>
<td>-0.05</td>
<td>0.10</td>
<td>0.03</td>
<td>0.10</td>
<td>0.00</td>
<td>APPL.</td>
<td>9.6</td>
<td>10.8</td>
<td>1.1</td>
</tr>
<tr>
<td>NFOAP</td>
<td></td>
<td>-0.24</td>
<td>-0.02</td>
<td>-0.10</td>
<td>0.18</td>
<td>-0.08</td>
<td>0.08</td>
<td>0.01</td>
<td>-0.09</td>
<td>-0.08</td>
<td>APPL.</td>
<td>5.2</td>
<td>6.6</td>
<td>1.1</td>
</tr>
<tr>
<td>SRCAP</td>
<td></td>
<td>-0.26</td>
<td>-0.24</td>
<td>0.05</td>
<td>0.07</td>
<td>0.17</td>
<td>0.13</td>
<td>0.18</td>
<td>-0.07</td>
<td>0.09</td>
<td>APPL.</td>
<td>6.9</td>
<td>11.6</td>
<td>3.2</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.

b Q-LAG tests whether the Input series is driven by the Output series;

c Q-ALL tests the association between the two series;
d Q-LEAD tests whether the Output series is driven by the Input series.
these results, the null hypothesis related to \( H_1 \) can be rejected, supporting our hypothesis that both sentiment indices should be concurrently related. Furthermore, the cumulative statistic (\( Q-LAG \)) indicates that the Index of Consumer Sentiment also tends to anticipate the Consumer Confidence Index.

Our second hypothesis is also confirmed. Although the individual cross-correlations are in general not significant, the cumulative statistic (\( Q-LAG \)) indicates (with a 0.05 chance of error) that the Buying Conditions Index for cars and new houses (\( SRCAR, SRCH \)) tends to anticipate the respective Buying Intentions Index (\( NFOCAR, NFOH \)). The same did not hold for appliances. No significant relationship was found.

In general, our results show that the two sources (\( SRC \) and \( NFO \)) yield consistent measures. This can be taken as an indication that they are able to capture the fluctuations of consumer attitudes and intentions over time. However, nothing can be said to this point, about their ability to anticipate changes in aggregate behavior (or expenditures). This issue will be addressed in the following sections.

**Testing the lead–lag relationships**

Our purpose here is to identify the lag between a change in each predictor (economic and attitudinal series) and a response in the dependent variable (expenditures), and to test the strength of this relationship. This information will be used in the following section for the selection of the most appropriate transfer function for explaining consumer expenditures.

This approach represents a major departure from previous studies in which lagged relationships are specified a priori, and linear regressions run to estimate the parameters of the pre-specified models. Here we attempt to identify the actual lagged relationship between two series based on the cross-correlations of their residuals.

Table 2 shows the cross-correlations between each predictor and the respective durable expenditures, after the temporal pattern had been sorted out from each series. A significant cross-correlation for a positive lag (lead) indicates that the predictor anticipates the dependent variable by a length of time equal to the lag. A significant cross-correlation for a negative lag indicates that the direction of causality is reversed.
If the attitudinal measures are to be helpful in anticipating demand, one would expect them to be significantly correlated with the expenditure series for a positive lag. Also, considering that consumer expectations are shortlived (Katona 1979a, b), and that our data is aggregated on a quarterly basis, it is reasonable to expect that the lagged relationship would not go beyond four quarters. Given these considerations, the following hypotheses are posed:

**H₃.** There is a significant cross-correlation between the sentiment indices (ICS and CCI) and consumer expenditures, for lags between 1 and 4.

**H₄.** There is a significant cross-correlation between the buying plan indices and respective consumer expenditures for lags between 1 and 4.

Hypothesis H₃ is only supported by the relationship between the Consumer Confidence Index (CCI) and Retail Sales of New Passenger Cars (CARS), for which a one-quarter lead was identified. The cumulative statistic in table 2 (Q-LEAD = 9.4) is significant at the 0.05 level and provides the confirmation.

As for hypothesis H₄, we found no evidence to reject the null hypothesis of lagged independence between buying plans and expenditures. For the three types of expenditures studied (cars, house, appliances), the buying plan indices did not seem to anticipate demand. The cumulative statistics (Q-LEAD) were not significant for any of these indices.

The results above are at odds with previous results by Mueller (1960, 1963), Adams (1964), Maynes (1967), and Curtin (1982). While only one lagged relationship was found in our results (CCI and CARS), the afore-mentioned authors had found evidence that both sentiment and intentions anticipate expenditures, when taken separately. Actually the results are not directly comparable, since the figures in table 2 measure the direct relationship between attitudinal indices and expenditures while the results from previous studies refer to the contribution of the attitudinal measures when economic variables are also included in the regression models. Similar tests will be performed next.

Although our results do not strongly support the hypothesis that attitudinal measures anticipate discretionary expenditures, they show significant concurrent association between these two sets of variables, with an exception for the expenditures on major appliances. This
exception might be understood if one takes into account that these expenditures involve a smaller portion of a household budget (relative to cars and houses) and would thus be less affected by variations in consumer attitudes and more influenced by conjunctural factors.

**Testing the contribution of attitudinal measures for explaining aggregate durable expenditures**

The extent by which attitudinal measures help in explaining and anticipating aggregate consumer expenditures will be tested next, by measuring the improvement in fit after each of these measures is added to a model which already includes economic predictors. Since the cross-correlation analysis (table 2) failed to show any relationship regarding expenditures on major appliances (APP), this test will be performed only for **CARS** and **HOM**.

The identification of the transfer function for each set of variables is based on the analysis of the cross-correlations presented in table 2. As mentioned before, with a single exception (**CCI** vs **CARS**), these correlations show, at most, a concurrent relationship between the attitudinal indices and actual expenditures. This leaves a question about the direction of causality. Confusion about the direction of causality between purchase behavior, behavior intentions and attitudes toward a behavior is not surprising. Fishbein (1975) in presenting the theoretical development of attitudes indicates that a person’s attitude toward an object is a function of his salient beliefs about that object. Furthermore, beliefs about an object are a result of a person’s life experience (Fishbein 1975: 217–218). It could be assumed that economic conditions are one of life’s experiences. Economic conditions therefore could indirectly affect attitude formation toward a particular purchase behavior through a person’s belief structure. Fishbein (1975: 288) in discussing the formation of behavior intention, does indicate the potential for error in relying on attitudes to forecast behavior with the following statement:

'Although we view a person's attitude toward and object to be related to the totality of his intentions with respect to the object, there is no necessary relation between attitude and any given intention.'
Table 3
Transfer functions for CARS.

<table>
<thead>
<tr>
<th>Equation</th>
<th>$CAR_i = \beta_0 + \beta_1 PRIC + \beta_2 INC + (1 + \beta_3 B)^{-1} a_i$</th>
<th>$MSE$</th>
<th>$R^2$</th>
<th>$Q$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$CAR_i = -0.10 PRIC + 5.66 INC + (1 + 0.46 B)^{-1} a_i$</td>
<td>0.650</td>
<td>0.66</td>
<td>8.4</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$CAR_i = -0.07 PRIC + 4.94 INC + (0.03 - 0.03 B) CCI + (1 + 0.55 B)^{-1} a_i$</td>
<td>0.561</td>
<td>0.71</td>
<td>8.6</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>$CAR_i = -0.07 PRIC + 3.57 INC + 0.01 ICS + (1 + 0.48 B)^{-1} a_i$</td>
<td>0.634</td>
<td>0.66</td>
<td>7.6</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>$CAR_i = -0.09 PRIC + 4.53 INC + 0.07 NFOCAR + (1 + 0.46 B)^{-1} a_i$</td>
<td>0.645</td>
<td>0.66</td>
<td>8.1</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>$CAR_i = -0.07 PRIC + 3.34 INC + 0.01 SRCAR + (1 + 0.46 B)^{-1} a_i$</td>
<td>0.624</td>
<td>0.67</td>
<td>8.6</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

Bettman (1979) even goes further than Fishbein in proposing that attitudes are not a necessary component of all choice processes:

‘Attitudes and choice can be separate phenomena, which may go on in parallel with each other. Attitudes need not be a necessary component of all choice processes. The relationship of attitudes to the choice process may vary with degree of experience with the choice.’

Fishbein and Bettman’s propositions not only suggest that the relationship between attitudes and behavior could be weak, but also can be used to explain the reverse causality between these two phenomena. If one considers the aggregate expenditures on consumer durables as proxies of current economic conditions, and if one assumes that these current conditions affect the formation of attitudes, then attitudes could be a consequence of expenditures. Our study has found both causal directions, depending upon the durable good examined.

The objective of this study was not to explain how attitudes are formed but to determine their contribution to explaining changes in durable goods expenditures. The transfer functions built in this study all use attitudinal indices as predictor variables.

*Retail sales of new cars (CARS)*

The first equation of table 3 presents the transfer function identified with only economic predictors ($PRIC$ and $INC$). The following equa-
Table 4
Transfer functions for HOUSES.

<table>
<thead>
<tr>
<th>Function</th>
<th>$MSE$</th>
<th>$R^2$</th>
<th>$Q$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$HOU_i = - 80.4 MORT_i - (134.1 B) INC_i + a_i$</td>
<td>2396.3</td>
<td>0.87</td>
<td>14.0</td>
<td>-</td>
</tr>
<tr>
<td>(18.9)</td>
<td>(175.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$HOU_i = - 79.1 MORT_i - (106.2 B) INC_i + 0.74 CCI_i + a_i$</td>
<td>2383.7</td>
<td>0.87</td>
<td>14.1</td>
<td>0.3</td>
</tr>
<tr>
<td>(18.2)</td>
<td>(166.7)</td>
<td>(0.87)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$HOU_i = - 76.8 MORT_i - (107.7 B) INC_i + 0.75 ICS_i + a_i$</td>
<td>2383.8</td>
<td>0.87</td>
<td>14.1</td>
<td>0.3</td>
</tr>
<tr>
<td>(19.8)</td>
<td>(185.0)</td>
<td>(1.48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$HOU_i = - 62.9 MORT_i - (150.9 B) INC_i + 43.2 NFOH_i + a_i$</td>
<td>2137.4</td>
<td>0.89</td>
<td>11.4</td>
<td>5.9</td>
</tr>
<tr>
<td>(19.4)</td>
<td>(167.6)</td>
<td>(18.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$HOU_i = - 55.75 MORT_i - (104.2 B) INC_i + 1.13 SRCH_i + a_i$</td>
<td>2219.0</td>
<td>0.88</td>
<td>11.8</td>
<td>3.9</td>
</tr>
<tr>
<td>(22.4)</td>
<td>(171.2)</td>
<td>(0.59)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

tions measure the contribution of each attitudinal index beyond and above the economic predictors. A diagnostic check on the residuals from these models showed no significant auto-correlations or cross-correlations with the predictor series, which indicates that the relationship between the dependent variable and predictors and the temporal pattern in the expenditure series has been accounted for.

The proportion of variance explained by each model in table 3 shows clearly that the two buying intention indices ($NFOC$ and $SRCAR$) and the Index of Consumer Sentiment ($ICS$) provide a minimal contribution in explaining expenditures for new cars, despite the concurrent correlation shown in table 2.

Based on the proportion of variance explained, the only improvement in fit was obtained with the use of $CCI$. The $F$ statistic confirms this conclusion. The only statistically significant decrease in mean-square-error resulted from the use of $CCI$.

*Sales of new single-family houses*

The transfer functions in table 4 show that only $NFOH$ and $SRCH$ resulted in a measurable improvement in $R^2$ when compared with the model containing only objective predictors ($MORT$ and $INC$). However, the improvement provided by $SRCH$ is not statistically significant (at 0.05 level), leaving $NFOH$ as the only attitudinal measure with
Table 5
Cross-correlations of residuals: attitudinal indices vs income.

<table>
<thead>
<tr>
<th>Input series</th>
<th>Lag</th>
<th>Q-LAG</th>
<th>Q-ALL</th>
<th>Q-LEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>CCI</td>
<td>-0.22</td>
<td>0.10</td>
<td>0.10</td>
<td>-0.02</td>
</tr>
<tr>
<td>ICS</td>
<td>-0.43*</td>
<td>-0.10</td>
<td>0.13</td>
<td>0.42*</td>
</tr>
<tr>
<td>NFOCAR</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.12</td>
<td>0.04</td>
</tr>
<tr>
<td>SRCAR</td>
<td>-0.32*</td>
<td>-0.09</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>NFOH</td>
<td>0.09</td>
<td>-0.19</td>
<td>-0.05</td>
<td>-0.11</td>
</tr>
<tr>
<td>SRCH</td>
<td>-0.33*</td>
<td>-0.13</td>
<td>-0.02</td>
<td>-0.35*</td>
</tr>
<tr>
<td>SRCAP</td>
<td>-0.11</td>
<td>0.06</td>
<td>0.16</td>
<td>-0.06</td>
</tr>
<tr>
<td>NFOAP</td>
<td>0.01</td>
<td>0.04</td>
<td>-0.04</td>
<td>-0.01</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level.

b Q-LAG tests whether the Input series is driven by the Output series;
c Q-ALL tests the association between the two series;
d Q-LEAD = tests whether the Output series is driven by the Input series.
some contribution to explain changes in the sales of new single-family houses.

The results presented in this section do not provide strong support to the hypothesis that attitudinal indices can anticipate or explain variations in consumer expenditures for durable goods. Of all six indices tested, only two were found to have any impact on expenditures: (a) the Consumer Confidence Index anticipates changes in retail sales of new cars, and (b) Plans to Buy a New House (NFOH) explain concurrent change in the sales of new single-family units. The first result, although in agreement with Mueller (1960, 1963), Adams (1964), Maynes (1967) and Curtin (1982), represents one strike out of four trials (CARS, HOME vs CCI, ICS), hence not an overwhelming support to the consumer sentiment indices. The same is true for the second result. While in agreement with the same authors listed above, it also represents one significant result out of four attempts. On the other hand, the cross-correlations presented in table 5 indicate that these attitudinal measures might be useful in anticipating and explaining changes in Disposable Income, a proxy to the general conditions of the economy. The cumulative tests (Q-ALL, Q-LEAD) indicate that CCI, ICS, SRCAR and NFOH are associated with the disposable income series (INC), and that CCI, ICS and SRCAR anticipate variations in INC. These results might be saying that rather than being leading indicators for the purchase of specific durable goods, the sentiment and buying intention indices would be broad measures of consumers' expectations about their future economic conditions.

Conclusions

This article examined the predictive usefulness and explanatory power of the most common psychological predictors of durable goods expenditures. Consumer expenditures on new cars, appliances and homes were analyzed as a function of a set of economic and psychological variables.

The contributions of these psychological indices have been the subject of a long controversy and have consequently received the attention of many researchers in the past. However, a recently developed methodology for time-series analysis provided the opportunity for more scrutiny. This methodology overcomes the problem of autocorre-
lation, so common in time-series analysis, allowing for a proper identification of the lead–lag relationship between two or more variables over time.

Cross-validation of attitudinal measures

The availability of data from two different sources (Survey Research Center and Conference Board) provided an opportunity for testing the convergent validity of these measures of consumer attitudes. A significant concurrent cross-correlation of residuals showed a convergent validity between the Consumer Confidence Index and the Index of Consumer Sentiment. This suggests that both measurements are capturing consumer's reactions to the current economic conditions.

As for purchase intentions, the indices published by the Survey Research Center anticipate the ones published by the Conference Board (with the exception of appliances for which no relationship was found). This anticipation is explained by the fact that the former source measures intentions as ‘good time to buy’ while the latter directly asks for intentions to make a purchase within the next six months. Although not directly addressing the usefulness issue, this validity test indicates that both sources are measuring the constructs intended.

Identification of leading relationships

Among all attitudinal variables, only the Consumer Confidence Index published by the Conference Board was found to anticipate consumer expenditures. And even then, this relationship was found only regarding the purchase of new passenger cars. Our analysis could not identify any lead–lag relationship between intentions to buy and aggregate expenditures.

However, the cross-correlation of residuals showed a strong concurrent relationship between many of the attitudinal measures and the aggregate expenditures. These results indicate that the attitudinal measures might provide additional information in explaining changes in aggregate expenditures. One noticeable exception was the case of major household appliances, for which no concurrent or leading relationship was detected. Another surprising result was the fact that the sales of new houses and household appliances seem to anticipate changes in consumer sentiment (CCI and ICS), rather than the reverse. This
might support the assumption that consumers form their attitudes (or sentiment) based on their own past experience, in this case represented by market conditions (sales of houses and appliances).

Although only one leading relationship was found between consumer attitudes and expenditures, our results strongly show these former measures as leading indicators of Per Capita Disposable Income. If one considers this latter variable as a proxy to the overall economic conditions, these results might indicate that consumers are able to foresee changes in economic conditions in general, better than their own expenditures on specific goods. However, these cross-correlations also show significant concurrent relationships between some of the attitudinal measures and income. This relationship poses a problem of multicollinearity which might dampen the actual contribution of these attitudinal measures in explaining consumer expenditures above and beyond objective economic variables (i.e., income).

Explanatory usefulness of attitudinal measures

The contribution of each attitudinal measure in explaining variations in consumer expenditures was assessed by adding each attitudinal variable to a transfer function which already included economic variables. These tests provided only two positive results. The Consumer Confidence Index significantly contributed to explain the changes in retail sales of new cars beyond the economic variables. Also, buying intentions published by the Conference Board contributed in explaining changes in aggregate sales of new single-family homes.

In conclusion, the use of consumer attitudes as leading indicators of actual expenditures was not fully supported by our results. As a matter of fact, even the concurrent relationship between these psychological measures and actual expenditures did not seem to add much information (in addition to objective economic variables) in explaining concurrent variations in expenditures.

The results indicate, however, that consumers seem to be able to anticipate broader changes in economic conditions, here represented by Per Capita Disposable Income.

Finally, one qualification should be added to the results here presented. These results were derived from quarterly data. The aggregation of data on a quarterly basis might have shown some lagged relationships (between 1 to 2 months) as concurrent associations, thus reducing
the actual anticipatory value of these predictors. Practical considerations, however, motivated the use of the quarterly aggregation. The Survey Research Center only started collecting its data on a monthly basis in late 1977, while the Conference Board started it by mid 1977. Hence, using monthly data would allow us to test these indices only for the past 6 years. In contrast, with quarterly data we were able to cover a longer period of 14 years. Furthermore, the identification of lead relationships of less than a quarter may not be of practical interest, since it leaves planners with too short a leeway to react to changes in demand.

Appendix

A transfer function has the general form:

\[ \partial(B)y_t = W_1(B)B^{b_1}x_{1t} + W_2(B)B^{b_2}x_{2t} + \ldots + \Phi(B)a_t/\Theta(B), \quad (A1) \]

where,

\[ \partial(B) = (1 - \partial_1B - \ldots \partial_rB^r), \quad (A2) \]

\[ W_i(B) = (W_{0i} - W_{1i}B - \ldots - W_{si}B^s), \quad (i = 1, 2, \ldots K) \]

\[ \Theta(B) = (1 - \theta_1B - \ldots - \theta_qB^q), \quad (A4) \]

\[ \Phi(B) = (1 - \phi_1B - \ldots - \phi_pB^p). \quad (A5) \]

This formulation provides a flexible distributed-lag relationship between each predictor \( x_{it} \) and the dependent variable, in addition to a general autocorrelation structure for the error term \( (\Phi(B)a_t/\Theta(B)) \).

The order of the polynomials in (A2), (A3), (A4), and (A5), and the lag for each variable \( (b_i; i = 1, 2 \ldots K) \) is identified from the patterns of the cross-correlations of residuals (described before). If these polynomials are correctly specified, efficient estimates can be obtained using Marquardt's non-linear least squares algorithm (Box and Jenkins 1970).
References


