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by

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ABSTRACT

Surveys collecting data on consumer attitudes and buying intentions have been performed in Sweden since 1973. This paper examines the usefulness of these data as quick indicators of the development of household expenditures on automobiles. In the evaluation we are considering the explanatory power as well as the prediction accuracy. It turns out that the best single indicator is among the plan indices. However, an indicator based on car registration statistics is found to be at least as good. By combining plan/attitude indices with car registrations our study shows that considerable improvements can be obtained.

1. INTRODUCTION

The consumption expenditures of Swedish households on cars constitute a relatively small part of total consumption expenditures (3%). However, this is the largest single component of consumer expenditures on durables, on average 35% in the period 1963-1990, and its great variability (ranging from 25% to 50%) makes it a strategic component to forecast.

There are many studies of households demand for cars trying to formulate causal models which then have been used for producing forecasts, the major approach being based on the stock adjustment model. (For a recent survey of some approaches see de Pelsmacker, 1990.)

In the case of short-term forecasting some alternative approaches have been presented. These are based on survey data collected from households concerning their buying plans of durables and their attitudes towards the general and private economic conditions. Considering the fact that car consumption expenditures are of a discretionary character households' attitudes and plans are a measure of their willingness to buy (Katona and Mueller 1952). The emphasis of these studies is on the predictive ability of models where macroeconomic variables and attitudes/plans are taken together and models where only attitude/plan variables are included (for a brief survey see Ågren 1989). A great advantage of the latter type of models is that they are based on data which are easier to produce than national accounts data and hence also available without long delays.

The first more comprehensive study of the predictive ability of consumer attitudes/plans was performed by Mueller (1963). It was based on 22 surveys performed in 1951-1961 and included models of total private consumption as well as several of its components. Her main findings concerning spending on new cars in the half-year following the survey are:

- personal disposable income explains almost no part of the variance
- the consumer attitudes make a significant contribution explaining 69% taken alone
- the contribution of car buying intentions is negligible when attitudes also appear.

Due to the limited number of observations these results must be considered as tentative. These early findings have all been more or less confirmed in a number of studies in various countries (for surveys see Pickering 1984, Kamakura and Gessner 1986).

There seem to be no published studies of the predictive ability of attitudes/buying plans on car buying purchases based on Swedish data. However, a study of these matters on total durable expenditures was presented by Ågren and Jonsson (1991). They found that buying intention variables concerning cars performed very well both as regards the contribution to the explanatory power and the improvement of the ex post forecasts.

In the present study we are going to investigate the predictive ability of attitudinal data and buying intentions on expenditures on automobiles of households. In doing this we are primarily interested in finding stable relationships including only this type of independent variables since this will give relatively quick forecasts. We will also test if economic variables like disposable income, wealth etc will add anything to the explanatory power. Our earlier promising results when using intentional data in a model of total durable expenditures have inspired us to do a more comprehensive study of how to use this information.

In Section 2 we will describe the data to be used in our study and in Section 3 we present the design of the study. The results are presented in Sections 4-7 and in the final section some concluding remarks are given.

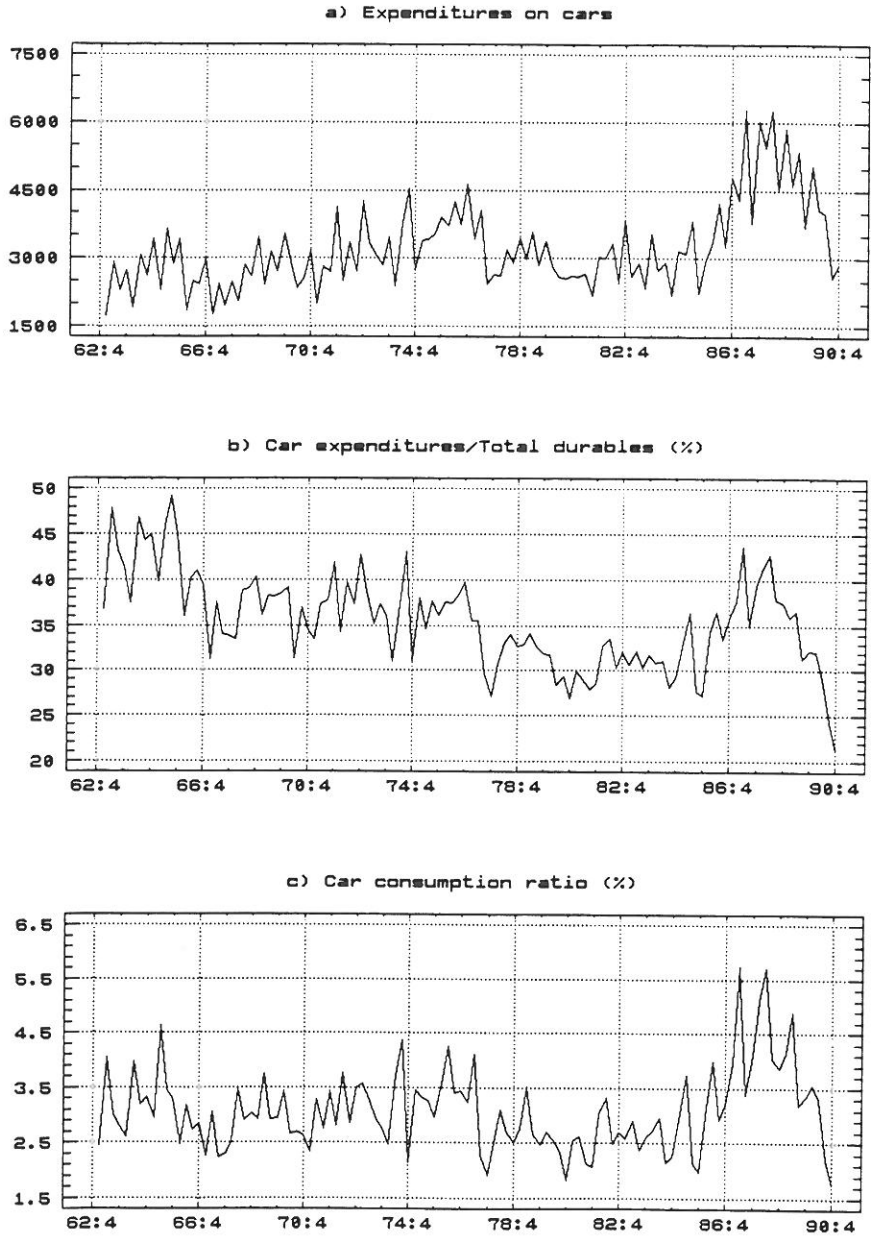
2. DESCRIPTION OF DATA

2.1 **The dependent variable.** In earlier studies of car demand two measures seem to be most frequently used, namely the number of new car registrations and households' expenditures on car purchases. In our study we are going to use the latter one obtained from national accounts statistics. The estimate of these expenditures is obtained by adding two separate components, the value of households' new car registrations and the value of cars transferred from the business sector to the households. The second part has had an increasing importance after 1985 and constitutes about 20-30% today.

In Figure 1a we have illustrated the quarterly expenditures on cars (CA) for the period 1963-1990. We note a decline starting around 1977. This may be due to the crisis in the Swedish industry which followed the high wage increases one or two years earlier. A deregulation of the financial market was carried out in the mid 80's, possibly contributing to the expansion of car demand which reached a top level at the end of the 80's. From the great variability of the series one can expect difficulties in modelling and predicting car expenditures. As already mentioned car expenditures constitute a great and fluctuating part of total expenditures on durables. As can be seen from Figure 1b this variability partly consists of a downward trend distorted by the already mentioned car buying boom in the late 80's. Finally in Figure 1c we show the development of the car consumption ratio. We note that the level is quite stable over time compared with the previous figure.

2.2 **The attitude and intentions data.** Consumer attitudes and buying intentions of Swedish households have been collected by Statistics Sweden since October 1973. The surveys are performed in the first month of each quarter and results are available in the following month. The survey design has undergone several changes (see Appendix 1) and from July 1985 the January and July surveys cover 1500 households while the April and October surveys cover 4200 households. The attitude questions (see Appendix 2) follow the tradition of Katona and Mueller (1952) . There are many different approaches when it comes to measuring purchase expectations (for a discussion see Pickering, 1983). The present approach, used by Statistics Sweden, is based on an assessment of the likelihood that the car purchase will be made within different time horizons. For a more general discussion on the measurement of attitudes and intentions, see Abeele (1988).

FIGURE 1. The quarterly development of households' expenditures on cars in billions of SEK 1985 prices (a), the relation between expenditures on cars and total durables (b) and the car consumption ratio (c) during the period 1963 - 1990.



The attitudinal questions are measured on a three-point scale of the form "Better", "The Same" and "Worse". A common practice is to calculate an index (called balances) based on the difference between the proportion of responses to the alternatives "Better" and "Worse". Another index is obtained by using the proportion of responses to the alternative "Better".

All the attitudinal indices to be used in our study are based on estimated proportions (in %) of households in the population in the given response categories. The notation used when labeling the variables consists of five letters. The first one denotes type of index (A = attitude), the second and third ones denote type of variable, the fourth one is B for better and D for difference (balance) and the last one is B for backward looking and F for forward looking.

AGEBF	=	General Economic situation , Better, Forward.
AGEDF	=	General Economic situation, Difference, Forward.
APFBF	=	Personal Financial situation , Better, Forward.
APFDF	=	Personal Financial situation, Difference, Forward
APFBB	=	Personal Financial situation , Better , Backward.
APFDB	=	Personal Financial situation , Difference, Backward.
AUPBF	=	UnemPloyment, Better, Forward.
AUPDF	=	UnemPloyment, Difference, Forward.

These indices will be used separately or added together in various combinations.

The questions about buying intentions concern the households' plans to buy a car within 3, 6, 12, and 24 months. The intentions are measured on an 11-point likelihood scale (see Appendix 2). The respondents are also asked whether the intentions concern a new or used car purchase[1] . We will be using the following notation for the plan variables in our study

PNi = the percentage of households that are 100% sure that they will buy a new car within i months (i=3,6,12, and 24)

PUi = the percentage of households that are 100% sure that they will buy a used car within i months (i=3,6,12, and 24).

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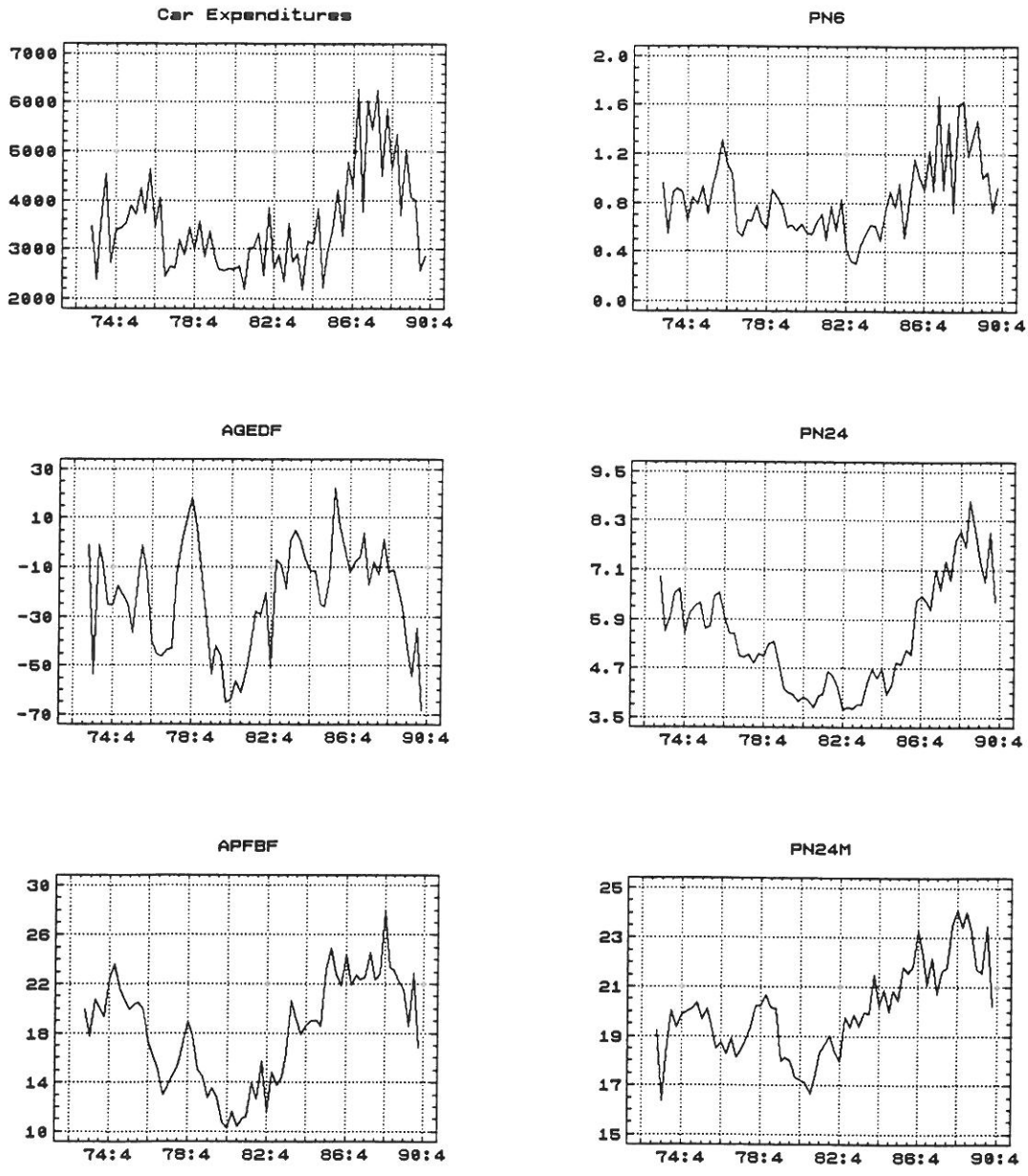
[1] A negligible part of the households has answered Don't know on this question.

FIGURE 2. The development of Car expenditures and five indicators 73:4 to 90:4.



We will also consider mean probabilities of new or used car purchases estimated as a weighted average of the observed likelihoods. The notation for these are PNiM and PUiM.

In Figure 2 some of the attitude/plan variables are illustrated together with car expenditures. An overall impression is that all the indices show a fairly good agreement with car expenditures, maybe with the exception of the AGEDF index. It is worth noting the relatively greater variability in the plan indices during the last 5 year period. This is explained by the increase of the sampling error caused by the reduction of the sample size (from July 1985).

In Appendix 3 pair-wise correlations between all the indices are presented. A few comments worth noting are:

- From the attitudinal part we note high correlations (about .90) for the personal financial situation between forward looking and backward looking questions. Furthermore, indices based on the same questions are all highly correlated.

- The plan indices are highly correlated, the higher the greater part they share. This is the case for new as well as for used cars. However, the level of the correlations is overall higher for new cars.

- The correlations between plans concerning new cars and attitudes about general economic conditions are very low and especially so for the index based on the response alternative "Better". The corresponding correlations are somewhat higher for used cars.

- The correlations between plans about new and used cars are positive but perhaps lower than expected especially for the short-term plans.

2.3 **Other indicators.** Due to the early availability one extra variable will also be included in our study, the total number of registered new cars. The new car registration statistics are published with a delay of 1-2 weeks on a monthly basis. In our study we use for each quarter the notation CREGi for the cumulative number of registrations after i = 1,2 and 3 months. CREG1 is of particular interest since it is already published when the survey-based data is available in the middle of each quarter.

3. DESIGN OF THE STUDY

3.1 **Design of the study.** In the seminal paper by Mueller (1963) the predictive ability of attitudes and buying plans was studied taken alone and together with economic variables like disposable income and prices. This approach has since been used in several other studies (see e.g. Ågren and Jonsson 1991). In general it has been found that attitudes contribute significantly in addition to economic variables whereas buying plans do not add anything extra taken together with the attitudes. In our study we are going to look at the usefulness of attitudes/plans as quick indicators. From this point of view the standard economic variables are disqualified. However, their predictive ability in addition to attitudes/plans will be checked. In the study it is assumed that logged car expenditures is linearly related to one or more indicators. One reason for using this approach is the underlying assumption of a multiplicative seasonal factor. It could be argued that car expenditures should be linearly related to buying plans but a preliminary analysis supported our choice of model.

We are going to look at different forecast horizons within one year. This also includes the actual quarter giving a quick estimate available more than one quarter earlier than the officially produced preliminary estimate.

Our procedure of selecting suitable indicators is based on 1) the R^2-criterion and stability in parameter estimates and 2) a forecast evaluation together with some subject matter considerations. This approach is repeated for three different periods giving an opportunity to evaluate the selection procedure.

3.2 **On using predictors based on survey data.** In the following study of the predictive ability of the survey based attitudes/plans these indices will enter the forecasting model as explanatory variables whereas the dependent variable is obtained from national accounts statistics. Our basic assumption is the existence of a linear relationship of the type

$$\ln CA_t = \alpha + \beta x_t + \varepsilon_t$$

where x_t is the population value of the index. However, this is estimated by X_t obtained from a sample of households of size n_t. The relation between the population

value x_t and the sample value X_t is assumed to be $X_t = x_t + u_t$ with the sampling error u_t being uncorrelated with x_t, having mean = 0, variance $V(u_t)$ depending on x_t and of course on the sample size n_t. Using the sample value instead of the population value in the model gives after some reformulations

$$\ln CA_t = \alpha + \beta X_t + \varepsilon_t - \beta u_t$$

One consequence of using the least-squares estimator on this model with measurement error is inconsistent parameter estimates. This implies that we can expect the β coefficient to be underestimated. Another effect of the measurement error in x_t occurs when the observed value is used in the forecast equation. The effect of the measurement error is related to the so called *reliability ratio* $k = V(x)/V(X)$ (see e.g. Fuller 1987). It can be shown under general conditions that the sample estimate of β tends to $k\,\beta$ and that the ratio between R^2 of the fitted model using X and the fitted model using x tends to k.

Of great importance for our study is of course the size of the reliability ratio k of our attitude/plan indices. The sampling errors of these indices, V(u), can be estimated at each time-point and V(X) can be calculated on the basis of the sequence of surveys. This enables us to obtain an approximate estimate of k. In order to illustrate the implications of the sampling error on k some calculations are presented in Table 1 for a few attitude and plan indices.

TABLE 1. Estimates of the reliability ratio for some indices. Period 76:3-88:4.

Index	Mean of X	V(X)	V(u)	k
AGEBF	12.7%	59.44	.1386	1.00
APFBF	14.8%	8.779	.1576	.98
PN3	.41%	.022	.0051	.77
PN6	.67%	.049	.0083	.83
PN12	1.37%	.168	.0169	.90
PN24	2.65%	.513	.0322	.94

An assumption underlying the calculation of k is the constancy of V(u) over time. In our case V(u) depends on x which varies over time. Our calculations are based on the

mean value of X assuming simple random sampling. According to Appendix 1 the sample size has undergone a change 1979 being reduced from 10 000 to 6600. In our calculation we have used a sample size of 8000. We have not extended our computations to cover the period 1985-1990 due to the reduction in the sample size 1985. We can see from the table that the low proportion variables are very sensitive to the sampling errors.

4. CHOOSING THE BEST SINGLE LEADING INDICATOR: R^2-CRITERION

4.1 **Introduction.** In this section we will try to find a good single leading indicator for consumer expenditures on cars. Our dependent variable has a strong seasonal variation which will be handled with dummy variables. Denoting the observed attitude/plan index by X_t the model to be used in this section is

$$\ln CA_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \alpha_3 D_{3t} + \beta X_{t-j} + \varepsilon_t, \quad (j=0,1,2,3) \qquad (1)$$

where D_{it} denotes the seasonal dummy variable for the i^{th} quarter. Since some of the attitudinal questions concern changes expected one year ahead one might argue for using the change in the dependent variable instead of the level. Therefore we will also briefly examine such a formulation of the model.

The study will investigate the suitability of the indicators for different forecast horizons covering the current period and up to three quarters ahead. This together with the great number of indices to be tried leads to a huge amount of results and we will only present the main findings.

4.2 **Stability in the R^2-criterion.** We will start this section by presenting results for model (1) and the current period. All the information which is of interest in our procedure of determining the best leading indicator can be found in Appendix 4. Results concerning indices using information on the question on unemployment have been excluded since they are not very promising. Figure 3 shows the R^2-values. Figure 4 illustrates the ratios b_3/b_1 and b_2/b_1 where b_1 is based on the period 76:3-84:4 and b_2 and b_3 are based on the two longer periods all three being estimates of β in the model.

FIGURE 3. R^2-values obtained by using 10 attitude indices and 16 buying plans indices (see Appendix 4) for the estimation periods up to 1984, 1986 and 1988.

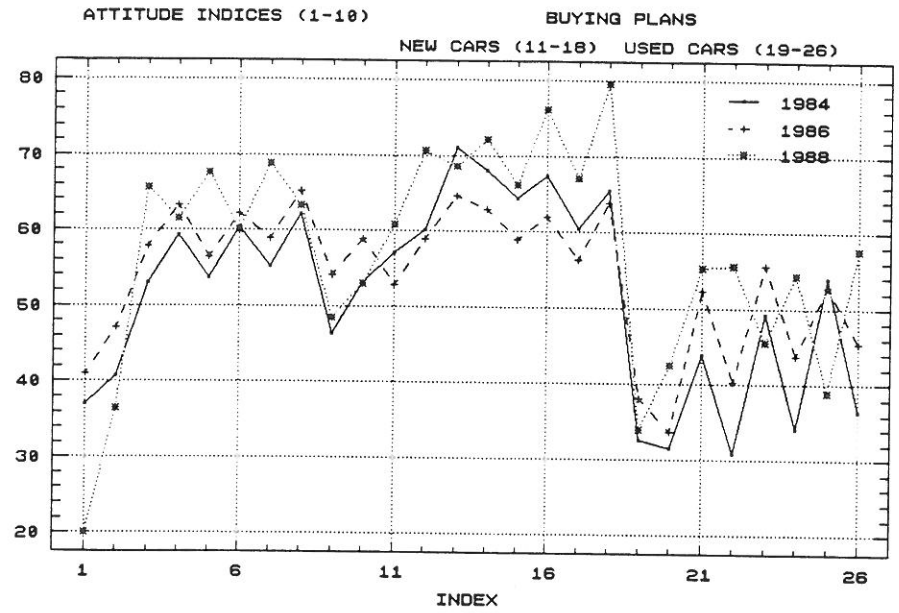
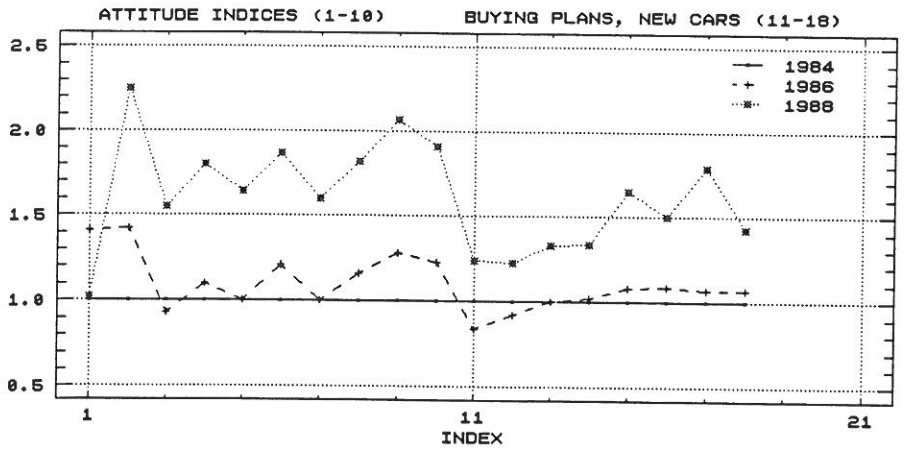


FIGURE 4. The ratios between the parameter estimates obtained for the two longer estimation periods to the shorter period for 10 attitude indices and 8 buying plans.



Starting by looking at the R^2-values of the attitude indices in the left part of Figure 3 (index no 1-10) it is clear that indices no 3-8 outperform the other four. These four ones include responses to the question on general economic conditions whereas the better performing indices are all based only on questions on the personal financial (PF) situation. The best indicator is always to be found among AIPFB or AIPFD (indices no 7 and 8). This indicates that information on backward and forward conditions should be used together.

Turning to the buying intentions indices in the right-hand part of Figure 3 we can see as expected that the indices concerning new cars (no 11-18) have much higher R^2-values than those based on used cars (no 19-26). Disregarding the used cars a basic finding is that mean probability variables (no 12, 14, 16 and 18) often perform better than the corresponding variables based on 100% certain responses (no 11, 13, 15 and 17). The exception from this pattern is PN6 (no 13) which is overall best for the two first time-periods. PN3 (no 11) which measures buying plans for the current quarter is found to be a poorer indicator than all the others. This might be due to the low proportion being measured (see the discussion in Section 3.2). PN24M (no 18) measures buying plans for a 2 years ahead period but in spite of this it is one of the best predictors which of course also could depend on the matters discussed in Section 3.2.

Comparing attitudes and plans for new cars we find that plans perform better for the periods up to 1984 and 1988 and plans and attitudes do equally well for the period up to 1986. In the table in Appendix 4 the bottom line gives the R^2-values obtained by replacing the index by a trend variable in our model. The results support our previous findings that plans and PF based indices perform well and are in fact much better than those for a trend model.

In order to get an idea of how well our models capture the business cycles reflected in the dependent variable we have also presented the Durbin-Watson test statistics in Appendix 4 where low values indicate a deviation from the general cycle. The plan indices are all acceptable in this sense. The DW-statistics are all lower for the attitudes and especially so for the longer period.

In Appendix 5 we have presented figures showing R^2-values for the different indices lagged one, two or three quarters. Looking at the buying plans indices concerning new

cars we observe that the R^2-values in general decrease with increasing lag. It is to be noted that this is also the case for the longer outlook variables. The decrease of the R^2-values is not as pronounced for the attitude indices as for the buying plans making them of about the same size at a lag of one quarter. Outstanding among the attitude indices are the three which are based on the response alternative Better which remain on the same high R^2-level for lags 0, 1 and 2. To summarize, the optimum lag for buying plans seems to be 0 but there are attitude indices for which the optimum lag might be greater than 0 (see index no 7, AIPFB). Lagging the indicators has been found not to improve the Durbin-Watson statistics in any interesting way.

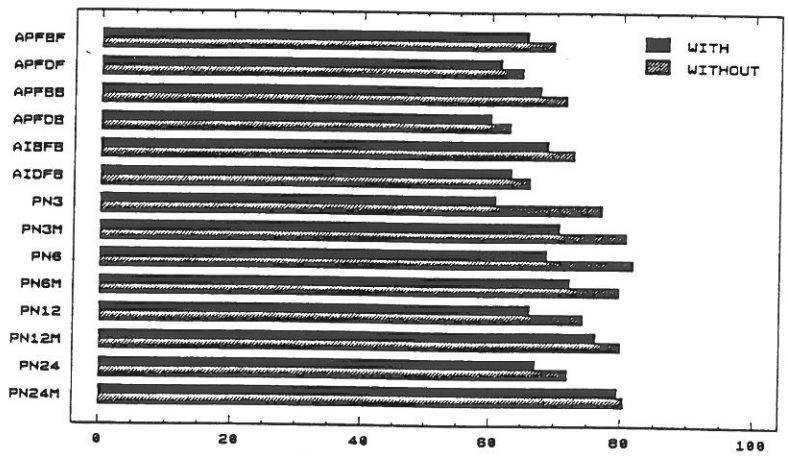
Next we will discuss the stability of the parameter β in our model. Figure 4 illustrates the ratios b_3/b_1 and b_2/b_1 for lag 0. Here b_1 is based on the period 76:3-84:4 and b_2 and b_3 are based on the two longer periods all three being estimates of β in the model. In this descriptive study of stability we focus our interest on deviations from 1. There are no large changes from 1984 to 1986 but adding the observations up to 1988 there is a general increase in the b values and especially so for the attitudes. Looking at the PF based indices (no 3-8) we note that the Better based ones are more stable than the Difference based ones. However, the most stable estimates are found among the plan indices with an outlook of 3 and 6 months and possibly also the remaining two indices based on mean probabilities. When considering models with lagged indices the instability of the parameter estimates increases with increasing lag with a few exceptions (see Appendix 6). Most interesting is to note that AIPFB shows about the same stability for lag 1 as for lag 0.

Finally we will also compare the above results with those obtained by using the car registration numbers. The results can be found in Appendix 4. Beginning with CREG1 (the most interesting variable due to its early availability) we note that it competes very well with anyone of the other indicators as regards the explanatory power. CREG2 and CREG3 which are based on registration statistics for two and three months respectively gives as expected even better R^2-values. Also here we note that the slope estimate increases when using the longer period and surprisingly this is also the case for CREG3. All the DW-statistics are found to be lower than for the plan indices for new cars. It is remarkable to note the especially low values when CREG3 is used.

The alternative model with annual changes of logged car consumption as the dependent variable did not prove to be useful since it resulted in very low R^2-values. This finding supports the traditional approach being used already by Katona and formulated in our model (1), i.e. attitudes predict levels better than changes even though some attitudinal questions regard future changes.

4.3 **On the effects of excluding small-sized samples.** We have earlier mentioned the problem with low proportion variables and the resulting sensitivity to the sampling errors. This occurs in particular for the surveys based on 1500 households (see Appendix 1). In order to get a feeling of the effect of the high sampling errors in these surveys we have estimated some of the models with these surveys excluded. The new R^2-values are presented together with the old ones in Figure 5.

FIGURE 5. R^2-values with and without the 1500 sized sample surveys. Period 1976:3 - 1988:4.



We note that all the R^2-values increase. The sizes of the increases are considerable for those indices which have relatively low reliability ratios in accordance with our discussion in Section 3.2 (cf Table 1). In the previous discussion we have found that PN6 was the best indicator for the period up to 1984. All the surveys performed during this period are based on large samples except the one in 1984:4. Now we also found it to be best for the longer period up to 1988. The parameter estimates have not been presented since there were no significant changes in them. The above results focus on the problems arising when using survey-based plan variables with too small samples.

5. CHOOSING THE BEST COMBINATION OF LEADING INDICATORS: R^2-CRITERION

5.1 **Introduction.** In the previous section we studied the performance of single indicators in the model. In this section we will see whether the addition of one or more indicators improves the results. Here our study covers the two periods 76:3-84:4 and 76:3-88:4, thus excluding 76:3-86:4 to reduce the amount of results. For the same reason we have only studied lags up to the second order and we will start by presenting results for the current period.

5.2 **Combinations of attitudinal indices.** The single indicators studied in Section 4.2 were either based on single questions or unweighted summation of responses to single questions. Combining single indicators implies that we allow for different weights on the questions. Our main finding is that the results obtained for a single indicator could not be significantly improved by adding one or more indicators. This is true also for lagged indicators.

5.3 **Combinations of plan indices.** We have earlier found that the best single indicators for the shorter period was PN6 and for the longer period PN24M. In Table 2 we present those combinations of indices which are significant and give the best fits when taken 2, 3 or 4 together. We note that the best single indicators enter in all the combinations and that the R^2-values can be significantly improved. In the best combination of two indices we find for both periods that an index based on used cars enters. One reason for this might be that the value of used cars transferred from the business sector to households is a part of expenditures on cars. Another reason is to

TABLE 2. R^2-values for the best combinations of plan indices.

No of indices	76:3 - 84:4		76:3 - 88:4	
	Selected indices	Adj R-sq	Selected indices	Adj R-sq
1	PN6	67.1	PN24M	77.7
2	PN6, PU24M	73.9	PU6M, PN24M	81.8
2 (only new cars)	PN6, PN24M	67.7	PN3M, PN24M	80.9
3 "	PN6, PN24, PN24M	72.3	PN3, PN24, PN24M	84.9
4 "	PN6,PN6M,PN24,PN24M	73.7	PN6,PN6M,PN24,PN24M	86.6

regard plans of buying used cars as an indicator of the willingness to spend money on new or used cars. Looking at the longer period only indices based on new cars were selected when considering three or four combinations. This was not the case for the shorter period but restricting our search to new car indices gave results almost as good. We note a high degree of stability in the outcome of the selection procedure.

5.4 **Combinations of attitudinal and plan indices.** For the shorter period the most interesting result is that PN6 together with AGEDF was found to be best (adj $R^2=74.3\%$) when one combines two indicators. For the longer period no combination of attitudes and plans could compete with combinations of plans only. However, disregarding the small sample surveys (see Appendix 1) the same pair of indices found best for the shorter period was best also here (adj $R^2=83.1\%$).

5.5 **Combinations of car registrations and plan/attitude indices.** In this section we will only use car registrations for the first month in each quarter (CREG1) since these data are available at about the same time as the other variables. Adding attitude indices to CREG1 gives only marginal improvements as compared with using CREG1 as a single indicator while adding plans gives large improvements. In Table 3 we have presented the best combinations with new car buying plans.

TABLE 3. The best combinations of CREG1 and new car buying plans.

Combinations	76:3 - 84:4		76:3 - 88:4	
	Adj R-sq	DW	Adj R-sq	DW
CREG1	70.6	1.20	75.9	.84
CREG1, PN24M	76.2	1.35	86.5	1.18
CREG1, PN24M, PN24	80.8	1.52	89.8	1.67

5.6 **Combinations of indices lagged one or two periods.** The main findings when combining indices lagged one period are:

- No significant improvement is obtained by using more than one attitude index.
- A significant improvement is obtained by combining new car plan indices.

- The best two indicators are PN24 and PN24M both for the shorter and longer estimation periods.

- Combinations of plans perform better than combinations of attitudes.

- Combinations of plans/attitudes were not better than combinations of plans. (For single indicators we found that attitudes and plans performed about the same.)

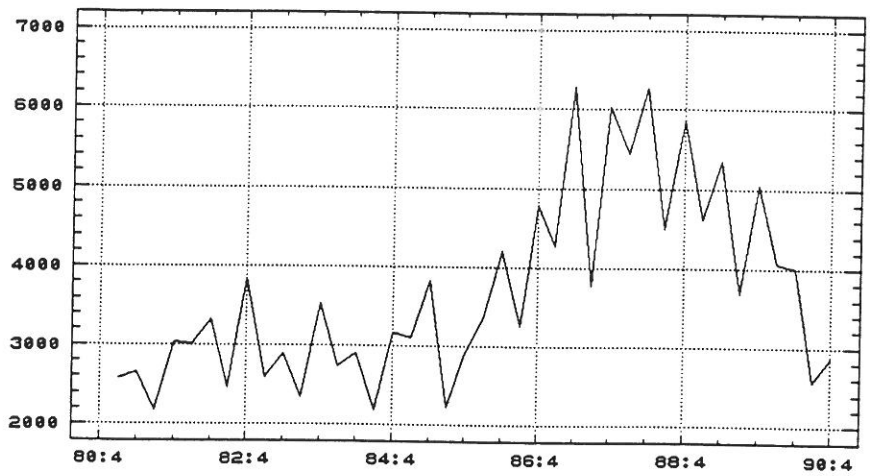
As regards combinations of indices lagged two periods the overall picture is more ambiguous since we get conflicting results for the shorter and longer periods. No combinations of indices perform significantly better than the best single attitude index for the shorter period whereas for the longer period we can find combinations of plans or plans/attitudes which outperform combinations of attitudes.

It is also worth mentioning that the explanatory power decreases with increasing lags.

6. Choosing the best combination of leading indicators: Forecast evaluation

6.1 **Introduction.** The forecasting evaluation to be presented in this section is based on the period 1985:1 - 1990:4. In Figure 6 we have illustrated the development of consumer expenditures on cars 1981 - 1990. As can be seen, the forecasting period includes the earlier mentioned boom in car expenditures with a period of increase (1985-86), high-level expenditures (1987-88) and decline (1989-90). The evaluation does not include a period with a stable development like e.g. 1983-84 since the number of observations to be used in the estimation of the model will be too small. In the evaluation we reestimate the model successively starting with the period 1976:3 to 1984:2 making a forecast for 1985:1 and then adding observations one by one. It is assumed that the forecast is being done in 1985:1 in February when all the indicators are available. The reason why the estimation period ends three quarters earlier is the delay in the production and dissemination of car expenditure data. As in the earlier section we will consider single indicators, combination of indicators and lagged indicators.

FIGURE 6. Car expenditures during 1981-1990 including the evaluation period.



6.2 **Forecasts using single indicators.** In Table 4 we present the results for unlagged indicators as measured by mean errors (ME) and mean absolute errors (MAD). As a basis for comparison we also give measures obtained by producing naive forecasts where the predicted value for a given quarter is the same as the observed value one year earlier[2] . In the table we also find the mean car expenditures (CA) for each period.

Starting with the attitudinal indices we note that indices based only on the questions about the household's own financial situation (APFxx) perform best overall and also in general for the separate periods. It is not evident whether balances or better based indices are to be preferred. This is in line with the R^2-evaluation in Section 4. For the first and third periods the forecast errors are smaller than those for the naive approach while for the second period the naive method substantially outperforms all the attitudinal indices. One possible explanation of this bad performance in the second period is the drastic change in the consumption ratio of cars which is also seen in the

[2] Forecasts have also been calculated on the basis of an ARIMA model. These results have not been presented since the naive forecasts were overall better.

expenditures on cars in the relation to total durable expenditures (see Figure 1b-c) leading to a huge underestimation.

Looking at the plan indices we find the best ones among the short-horizon indices for the whole period. However, for the separate periods the results are indecisive. For instance for the first two periods it makes no difference using a short- or long-horizon index. One striking feature to be noticed is that for the second period and a given horizon (i) the mean based index (PNiM) is always better than PNi while the opposite holds for the third period. In Section 4 we found that the long-horizon index PN24M was among the best single indicators. This is the case also here for the first and second periods but for the third period PN24M fails completely and is performing worse than all the other indicators. The short-horizon index PN3, however, performs very well for the third period but is among the worst of the plan indices in the second period. By examining the actual development of car expenditures one finds a steady decline both for 1989 and 1990 when comparing each quarter with the corresponding one a year earlier. A similar development is found for PN3 while PN24M continues to increase in 1989 and starts to decline 1990. This explains the difference in performance of the two indices mentioned above. Our conjecture to explain this phenomenon is that households tend to revise their short-horizon plans earlier than their long-term plans.

A comparison between attitudes and plans shows that the best plan index PN3M performs somewhat better than the best attitude index. This result is heavily dependent on the relatively poor results for the attitudinal indices in the second period. Also plan indices underestimate the development of car expenditures in the second period but not as much as attitudes.

Table 4 also presents results obtained by using car registration numbers, for the first month in each quarter (CREG1), for the first and second months (CREG2) and for the whole quarter (CREG3). As already mentioned CREG1 is possibly a useful indicator due to its early availability. This is confirmed by our results showing the lowest overall MAD value. However, better indices can be found for the first two periods while CREG1 is outstanding for the third period where it quickly catches the decline in car expenditures. One interesting observation is that even if CREG3 performs quite well compared with all the other indices it still underestimates the mean level of car expenditures with about 14% in the second period.

TABLE 4. Results of the forecast evaluation using single indicators. Mean Errors (ME) and Mean Absolute Deviations (MAD).

Period	85:1 - 90:4		85:1 - 86:4		87:1 - 88:4		89:1 - 90:4	
Index	ME	MAD	ME	MAD	ME	MAD	ME	MAD
AGEBF	1134	1268	446	595	2210	2210	747	998
AGEDF	1080	1152	345	538	2000	2000	894	919
APFBF	439	804	-39	463	1469	1469	-113	479
APFDF	804	925	165	428	1639	1639	607	707
APFBB	402	788	32	475	1395	1395	-222	494
APFDB	747	906	273	512	1660	1660	307	546
AIPFB	380	761	-42	459	1385	1385	-204	440
AIPFD	752	886	200	453	1610	1610	445	595
AIB	849	1012	232	456	1836	1836	479	744
AID	925	1015	238	455	1784	1784	752	807

Period	85:1 - 90:4		85:1 - 86:4		87:1 - 88:4		89:1 - 90:4	
Index	ME	MAD	ME	MAD	ME	MAD	ME	MAD
PN3	502	765	154	586	1380	1380	-27	328
PN3M	155	704	68	535	987	987	-589	589
PN6	321	753	208	552	1110	1132	-355	575
PN6M	62	883	220	579	929	1106	-963	963
PN12	391	867	418	601	1335	1335	-581	664
PN12M	8	956	397	590	917	987	-1290	1290
PN24	407	845	423	618	1356	1356	-560	560
PN24M	-95	961	352	531	812	903	-1449	1449
CREG1	425	662	-104	537	1193	1193	186	257
CREG2	372	504	43	429	918	918	154	166
CREG3	306	470	-14	462	723	723	208	226
Naive	105	855	579	645	805	852	-1070	1070
Mean CA	4262		3459		5303		4025	

Finally we present the main findings concerning lagged indicators. The mean absolute deviations increase with increasing lags both in the case of attitudes and plans. As mentioned earlier the short-horizon indices are parts of the long-horizon indices. Taking this into account by calculating indices like PN6-PN3 or PN12-PN6 do not change these results. The attitude indices AIPFB and APFBF perform best among all indices looking at the whole period for the lags studied (1,2 and 3) and are in general also better in the three sub-periods.

6.3 **On the effects of excluding small-sized samples**. We have earlier studied the effect of excluding the small-sized surveys (1500 households) when determining the best indicators using the R^2-criterion (see 4.3). We have also here taken away these surveys in all estimations and calculated forecast measures as before. For all the plan indices we obtain a decrease in the MAD-values for the third period. For the second period this is also the case for PN3 while a certain deterioration occurs for the longer-horizon indices. This result may be explained by the earlier discussed different levels of the indices.

6.4 **Forecasts using combinations of indicators**. In the R^2-evaluation we found that certain improvements could be obtained by combining especially plan indices (see Tables 2-3). Based on earlier results a relatively comprehensive study of the forecasting properties of combining two indices has been done. A few combinations of three and four indices have also been included in the study.

Our main findings concerning attitudinal and plan indices are:

- Pairwise combinations of attitudes do not improve the forecasts.

- Pairwise combinations of plans do not improve the forecasts overall but do so for the first two subperiods.

- Pairwise combinations of one attitude and one plan improves the forecasts. This is especially so for PN3M giving a MAD value of about 600 with e.g. AGEDF, APFDF and AID. The improvement is mainly due to the outcome in the third period.

- The combination of four plan indices in Table 2 gave the best forecasts of all combinations studied for the first two subperiods but gave poor results in the last period and can not compete when looking at the overall period.

In the case of lagged indicators we have found that the combination of attitudes and plans give improvements for given lags. Interesting to note is that the forecast errors do not seem to increase with increasing lag from lag 1.

Finally we will also investigate the predictive power of car registrations together with attitude/plan indices for lag 0. Some good combinations we have found are presented in Table 5. The best overall combination is CREG1 together with PN3M and AGEDF with a particularly good performance in the third period. Outstanding for the first two subperiods is the combination with PN24 and PN24M. This combination was also one of the best in the R^2-evaluation (see Table 3). However, these long-horizon indices perform badly in the third period as was also the case without CREG1.

TABLE 5. Mean Absolute Deviations for combinations with car registrations (CREG1).

Combinations	85:1-90:4	85:1-86:4	87:1-88:4	89:1-90:4
CREG1, PN3M	564	515	1000	176
CREG1, PN24M	606	386	672	761
CREG1, PN24M, PN24	635	315	437	1151
CREG1, PN3M, AGEDF	536	459	1022	125
Naive	855	645	852	1070
Mean CA	4262	3459	5303	4025

7. DO MACROECONOMIC VARIABLES ADD ANYTHING TO THE INDICATORS?

So far our study has been focused on the predictive ability of attitudinal and plan indices. It is also interesting to check whether macroeconomic variables like disposable income, wealth, etc. add anything to such indicators. In this limited study we have

considered variables corresponding to those used in the model of durable expenditures as specified in Ågren and Jonsson (1991)[3].

Disposable income is the most interesting potential indicator since quarterly forecasts are being published regularly. However, this variable does not add anything to the predictive ability when combined with the best single indicators or good combinations of indicators. Combinations of plans and economic variables that improve the predictive ability measured by R^2 can be found for the period up to 1984 but not for the period up to 1988.

Finally it is worth mentioning that combinations of macroeconomic variables can not compete with combinations of plan indices when using the R^2-criterion.

8. Concluding remarks and discussion.

The purpose of this paper was to investigate the predictive ability of attitudinal data and buying intentions on expenditures on automobiles of households. In our study we also included a predictor based on car registration data for the first month of each quarter. The evaluation of the estimated models was performed by using two different approaches. In the first approach we studied R^2-values and the stability in the parameter estimates and in the second we compared the forecast properties outside the estimation period. On the basis of different estimation and forecasting periods and using these two criteria we could also draw conclusions about the stability in the particular good combinations of indicators selected. The following summary starts with results for non-lagged indicators.

Among the attitudinal indices we found those based on questions about households' own financial situation perform best regardless of evaluation approach. However, on the basis of our results it is not possible to decide whether one should use balances or a 'better' based index. Overall the plan indices concerning new cars perform better or at least as good as the attitudes. The results indicate that the short-horizon indices perform somewhat better than the long-horizon ones. A significant improvement in the

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[3] Disposable Income (Y, Y_{-1}), Financial Wealth (FW_{-1}), Housing Wealth (HW_{-1}), Stock of cars (SA_{-1}), Car Prices (P), Rate of Interest (r).

predictive ability can be obtained by combining indices. When looking at the R^2-criterion this is so especially for plan indices but the overall forecast-evaluation shows improvements only if one combines plans with attitudes.

The predictor based on car registration data was found to perform at least as well as any other single predictor. Even though the car registration indicator is part of car expenditures the study shows that a considerable increase of R^2 can be obtained by adding especially long-horizon plan variables. The same combinations are also found to give improvements in the overall forecasts. However, these combinations are giving poor results for the period of rapidly declining car expenditures in 1989-90.

Our main finding from the study of lagged indicators is that the indices primarily give information about the same quarter as they are collected. This pattern is true for all the plan indices for new cars regardless of planning horizon but some of the attitude indices perform well even when lagged one or two periods as measured by the R^2-criterion.

Finally, two other findings in our study are worth mentioning. A small test was performed to see whether economic variables would add anything to the predictive power of the best combinations of indicators found. Of the variables included it is especially interesting to note that disposable income did not improve the models neither did any other variables in the overall evaluation. Secondly, the problem with low proportion variables and their sensitivity to sampling errors has been pointed out. Some of the surveys used in our investigation were based on small samples. When excluding these we found in particular the performance of the short-horizon plan indices (i.e. the low proportion ones) to be improved. Hence the choice of indicator is dependent on the sample sizes of the surveys.

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APPENDIX 1

Sample sizes used in the Swedish Household Surveys.

Period	January	April	July	October
1973	-	-	10 000	10 000
1974-1978	10 000	10 000	10 000	10 000
1979	10 000	10 000	6 600	6 600
1980-1983	6 600	6 600	6 600	6 600
1984	6 600	6 600	6 600	1 500
1985	6 600	1 500	1 500	4 200
1986-	1 500	4 200	1 500	4 200

APPENDIX 2

16 How likely is it, in percents, that you/your family will buy or change car within 2 years? Which of the alternatives between 0 to 100 do you choose?

Absolutely certain	100 %
	90 %
	80 %
	70 %
	-------
	20 %
	10 %
Absolutely no chance	0 %
Don't know	99

17 a-c What is the chance that you will buy or change car

	a) within 12 mths	b) within 6 mths	c) within 3 mths
Absolutely certain	100 %	100 %	100 %
	90 %	90 %	90 %
	---------	--------	---------
Absolutely no chance	0 %	0 %	0 %
Don't know			

18 If you buy or change car will it be a new or used one?

1 New
2 Used
3 Don't know

43 What do you think the general economic situation of Sweden is going to be over the next 12 months? Will it be better, worse, or about the same as now?

1 Better
2 The same
3 Worse
4 Don't know

45 What do you think about unemployment in Sweden over the next 12 months? Will it decrease, increase or be about the same as now?

1 Decrease
2 The same
3 Increase
4 Don't know

46 Do you think that your/your family's financial situation is better, worse, or about the same compared to 12 months ago?

1 Better
2 The same
3 Worse
4 Unable to answer...
5 Don't know

47 What do you think about your/your family's financial situation is going to be over the next 12 months? Will it be better, worse, or about the same as now?

1 Better
2 The same
3 Worse
4 Don't know

APPENDIX 3

Correlations between attitudes and plan indices based on the period 76:3-88:4.

	AGEBF	AGEDF	APFBF	APFDF	APFBB	APFDB	AUPBF	AUPDF
AGEDF	0.89							
APFBF	0.47	0.75						
APFDF	0.60	0.83	0.94					
APFBB	0.27	0.60	0.91	0.87				
APFDB	0.32	0.54	0.79	0.88	0.89			
AUPBF	0.61	0.77	0.68	0.73	0.63	0.56		
AUPDF	0.53	0.77	0.79	0.80	0.75	0.64	0.94	
PN3	0.17	0.37	0.58	0.56	0.62	0.56	0.56	0.55
PN3M	0.13	0.38	0.66	0.62	0.70	0.61	0.57	0.59
PN6	0.11	0.33	0.62	0.62	0.70	0.69	0.54	0.54
PN6M	0.09	0.35	0.68	0.68	0.75	0.74	0.54	0.56
PN12	0.09	0.29	0.57	0.63	0.68	0.76	0.54	0.52
PN12M	0.15	0.39	0.68	0.73	0.77	0.81	0.60	0.60
PN24	0.08	0.29	0.62	0.68	0.75	0.85	0.49	0.50
PN24M	0.15	0.41	0.73	0.76	0.81	0.84	0.57	0.59

	PN3	PN3M	PN6	PN6M	PN12	PN12M	PN24
PN3M	0.96						
PN6	0.91	0.94					
PN6M	0.83	0.91	0.96				
PN12	0.82	0.86	0.93	0.93			
PN12M	0.76	0.83	0.89	0.94	0.96		
PN24	0.71	0.76	0.85	0.89	0.94	0.96	
PN24M	0.66	0.76	0.81	0.89	0.89	0.97	0.95

	AGEBF	AGEDF	APFBF	APFDF	APFBB	APFDB	AUPBF	AUPDF
PU3	0.30	0.44	0.42	0.41	0.47	0.32	0.41	0.43
PU3M	0.36	0.55	0.59	0.48	0.52	0.27	0.48	0.55
PU6	0.29	0.50	0.65	0.63	0.65	0.57	0.43	0.47
PU6M	0.36	0.60	0.72	0.61	0.61	0.40	0.53	0.60
PU12	0.36	0.53	0.65	0.71	0.72	0.74	0.44	0.46
PU12M	0.43	0.71	0.80	0.75	0.77	0.59	0.66	0.72
PU24	0.33	0.49	0.62	0.74	0.71	0.83	0.46	0.47
PU24M	0.46	0.76	0.87	0.82	0.84	0.66	0.70	0.77

	PU3	PU3M	PU6	PU6M	PU12	PU12M	PU24
PU3M	0.86						
PU6	0.71	0.75					
PU6M	0.59	0.85	0.82				
PU12	0.46	0.41	0.74	0.58			
PU12M	0.48	0.66	0.70	0.85	0.78		
PU24	0.38	0.24	0.57	0.36	0.88	0.62	
PU24M	0.51	0.66	0.68	0.80	0.72	0.96	0.65

Correlations between new/used buying plans of the same time horizon.

PN3 - PU3	0.38	PN12 - PU12	0.57
PN3M - PU3M	0.41	PN12M - PU12M	0.56
PN6 - PU6	0.46	PN24 - PU24	0.75
PN6M - PU6M	0.43	PN24M - PU24M	0.65

APPENDIX 4. Estimation results for model (1) without lags.

INDEX		76:3 - 84:4			76:3 - 86:4			76:3 - 88:4		
	No	R-sq	b	DW	R-sq	b	DW	R-sq	b	DW
AGEBF	1	37.1	.0061	.86	41.0	.0086	.86	20.0	.0062	.32
AGEDF	2	40.8	.0024	.85	47.1	.0034	.87	36.5	.0054	.39
APFBF	3	52.9	.029	1.00	57.7	.027	1.04	65.6	.045	.80
APFDF	4	59.3	.010	1.16	63.2	.011	1.19	61.5	.018	.66
APFBB	5	53.7	.028	1.13	56.4	.028	1.08	67.6	.046	.79
APFDB	6	60.4	.0091	1.23	62.1	.011	1.14	60.0	.017	.55
AIPFB	7	55.2	.015	1.07	58.8	.015	1.05	68.8	.024	.77
AIPFD	8	62.1	.0051	1.23	65.1	.0059	1.20	63.3	.0093	.61
AIB	9	46.3	.0058	.96	54.0	.0074	1.03	48.4	.012	.55
AID	10	53.1	.0022	1.03	58.9	.0027	1.06	53.0	.0042	.52
PN3	11	57.1	.68	1.51	52.8	.57	1.55	60.8	.84	1.43
PN3M	12	60.1	.66	1.50	58.9	.61	1.57	70.6	.81	1.66
PN6	13	71.0	.51	1.47	64.6	.51	1.51	68.6	.68	1.50
PN6M	14	68.1	.41	1.39	62.8	.42	1.42	72.2	.55	1.53
PN12	15	64.4	.26	1.44	58.8	.28	1.31	66.1	.43	1.05
PN12M	16	67.4	.22	1.47	61.9	.24	1.31	76.2	.33	1.24
PN24	17	60.3	.14	1.25	56.2	.15	1.13	67.1	.25	.82
PN24M	18	65.4	.14	1.44	63.8	.15	1.37	79.5	.20	1.30
CREG1		74.2	.37	1.20	70.7	.34	.97	77.8	.49	.84
CREG2		80.4	.19	.76	76.9	.19	.78	84.6	.26	.68
CREG3		82.5	.14	.55	79.9	.14	.55	88.5	.17	.45
T + S		45.9	-		30.0	-		37.4	-	

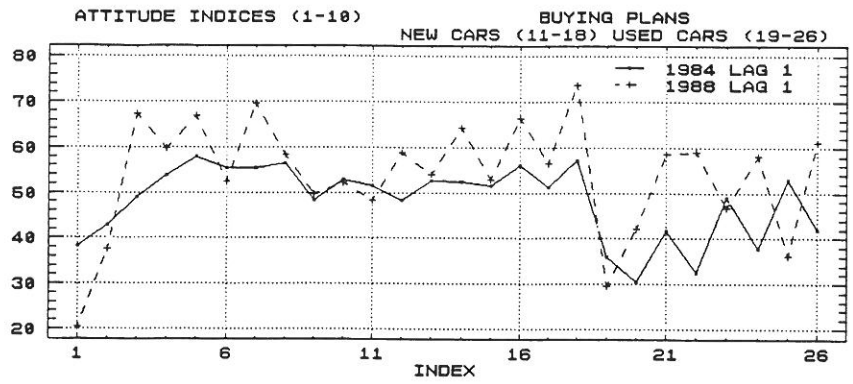
1) The indicators 1-6 and 11-18 have been defined in Section 2.2 and 7-10 are defined as follows:

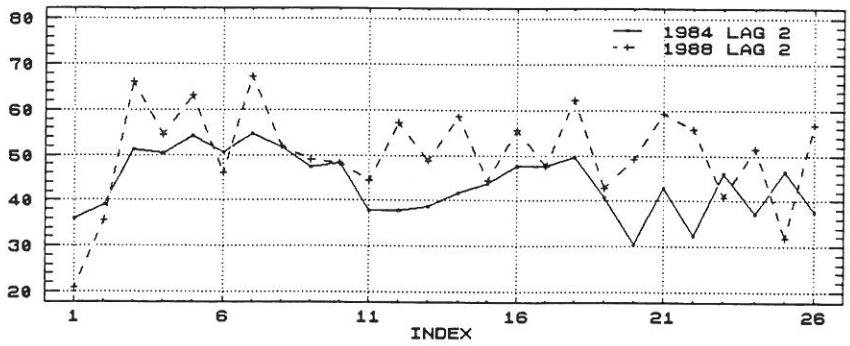
AIPFB = APFBF + APFBB
AIPFD = APFDF + APFDB
AIB = AGEBF + AIPFB
AID = AGEDF + AIPFD

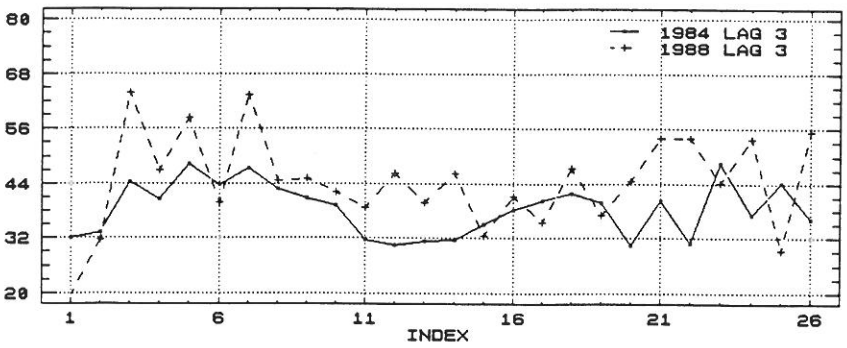
2) Corresponding to the eight indices for new cars (11-18) we also have defined eight indices for used cars, 19-26.

3) T + S corresponds to a model for ln CA with trend and seasonal dummies.

APPENDIX 5. R^2-values obtained by using 10 attitude indices and 16 buying plans indices[4] lagged 1, 2 and 3 times for the estimation periods up to 1984 and 1988.

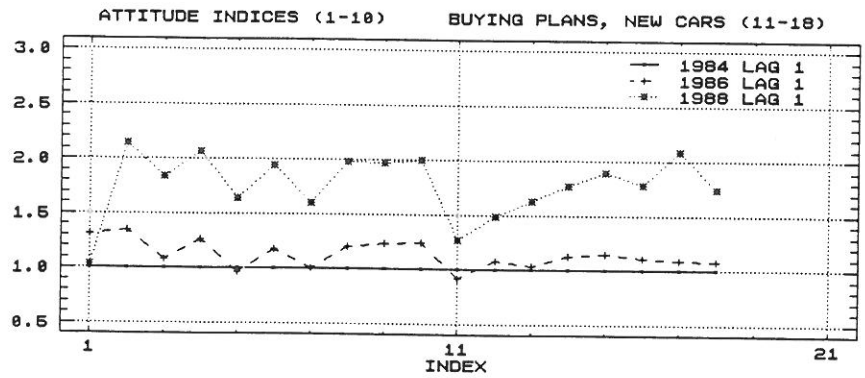


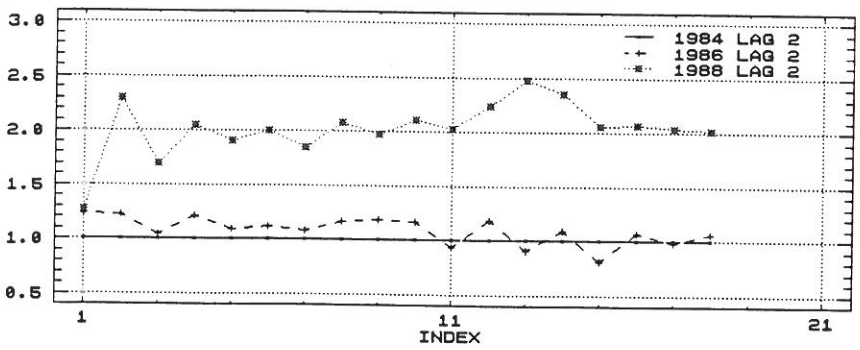


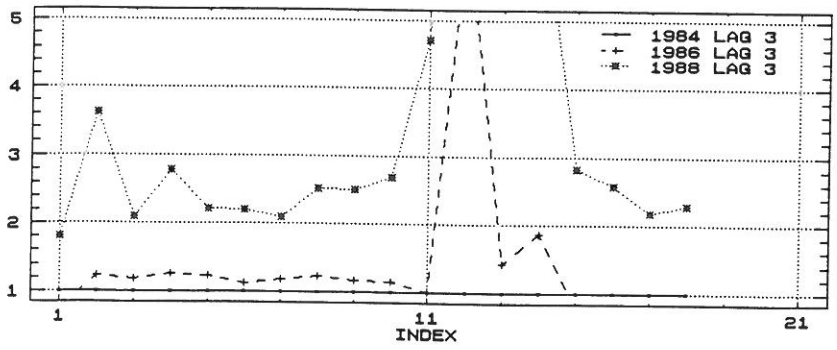


[4] The index numbering is defined in Appendix 4.

APPENDIX 6. The ratios between the parameter estimates obtained for the two longer estimation periods to the shorter period for 10 attitude indices and 8 buying plans indices[5] lagged 1,2 and 3 times.







[5] The index numbering is defined in Appendix 4.

SAMMANFATTNING

Statistiska Centralbyrån har sedan oktober 1973 gjort regelbundna kvartalsvisa undersökningar av hushållens attityder till den egna ekonomiska situationen och landets ekonomi i stort. Hushållen tillfrågas också om sina planer på bilinköp inom olika tidshorisonter. På basis av svaren på frågorna har vi konstruerat flera alternativa attityd- och planindex. Syftet med vårt arbete var att undersöka prognosförmågan hos sådana index för hushållens kvartalsvisa bilutgifter. Preliminär statistik över dessa utgifter blir inte tillgänglig förrän 1-2 kvartal efter det kvartal utgifterna avser. Det är därför av intresse att göra prognoser inte bara framåt i tiden utan också för innevarande kvartal. Ytterligare en indikator inkluderades i vår undersökning, nämligen antalet nyregistrerade bilar första månaden i respektive kvartal.

Vi antog att variationen i bilutgifterna kan beskrivas med hjälp av en eller flera av de ovan nämnda indikatorerna. Vid utvärderingen användes två olika ansatser. I den första ansatsen undersöktes de olika indexens förmåga att förklara variabiliteten i bilutgifterna inom perioderna (1976:3-1984:4, 1976:3-1986:4 och 1976:3-1988:4). I den andra jämfördes indexens prognosegenskaper utanför estimationsperioderna för tre olika tidsperioder under slutet av 80-talet (1985-1986, 1987-1988 och 1989-1990). Skälet till flera undersökningsperioder är att vi vill dra slutsatser om stabiliteten i urvalet av "bästa" index.

Vi börjar vår resultatredovisning för innevarande kvartal. Bland attitydindexen fann vi att de index som baseras på frågor om hushållets egen ekonomiska situation var bäst oavsett utvärderingssätt. Överlag visade det sig att planindex rörande nya bilar var minst lika bra som attitydindexen. Resultaten indikerar att index baserade på kortsiktiga planer är något bättre än de som avser planer på längre sikt. Genom att samtidigt använda flera index kan vi få avsevärt bättre resultat.

Användandet av bilregistreringsstatistik som prognosinstrument visade sig ge minst lika bra resultat som någon annan enstaka attityd- eller planindikator. Det är emellertid möjligt att uppnå ännu bättre resultat om man utnyttjar bilregistreringsdata tillsammans med attityd- och/eller planindex. Emellertid visar det sig att den bästa kombinationen inkluderar olika index beroende på vilken prognosperiod som använts. Vissa kombinationer underskattar uppgången 1987-1988 i bilutgifterna men klarar nedgången 1989 och 1990, medan förhållandet är det motsatta för andra kombinationer (se Tabell 5).

Våra försök att göra prognoser med olika tidshorisonter visade att indikatorerna primärt ger information om samma kvartal som de insamlats. Detta mönster stämmer för alla planindex för nya bilar, medan några av attitydindexen visade sig vara relativt bra även för prognoser ett eller två kvartal framåt.

Vi har också undersökt huruvida makroekonomiska variabler, som exempelvis disponibel inkomst, tillför information utöver attityder/planer vad gäller bilutgifternas variabilitet. Det visade sig då i huvudsak att så inte var fallet.

Slutligen är det värt att påpeka att urvalet av bra indikatorer har visat sig vara beroende av antalet hushåll som ingått i undersökningarna. Detta antal har varierat kraftigt över åren (se Appendix 1). De index som avser att mäta hushållens inköpsplaner på 3-6 månaders sikt blir mycket osäkert skattade för de små undersökningarna under de senaste sex åren. Resultatet förbättras avsevärt för dessa index om de små undersökningarna utesluts ur analysen.

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