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EFFECTS OF ONLINE SHOPPING ON VEHICULAR TRAFFIC

October 2001

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16. Abstract

The purpose of this research was to assess and project the effects of online shopping on vehicular traffic. It was anticipated that as more people purchased goods and services online. short-distance traffic would be reduced.

The method of study was personal interviews following a literature review of this subject. Efforts were focused on consumers' shopping behaviors and the resulting effects on short-distance traffic. Survey data were combined with forecasts of online shopping volume from eMarketer, and estimates of total trip savings were made for the years 2000 and 2004.

The results were not encouraging. We estimated that online shopping reduced total short-distance vehicle traffic by only 0.31 percent in 2000, and in 2004, the reduction in short-distance vehicle traffic will be about 0.93%.

The implications are that online shopping cannot be counted on for significant reduction in vehicular traffic in the short to immediate term. However, this conclusion will change if technology development moves ahead to the point of making online shopping more attractive for the majority of shoppers.

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EXECUTIVE SUMMARY

The purpose of this research was to assess and project the effects of online shopping on vehicular traffic. As more people purchased more goods and services online, we anticipated that short-distance traffic would be reduced. Working against this trend would be the increase in traffic accruing to short-distance delivery of products purchased online. However, the result should be a net reduction in traffic as short-distance shopping is replaced with more efficient short-distance shipping. Another expected effect was the reduction in need for parking at shopping centers, which might eventually have land use implications.

This study began with a series of personal interviews, after we discovered a scarcity of prior research on this topic. We quickly discovered that parking concerns and short-distance shipping concerns had not been impacted visibly yet. The booming economy in early 2000 had washed out any effects we might have observed otherwise.

Accordingly, we focused our efforts on consumers' shopping behavior and the resulting effects on short-distance traffic.

After learning more about the context of online shopping from our interviews, we created a questionnaire and tested it with business students. We ran the revised questionnaire and a second improved questionnaire on InsightExpress's online research service. We used the online research service because it offered numerous advantages over the mall intercept method we had originally intended to use. Most important, it offered an efficient means of accessing our target respondents—online shoppers.

We combined the survey data with forecasts of online shopping volume from eMarketer, a firm specializing in market research on Internet-related industries. The survey data gave us estimates of trip savings for shopping activity; eMarketer gave us estimates of the volume of shopping activity. We then calculated estimates of total trip savings for 2000 and 2004.

Trip savings in 2004 were projected based on assumptions concerning a shift in the distribution of shoppers from early adopters to a balance between early adopters and later adopters.

Data from the U.S. Department of Transportation Federal Highway Administration (US DOT FHWA) provided the basis for projecting short-distance vehicular traffic for 2000 and 2004. We were then able to compare our estimates of trip savings with these projections of total vehicle traffic.

The results were not encouraging. We estimated that online shopping reduced total short-distance vehicle traffic by only about 0.31 percent in 2000. In 2004, we project the reduction in short-distance traffic will be about 0.93 percent.

We increased the estimates for trip savings per transaction by about two standard deviations. Even using these extreme estimates, we could only project about a 2.7 percent reduction in short-distance traffic in 2004.

The implications are that online shopping will not reduce vehicular traffic greatly in the short to intermediate term. This conclusion would change if technology development moved ahead to the point of making online shopping much more attractive for the majority of shoppers.

INTRODUCTION

Transportation and environmental policy makers have questioned whether the onset of online shopping will have an effect on transportation congestion and related systems, such as air pollution and land use. The hope is that online shopping will result in fewer trips being made, thus contributing to relief of congestion, reduction in air pollution, and fewer demands for retail and parking space. While online shopping is still in its infancy, the rapid increase in Web shopping suggested that the real impact might be felt in the near future.

With this as background, the current study was launched to attempt to assess the current and future impact of online shopping on transportation patterns. The study relied on consumers' self-reports of behavior changes. While this is not the most reliable way to assess behavior changes, it enables changes to be linked to reports of consumer motives and consumers' procilivities to adopt innovations. This kind of research thus enhances insight into the adoption process, so that future trends in behavior changes can be better anticipated. Without such insights, quantitative modeling efforts (such as using the Bass model or others) would need to rely on few data points and would make forecasts with limited confidence.

The findings we present in this report suggest that the current effects of online shopping are minimal. Over the next few years, the impacts are likely to remain "under the radar" until a critical mass of trip savings is achieved. Further, as more online shopping occurs, the effects on trip savings are diminished—trip savings per dollar spent appear to decrease as more purchases are combined in each "shopping event." As online shopping is adopted more readily, more shopping events will constitute multiple purchase events. Another disappointing result is the apparent lack of impact on peak congestion periods. It appears that weekend traffic is reduced more than weekday peak commute traffic.

Accordingly, the policy implications of these findings would appear to have a negative hue. For the near and middle term, more impacts can be expected from other electronic activities. Telecommuting comes to mind as the Web-related activity with the highest likelihood of reducing commute-time traffic congestion.

METHODOLOGY

We began this research with three guiding elements in mind. First was the overall purpose of the research—to investigate the effects of online shopping on transportation and traffic. One key goal of this research was to project or forecast any savings in physical trips resulting from online shopping.

The second guiding element was our rudimentary expectation of the findings that would result from our research efforts. We realized that our expectations were based on little more than our own experiences with online shopping. Accordingly, we started with a set of working hypotheses, which we laid out in the original proposal for this research. These working hypotheses were expressed as a set of findings expected as online shopping is adopted:

1. A decrease in peak-time shopping trips
2. A decrease in the number of shopping trips
3. A decrease in the duration of shopping trips
4. An increase in traffic congestion stemming from increased delivery of online product orders.

We recognized that our working hypotheses were naïve and that we knew little about how online shopping translated into changes in physical shopping behavior. We also suspected, as was quickly borne out, that other investigators had done little relevant research. Given a lack of theory and data to build upon, we expected that we would need to begin our research with an exploratory component. The method of assessing transportation impacts and projecting the effects would be designed as the research progressed.

Our third guiding element was that we needed to obtain data directly from individuals if we were to understand relationships and make reasonable projections. Therefore, we anticipated interviewing shoppers and using some kind of questionnaire to obtain usable data.

As the interview portion of the research unfolded, we learned that the changes in shopping trip duration would be difficult to separate from other trends. Also, changes in traffic congestion from product delivery increases were negligible, as we learned in discussions with a UPS executive. Accordingly, we concentrated on the first two working hypotheses, refining our focus to

projecting the effect of online shopping on the number of physical shopping trips and on peak-time demand.

In our proposal, we had stated that hypotheses for seasonal traffic changes and modal usage shifts would be developed during the exploratory phase of the research. As our interviews progressed, we saw that the largest seasonal effects would be differences between the holiday season and the rest of the year. Modal shifts were beyond the insight of the research team at the time the project began, but we expected to make appropriate hypotheses during the exploratory phase. As we learned later, it is too early in the adoption of online shopping to be able to tease out modal shifts or seasonal traffic changes. The timing of the data collection also made it difficult to anticipate changes in physical shopping at holiday time, because the data were collected in May and September. This was too late for those interviewed to remember accurately what they had done in November and December of 1999 and too early to anticipate actual behavior for the holiday season of 2000.

As a result of these factors, the research focused on determining how online shopping affects the number of physical trips shoppers take to retail outlets and the timing of those trips.

CONCEPTUAL DEVELOPMENT OF THE PROJECTIONS

We did not find any prior research or theoretical articles that concerned the conversion of online shopping activity into changes in physical shopping. Therefore, we were left with the need to perform exploratory research.

The key concept that helped us formulate our thinking on how to project shopping behavior into the future was the idea of segmentation in the diffusion of innovations. Rogers has found that first-time adoption of an innovation differs in timing and circumstances for different types of users.[1] Adopters fall into five categories or segments: innovators, early adopters, early majority, late majority, and laggards. The number of adopters is distributed roughly normally around the mean time to first adoption (see Figure 1). Innovators are roughly three standard deviations from the mean; at two standard deviations, the early adopters category starts; the early majority begins at one standard deviation from the mean and accounts for roughly a third of new adopters; the late majority begins at the mean and extends one standard deviation behind the mean, accounting for another third of adopters; laggards begin one standard

[1] Rogers, Everett M. *Diffusion of Innovations*, 4th ed., New York: Free Press, 1995.

deviation past the mean and account for all other adopters, about one sixth of the number of adopters.

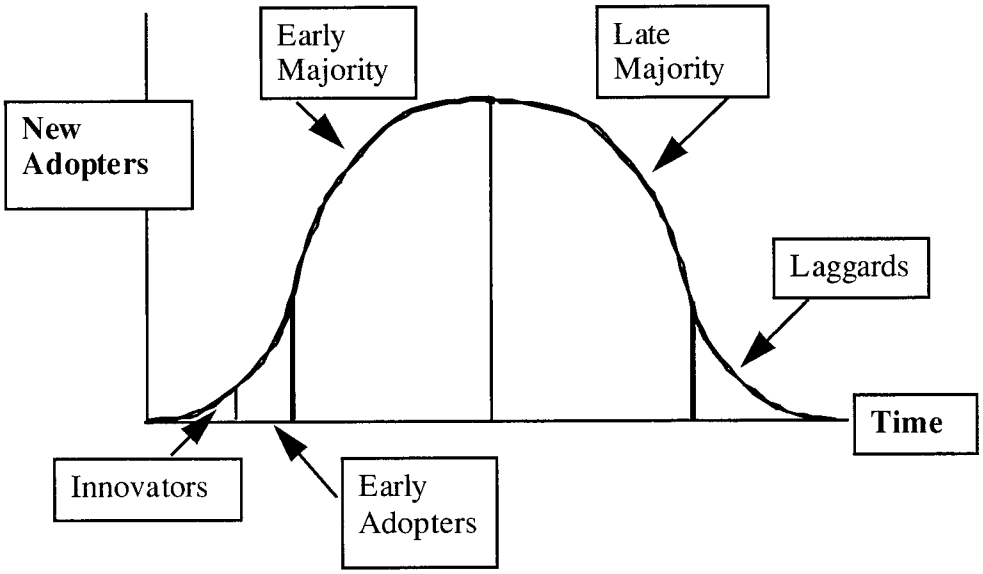

Figure 1. Types of New Adopters

Geoffrey Moore has observed this same distribution for adopters of high-technology new products and has developed extensive managerial implications based on the distribution.[2] Although Rogers and Moore differ on some elements of the characteristics of the adopter groups, the differences are not important for this research.

This concept of different segments of adopters, adopting at different times, can be used in projecting future trip savings. Rogers argues that the personal characteristics of adopter groups make their behavior largely consistent: If a group acts as innovators for one type of new product they will tend to be innovators for other products; if they are late majority adopters for one product, they are likely to be late majority adopters for other products; and so on. In this research, we asked respondents to characterize their own adoption tendencies and, in effect, categorize themselves. We then were able to change the weight given to each adoption group to reflect Rogers' ideal distribution of adopter categories. Instead of equal weighting of respondents' answers, the

[2] Moore, Geoffrey. *Crossing the Chasm*, New York: HarperCollins, 1991; *Inside the Tornado*, New York: HarperCollins, 1995; *Living on the Fault Line*, New York: HarperCollins, 2000.

shopping behavior and trip-saving characteristics would be weighted by their adopter category membership, to be included in the calculation of the 2004 projections. The mechanics for accomplishing this are described fully in Appendix E, "The Model for Projecting Trip Savings."

EXPLORATORY RESEARCH

The first phase in performing the research was to obtain a deeper understanding of how online shopping translated into changes in travel behavior. We did this through a short series of exploratory interviews. The approach taken was consistent with a grounded theory approach. It was not important to obtain a great number of interviews; we only needed enough to get a sense of context, language, and likely relationships. We prepared a short series of open-ended questions focusing on the respondent's most recent online shopping experience. The questions are shown in Appendix A. These questions were a guideline for questioning; the interviewer asked add-on questions as appropriate. The idea was to let the respondent talk about his or her experience in online shopping and then talk about how he or she would have shopped for the same products or services offline. These qualitative data then would become the basis for designing a survey to address our working hypotheses and the forecasting issues we faced. The questions dealt with the following topics:

- The shopping process
- Motivations for shopping online
- The number of trips taken, why, and when
- The number of trips saved and when they would have occurred, if taken
- Factors that would likely affect shopping behavior, such as type of products, price range, importance, familiarity with the products and merchants
- Satisfaction with the experience and the likelihood of shopping online in the future.

Sixteen people were interviewed over four weeks. At first we recorded the interviews, but this was cumbersome; taking notes was found to suffice for our purposes. Over the exploratory period, we met several times to discuss our interviews. We refined some lines of questioning, but found that the original script was workable.

At the end of April 2000, we summarized the relationships and factors we expected to be relevant. These were:

- The type of product has an effect on the travel saved by online shopping.
- The range of shopping trip combinations was vast—people often shopped for multiple items online. Of course, people often combine shopping trips offline, as well.
- Peoples' experience with a product category can influence the number of trips saved. However, sometimes this will actually be negative savings—shopping online will induce more trips than would have been taken otherwise.
- Key reasons for shopping online were convenience, time savings, selection, prices, and access to retailers and products that otherwise would not be accessible. The respondent could calculate trip savings fairly easily when time savings, convenience, and price comparisons were key motivators. Trips savings were less easily calculated when the Web offered access to products or retailers that a consumer normally could not find.
- Physical trips often were thought to be required when shopping for items that the consumer felt needed inspection or trial. Online shopping could reduce these trips, but not eliminate them.
- The number of trips saved also was affected by whether the consumer was shopping for a single item (or type of item, if was to be bought in quantity) or for several types of items.

Other factors that might affect trip savings included demographic differences, prices of the products sought, and familiarity with products or brands sought.

The initial questionnaire and succeeding versions of it were tested with three classes of business students at San José State University. The tests involved students filling out the questionnaires and making comments as to whether it was readable and understandable. Based on these comments, we further refined the questionnaire.

USE OF ONLINE SURVEY TECHNIQUE

The original proposal for this research called for respondents to be recruited from stores in shopping malls. While the exploratory research was being done in early 2000, an Internet phenomenon emerged: Research companies began offering do-it-yourself online questionnaire research. We investigated two

providers of online surveys, InsightExpresss (www.insightexpress.com) and Zoomerang (www.zoomerang.com). QuickTake.com also was evaluated, but left the market before we were ready to choose a vendor. (They reentered the market in 2001.)

We evaluated the cost and capability of each and chose to use InsightExpress. Zoomerang's sampling process and cost were not communicated clearly, but InsightExpress's cost was understandable and reasonable. Also, InsightExpress offered direct access to respondents who were prequalified as online shoppers.

We needed to adapt the questionnaire to InsightExpress's online format. We submitted the questionnaire and InsightExpress staff examined it, made suggestions, and approved a revised version for posting.

Use of the online survey was judged to have numerous advantages with acceptable methodological shortcomings. The principal negative aspect of the online questionnaire approach was the choice of a sample. InsightExpress recruits respondents through banner advertisements placed on Web sites with visitors known to fit the sample frame. The banner ad asked for online shoppers willing to give an opinion. Of those who clicked on the ad, about half completed the questionnaire.

The concern is whether this is a random sample. We believed the threat to random selection was similar to that posed by other methods of respondent recruitment. In all survey methods, there is a stage at which the potential respondent makes a choice of whether or not to respond. The difference is that respondents who have opted into a research panel may be systematically different in some way from those who decide to answer a questionnaire on a one-time basis. As long as the opt-in method casts a wide net and as long as a penchant for answering questionnaires does not skew results, there should be no difference in the survey outcome. In this case, respondents in our qualitative interviews reported trip savings very close to the average number of trips reported saved by survey respondents. Therefore, we believed that any bias that existed was likely to have minimal effect.

The advantages of using online surveying were numerous. The cost difference allowed us to collect data from 600 respondents instead of 100 to 200. The sampling process used by InsightExpress ensured that we received responses from people who were within our sample frame and that these respondents were recruited efficiently. Collecting data through mall or store intercept interviews, as we originally proposed, would have been less efficient in that we

would have had to approach many potential respondents who had not done much online shopping.

The online survey also provided data quickly, accurately, and in usable form. We had no expense or time taken for entering data or checking to ensure that data were entered accurately. We were able to analyze the data relatively quickly and revise the questionnaire in time to launch another survey.

The advantages of cost and timeliness seemed to outweigh the drawbacks. The negative effects appear to be minimized, given the situation. Since we needed to represent the population of online shoppers, reaching them via the Internet was not only appropriate but also more efficient than trying to reach them through store intercept interviews. The method by which the respondents were obtained created a sample of people who have opted in to the process. Mall intercepts would have obtained a sample that in itself was opt-in as well, so it was judged that little was lost in the selection process.

Once the data were obtained from the surveys, two classes of marketing undergraduate students interviewed respondents of their own choosing in order to validate the results from the online surveys. The data they obtained were consistent with the data we received from the surveys. The students also obtained data on when during the week respondents thought trips were saved through online shopping.

First Survey Questionnaire

The first survey, shown in Appendix B, was intended to assess trip savings associated with any kind of online shopping activity, whether it led to an online purchase, offline purchase, combination purchase, or no purchase. It asked the respondent to recall his or her most recent shopping experience in which some shopping was done online. We chose this as our shopping event of interest because interviews indicated this was the event that people could best recall and because it included all kinds of online shopping.

InsightExpress administered the first survey on July 7 and 8, 2000. Data collection ceased as soon as the contracted number of completed surveys was received. Of the 548 persons who responded to the banner ads by clicking through to the Web page for the survey, 301 responses were received—a nominal response rate of 54.9 percent. The data were delivered to us in an Excel file. We examined the data and removed the obvious outliers—respondents who said that they had saved more than 15 trips in their latest

online shopping experience. This was an arbitrary cutoff point, made because there was a break in the frequency distribution for this question. Based on our interviews, we suspected the accuracy, and even the motives, of anyone reporting trip savings as high as 15 for a given online shopping session. It is entirely possible that we eliminated some respondents who indeed saved an extraordinary number of trips by shopping online. We think it is more likely that we included a few respondents who inflated the number of trips saved for whatever reason, but whose inflated number was still below our cutoff point. In the "Discussion, Conclusions, and Implications" chapter, we discuss more thoroughly the ramifications of the inaccuracy of respondents' reported trip savings. After eliminating the outliers, we were left with 278 usable responses.

Lessons from the First Survey Leading to the Second Survey

Results of Survey 1 are included in the analysis leading to projections of trip savings. The most important outcome of the first survey was the proportion of shopping activity that led to offline purchases or no purchases.

Along with these data, we learned a great deal from the first survey that helped sharpen our thinking on calculating trip projections. Concurrently, we found a useful projection of online shopping activity from the research company eMarketer, which is discussed beginning on page 13.

We had grouped categories based on similarities in buying behavior and expected to find a third-party projection of online shopping with product categories that would translate well into ours. In retrospect, we would have been better served to ask open-ended questions such as, "What kinds of products did you shop for?" We had tried to avoid open-ended questions to boost response rate, but this was probably not as great a problem as we anticipated because of the opt-in nature of the responding audience.

To project trip savings, we needed to match our data to the product categories used by eMarketer. We had expected to find projections with categories more granular than our own. Instead, we found that projections available at the time were about the same granularity as ours, but in somewhat different categories. Therefore, we had to ask respondents to categorize their purchases using the same categories that eMarketer used.

We also had expected that market research firms would forecast the number of transactions or dollars spent per transaction. (We had seen such a projection several months before, but were unable to find an updated version). We

discovered that no one was projecting the number of transactions, only the dollar amounts. If we were going to project trip savings, we needed to project trips saved per transaction. This way we could translate from a projection of market activity to trips saved. With no reporting of numbers of transactions, we needed to estimate dollars per transaction so we could get from dollars (which were already projected) to trips saved. Therefore, we had to ask about actual purchases, not just online shopping sessions. We also needed a way to distinguish single-product transactions from those involving several purchases.

While we collected data on several variables that might be related to buyer behavior, we found that most of these were not useful in projecting ahead to 2004. We had no empirical or theoretical means for using them to project changed buying behavior and hence purchases and trip savings. The only concept that gave us a theoretical structural change over time was the idea of different groups of people based on differences in adoption categories. As we explain beginning on page 14, we used a theoretical future distribution to assist in making projections of trips saved.

Survey 2

In this survey, shown in Appendix C, we focused on the most recent online *purchase* made by the respondent. This would allow us to translate the eMarketer dollar projections directly into trips with the data we obtained from the survey.

InsightExpress administered the second survey October 12 through 14, 2000. Data collection ceased as soon as the contracted number of completed surveys was received. Of the 665 respondents who responded to the banner ads, 300 responses were received for a nominal response rate of 45.1 percent. After we eliminated the outliers with trip savings greater than 15, we had 275 usable responses. For most of the calculations, we also eliminated respondents who completed the survey but had not made a purchase of any kind, leaving 259 responses.

Upon completion of the second survey, we had sufficient data to calculate trip savings and project it to 2004.

CALCULATING TRIP SAVINGS FOR 2000

Several research firms have conducted studies attempting to assess the amount of online shopping done in the United States in 2000 and beyond. Rather than

try to come up with our own forecast of this activity, we rely on these other firms for the baseline forecast of online purchasing activity. We used the forecast done by eMarketer because their forecast is based on an evaluation of all these other forecasts. eMarketer does not collect data directly, but performs meta analysis on the forecasts done by other research firms to arrive at its own forecasts. eMarketer analysts use enough judgment and evaluation that their forecasts can be said to be their own work, not simply a composite of the works of the others.

Our task was to translate these forecasts into changes in the number of physical shopping trips taken by U.S. consumers, based on the surveys.

All the forecasts by research companies state the amount of online purchase activity in terms of dollars spent. We had hoped that a research firm would state their forecast in terms of number of transactions, as well. However, as of August 1, 2000, none had done their forecasts in this format (nor have any done so to date), so we had to estimate the number of transactions. This was necessary because shopping trips are related more to a shopping session than to number of products or items purchased. Accordingly, we had to estimate what proportion of the amount spent online was spent on single-purchase transactions and what was spent on combination purchases. Then we determined how many transactions were single purchase and how many involved combination purchases, based on the average amount spent for each type of transaction. Once we had the number of each type of transaction, we multiplied these by the average number of trips saved per type of transaction and added the products together. Single-purchase transactions were made more complex by calculating transactions and trips saved for each product category.

Equations for these calculations are presented in Appendix E, "The Model for Projecting Trip Savings," which shows the forecasting model.

TRIP SAVINGS IN 2004

The following things can change in the next few years:

- The number of people buying online
- The distribution of products and services that are purchased
- The amounts individuals spend online

- The familiarity that consumers have with products offered online, the companies offering products online, and the process of shopping online
- The distribution of innovation adopter categories that online consumers fall within
- The distribution of items purchased singly and in combinations in online purchasing sessions.

To anticipate the trips saved, we will approximate these effects, as described below.

The increase in the number of people shopping online and the amount being spent online is taken from the forecast made by eMarketer in November, 2000.[3] The eMarketer forecasts are stated in terms of dollars spent by product type. It is not important to try to anticipate how many buyers actually participate, since we do not care whether a trip savings number comes from few or many drivers. Nor is it important to try to account for the effect of increased familiarity, since the eMarketer forecasts implicitly take this into account.

Given the eMarketer forecasts by product category for 2004, we must attempt to translate these into number of transactions. Once given a number of transactions, we must estimate the types of transactions these represent and then determine the trip savings from each type. In the 2000 estimate, we can divide transactions into single purchases and combination purchases based on the distribution reported in our survey, as explained above. In projecting future transaction types, we would anticipate more transactions to be combination rather than single purchase. As people buy more items online and shift more of their purchasing online, more online shopping sessions will be for multiple items. The data we have to help approximate this shift in transaction types comes from the distribution of innovation adopter types.

All temporally driven shifts in this forecast will come from a shift in the distribution of adopter types. As will be seen in the chapter "Discussion, Conclusions, and Implications," the adopter types in 2000 were weighted heavily toward the innovator, early adopter, and early majority types. In 2004, we will assume the following distribution of purchasers, based on Rogers' ideal distribution of adopter categories:[4]

[3] eMarketer. *The eCommerce: B2C Report*, November 2000.

[4] Rogers. *op. cit.*, pp. 257-256.

- 16 percent are innovators and early adopters.
- 34 percent are early majority adopters.
- 34 percent are late majority adopters.
- 16 percent are laggard adopters.

For each category of adopter type, the average amounts spent in single purchases and in combination purchases will be determined, as well as the average trip savings for each type of transaction within each type of adopter category. Total trip savings, then, will be a sum of the linear combination of the savings by adopter type, adjusted for the proportions of single and combination transactions. The equation for this calculation is presented in Appendix E.

This leaves two factors unaccounted for in the trip savings projection model: familiarity and comfort level. As familiarity increases the number of items being bought by each household, more items will be shopped for and purchased in combination. At the same time, the comfort level of consumers will start to rise and they will be less inclined to make shopping trips to physically inspect and try the merchandise or service. We have no way of anticipating how either of these trends will progress. Even though we took samples at two points in time, these two surveys occurred only months apart, so there was not enough time to observe trends. Because the surveys were not done as repeated measures on the same respondents, the ability to spot trends is further weakened. For now, we consider these two trends to be offsetting. More combination purchases will tend to reduce the overall number of trips saved; more familiarity will tend to increase trips saved. We leave it to future research efforts to track these effects.

A third factor unaccounted for in these estimates is the different trip savings for each product category. The problem here is the sample size. With a large enough sample, we could calculate estimates of the trips saved by each adopter category for each single-purchase product category. Given four adopter categories and 11 product categories, we did not have enough data points to calculate reliable means for each of the 44 category combinations. Therefore, we treated single purchases as a single category.

RESULTS

As discussed in the previous section, we estimated total trip savings by breaking the estimate into components. Components for the 2000 estimate and for the 2004 estimate were somewhat different, as described in Appendix E. In this section, we first discuss the components of the 2000 estimate and then report the components of the 2004 estimate.

TRIP SAVINGS IN 2000

Trip savings in 2000 were estimated for the following components:

- Single-product purchases
- Multiple-product purchases
- Offline purchases in which some of the shopping effort was performed online
- Shopping that resulted in a decision not to purchase anything.

Single-Product Purchases and Trip Savings in 2000

The first set of results pertains to trip savings from single-product purchases on the Web. The components of the calculation, for each product category, are:

- Dollars purchased, 2000, estimated, from eMarketer
- Dollars per transaction, from the second survey
- Number of transactions, calculated by dividing total dollars by dollars per transaction
- Average number of trips saved, per transaction, from the second survey
- Total trips saved, by product category, calculated by multiplying total number of transactions by the average number of trips saved
- Total trips saved, summed across categories.

Table 1 shows these calculations. The total number of trips saved from single online purchases in 2000 is estimated to be 131,500,040. To make this calculation consistent with Federal Highway Administration (FHWA) data, discussed later in this chapter, we multiplied this number by 2. Our respondents were indicating trips saved in terms of round trips, while the

FHWA data are reported in terms of trip segments. Thus the total of trips saved is 263,000,080.

Table 1: Estimated Trip Savings Calculations, Single Purchases, By Product Category

Category	*Transactions*	*Trips/ Transaction*	*Trips Saved*
Travel	3,527,929	1.82	6,420,831
Computer-related	8,378,832	2.77	23,209,365
Music	2,910,542	4.89	14,232,550
Apparel/Footwear	4,850,903	3.53	17,123,688
Gifts/Flowers	3,175,136	2.90	9,207,894
Health/Drugs	4,145,318	3.46	14,342,800
Home-related	2,910,542	3.44	10,012,264
Books	4,850,903	2.53	12,272,785
Food/Beverages	617,388	1.00	617,388
Other	7,055,858	3.41	24,060,476
Total round trips	42,423,351		131,500,040
Total trips (round trips x 2)			263,000,080

Combination Purchases and Trip Savings in 2000

The next set of results concerns the trips saved from online purchases that occurred in combinations during 2000. As discussed on page 16, we found that our original plan for estimating such purchases was too ambitious. We did not have a large enough sample size to obtain data on commonly purchased combinations of products or services. Accordingly, we treated this element of the overall calculation of the trip savings estimate as a single calculation, rather than as a sum of weighted averages for common combinations. The elements of this portion of the calculation are as follows:

- Dollars purchased in combination purchases, 2000, estimated, from eMarketer;
- Dollars per online combination purchase, from the second survey;
- Number of online combination purchases, calculated by dividing total dollars by dollars per transaction;
- Average number of trips saved, per transaction, from the second survey;
- Total trips saved, calculated by multiplying total number of transactions by the average number of trips saved;

Table 2 shows the data obtained and used in the calculation. The total trips saved from online combination purchases in 2000 were estimated to be 169,074,740. Again, adjustments were made to account for differences between our data and FHWA data. For combination purchases, we assumed that trip chaining would result in three trip segments for each round trip saved. Thus the total number of trips saved from combination purchases is 507,224,220.

Table 2: Estimated Trip Savings Calculation, Combination Purchases

A. Total Dollars Spent in Combined Purchases	$27,676,00,000
B. Average $ per Transaction	$640.03
C. Total Transactions, Combined Purchases (A/B)	43,241,622
D. Average Trips Saved per Combined Purchase Transaction	3.91
E. Total Round Trips Saved in Combined Purchases, 2000 (C*D)	169,074,740
F. Total Trips Saved (round trips x 3)	507,224,220

Trips Saved from Offline Purchases, 2000

After accounting for shopping trips saved from purchases made online, the calculation of total trips saved must include savings from purchases made offline. For many products, the consumer needs to see and try the merchandise or talk directly with a retail sales person. For other purchases, the consumer does not want to wait for shipping. After performing some search and comparison online, the consumer then completes the process offline. Trips are

still saved in the portion of the process performed online. In the first survey, consumers were asked about their behavior whether the purchase was made online or offline. Offline transactions are assumed to be the same proportion of total transactions as observed in the survey. The calculation for trips saved from online shopping for offline purchases is shown in Table 3. Again, we converted round trips into total trips by multiplying by 2.

Table 3: Estimated Trip Savings Calculation, Online Shopping for Offline Purchases, 2000

A. Total Single-Purchase Transactions	42,423,351
B. Total Combined-Purchase Transactions	43,241,622
C. Total Online Transactions (A+B)	85,664,973
D. Total Offline Purchase Transactions /Total Online Transactions	0.111
E. Total Offline Purchase Transactions	9,540,886
F. Average Trips Saved Per Offline Purchase Transaction	2.23
G. Total Round Trips Saved in Offline Purchases, 2000 (E*F)	21,285,716
H. Total Trips Saved in Offline Purchases, 2000 (G x 2)	42,571,432

Trip Savings from Online Shopping Resulting in No Purchases, 2000

The calculation for total trip savings must also include savings from shopping done online that did not result in any purchases. Sometimes consumers shop and decide that they do not want to buy. As discussed in Appendix E, this calculation cannot be derived directly from secondary and primary data, but must be estimated from an assumed relationship between sessions that result in purchases and those that do not. In both surveys, we received responses from consumers who shopped but did not make a purchase. We assume that the proportion of total shopping sessions that do not result in purchases is the same proportion observed in our survey. The calculation for shopping that does not result in any purchases is shown in Table 4, converting round trips into total trips by multiplying by 2.

Table 4: Estimated Trip Savings Calculation, Online Shopping for Nonpurchases, 2000

A. Total Single-Purchase Transactions	42,423,351
B. Total Combined-Purchase Transactions	43,241,622
C. Total Online Transactions (A+B)	85,664,973
D. Nonpurchases /Total Online Transactions	0.073
E. Total Nonpurchase Sessions (D*C)	6,292,925
F. Average Trips Saved Per Nonpurchase Session	1.59
G. Total Trips Saved in Nonpurchase Sessions, 2000 (E*F)	10,005,750
H. Total Trips Saved in Offline Purchases, 2000 (G x 2)	20,011,500

Total Trip Savings from Online Shopping, 2000

Adding these four elements together yields the estimate of number of trips saved in 2000 as 832,807,232.

The question then is, what proportion of the total number of automobile trips taken does this represent? Total vehicle trips less than 100 miles (one-way) in the United States in 1995 was reported as 229,745,000,000 by the U.S. DOT[5]. Making a straight-line projection of the increase in trips (based on the average annual increase in auto trips reported by U.S. DOT from 1977 to 1995 of 3.4 percent per year) brings the estimate of total vehicle trips in 2000 to 271,549,350,000. Thus the percentage of automobile trips reduced by online shopping in 2000 is estimated to be 0.084 percent. This information is summarized in Table 5.

[5] U.S. Department of Transportation, Federal Highway Administration. *National Personal Travel Survey*, 1997.

Table 5: Estimated Trip Savings from Online Shopping in the U.S. in 2000, Compared to Estimated Total Automobile Trips (Less than 50 Miles in Length)

Total Trips Saved from Online Shopping	832,807,232
Single-Purchase Trip Savings	263,000,080
Combination-Purchase Trip Savings	507,224,220
Offline-Purchase Trip Savings	42,571,432
Nonpurchase Trip Savings	20,011,500
Total Short-Distance Automobile Trips Taken in 2000, est.	271,549,350,000
Percentage Reduction in Total Short-Distance Automobile Trips, 2000, est.	0.307 %

ESTIMATES FOR 2004

To estimate trip savings for 2004, we used eMarketer's estimates of online consumer purchases for 2004 as the base volume. They estimated that U.S. consumers would spend $125,600 million online in 2004. To translate this into trips saved from online shopping, we again broke the total into amounts for single purchases and combination purchases. We expect, however, that combination purchases will increase over time. As discussed in the "Methodology" section, we used the idea that segments exist based on the propensity of people to adopt innovations. As shown in Appendix E, we assumed a distribution of adopter categories that reflected a maturing market rather than a new market. We used the same transaction sizes and trip savings figures, as well as the original distribution of single purchases and combination purchases, for each adopter category. We simply changed the weights for adopter categories in determining total trips saved.

Table 6 shows the conversion of adopter category weights from 2000 to 2004.

Table 6: Conversion of Adopter Categories' Weights from 2000 to 2004—Elements for Calculation from Sample Data

Category	*% of total sample, 2000*	*% of total $ volume in sample*	*Mean $ per trans-action*	*Trips saved per transac-tion*
Innovators/Early Adopters	16.99%	43.21%		
Single Purchase	06.18%	01.72%	117	1.625
Combination Purchase	10.81%	41.48%	1610	4.643
Early Majority	38.61%	32.30%		
Single Purchase	19.31%	09.14%	199	3.780
Combination Purchase	19.31%	23.16%	503	3.300
Late Majority	25.10%	20.01%		
Single Purchase	14.29%	11.98%	352	2.973
Combination Purchase	10.81%	08.03%	312	4.214
Laggards	19.31%	04.49%		
Single Purchase	11.20%	02.35%	88	2.897
Combination Purchase	08.11%	02.14%	111	3.952

The first column shows the percentage of respondents in each of the categories. The respondents fall more toward the early categories in the adoption cycle, but not by a large amount. Similarly, the first two adoption categories show a somewhat higher concentration of combination purchases than do the remaining two categories. The second column shows that the highest concentration of dollar purchases is in the combination-purchase categories within the first two adopter categories. Mean dollars per transaction and trips saved per transaction are shown in the last two columns. The biggest surprise is the large transaction size for combination purchases among innovators. It should be noted that the sample size in this category was large enough that this statistic is not an aberration due to a small cell size. Another unexpected result is the trips saved per transaction shown for combination purchases in the early majority category. This is smaller than the average trips saved for the single-purchase category. Although the rank order is reversed from what might be expected, the mean trips saved are not out of an acceptable range.

Table 7 shows how these statistics are used in the calculation of projected trip savings in 2004. Calculations shown are for round trips.

Table 7: Adopter Categories Converted from 2000 to 2004— Calculations of Trip Savings

Category	*Assumed % of shoppers in 2004*	*% of total $ volume in 2004*	*2004 trans-actions (millions)*	*Round trips saved, 2004 (millions)*
Innovators/Early Adopters	16.00%	40.69%		
Single Purchase	05.81%	01.62%	17.43	28.32
Combination Purchase	10.18%	39.07%	30.48	141.51
Early Majority	34.00%	28.44%		
Single Purchase	17.00%	08.05%	50.79	191.97
Combination Purchase	17.00%	20.39%	50.92	168.04
Late Majority	34.00%	27.11%		
Single Purchase	19.35%	16.23%	57.93	172.22
Combination Purchase	14.65%	10.87%	43.78	184.47
Laggards	16.00%	03.72%		
Single Purchase	09.28%	01.95%	27.80	80.55
Combination Purchase	06.72%	01.77%	20.05	79.23

The first column of data shows the assumed distribution of the population of online shoppers after the market has adjusted to the relative newness of shopping online. By adjusting for this difference in weighting, a different distribution of dollar purchases is achieved, as shown in the second column. By multiplying these proportions by the total amount projected to be spent, the total amount per category is obtained. Dividing by the dollars per transaction for each grouping obtains the number of transactions, shown in the third column of data. Multiplying these by the average number of trips saved obtains the projection of trips saved (round trips) for each category. Before adding all the trips saved together, we again have to convert to trip segments to make these compatible with FHWA data. We used a factor of 2 for single-purchase transactions and a factor of 3 for combination purchases. For offline purchases and no-purchase situations, we used a factor of 2.

These are added up and compared to the total number of trips expected to be taken in 2004. As can be seen in Table 8, the expected level of online shopping yields a 0.9 percent decline in overall trips taken in 2004.

Table 8: Projection of Trips Saved Through Online Shopping in 2004

Total Trips Saved Through Online Single Purchases	946,114,800
Total Trips Saved Through Online Combination Purchases	1,719,788,300
Total Trips Saved Through Online Shopping for Offline Purchases	148,107,600
Total Trips Saved Through Online Shopping, No Purchase Made	69,449,570
Total Trips Saved, 2004	2,883,460,000
Total Short-Distance Round Trips Taken, Projected, for 2004	310,406,580,000
Percentage of Trips Saved	0. 929 %

Implications of the small impact on total trips taken are explored in the next section of this report.

The impact is somewhat more pronounced when viewed by time of the week. In a follow-up survey, senior undergraduate students interviewed people who purchased products through online shopping and found that 75 percent of the trips saved would have been weekend trips. Assuming that 75 percent of trips savings subtract from weekend traffic, trips saved for 2000 are shown in Table 9.

Table 9: Weekend Trips Saved, Percentage of Total Weekend Short-Distance Trips, 2000

Vehicle Trips, 2000, est.	271,549,350,000
Weekend Trips, 2000, est. (0.269 * Total Trips)	73,047,411,000
Trips Saved from Online Shopping, 2000	832,807,232
Weekend Trips Saved from Online Shopping, 2000 (0.745 * Total Trips Saved)	620,441,388
Percentage of Weekend Trips Saved, 2000	0.849%

Table 10 shows the savings of trips on weekends projected for 2004.

Table 10: Weekend Trips Saved, Percentage of Total Weekend Short-Distance Trips, 2004

Vehicle Trips, 2004, est.	310,406,580,000
Weekend Trips, 2004, est. (0.269 * Total Trips)	83,499,370,000
Trips Saved from Online Shopping, 2004	2,883,460,000
Weekend Trips Saved from Online Shopping, 2004 (0.745 * Total Trips Saved)	2,148,177,700
Percentage of Weekend Trips Saved, 2004	2.57%

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

When we began this research, we expected to find some level of noticeable impact on traffic. The implication of the findings is that there will not be much reduction in traffic from online shopping in the next few years. However, there may be a noticeable, but still small, impact on weekend traffic by 2004.

This implies that large reductions in traffic congestion will have to come from other sources. The obvious source for the most reduction in peak weekday traffic is telecommuting. People working from home one or more days a week would take sizable numbers of people off the road at times when the congestion is worst. A similar method of traffic reduction is remote site telecommuting. In this method, people would travel a short distance to an office that offered Internet or some other networked capability for connecting to the home office.

Also note that exogenous events, such as the terrorist attacks of Fall, 2001, may have an impact on consumers' decision processes, which may lead them to change their online shopping behavior.

With the type of projection done in this research, no reliable confidence level can be estimated—there are too many variables involved in the projection calculations to evaluate. More important, the key variable from which the estimates derive is eMarketer's projection of online purchases, and eMarketer does not provide any confidence level of their estimate.

To put the estimate in perspective and to give a sense of a reasonable range for our estimates, we calculated an extreme estimate for trips saved using the standard deviations (s.d.) of the distribution of responses for the trips saved variables. Using t statistics for a 95 percent confidence interval, we assumed that the mean trips saved for single-purchase, combination-purchase, offline-purchase, and no-purchase situations were t (95 percent, two-tailed) * s.d. from the sample means. Then using the numbers of transactions already calculated for these categories, we arrived at the estimates in Table 11.

The result shows that even with extremely high trip savings assumed, short-distance traffic still decreases only about 2.7 percent for the year. This will be a noticeable drop in high-congestion areas, but is still relatively minor in magnitude.

Table 11: Projection of Trips Saved Through Online Shopping in 2004, Extreme Case

Total Trips Saved Through Online Purchases	7,423,590,000
Total Trips Saved Through Online Shopping for Offline Purchases	555,669,300
Total Trips Saved Through Online Shopping, No Purchase Made	265,550,400
Total Trips Saved, 2004	8,244,810,000
Total Short-Distance Round Trips Taken, Projected, for 2004	310,406,580,000
Percentage of Trips Saved	**2.66%**

Several limitations of the research need to be noted. First, we dropped the outlier respondents from the analysis. This tends to lower the mean trip savings measured in the samples. However, since the trip savings reported by the outliers lacked credibility—typically well over 20 trips saved per shopping session—we believe accuracy is most likely improved rather than degraded. In a small sample study, the effect of a few outliers will tend to be exaggerated in calculating estimates of population parameters, so it is better to remove the outliers from the analysis than to leave them in and probably increase the inaccuracy of the estimates.

This gives rise to a more important question, that of the accuracy of the self-reported trip savings. Given our interviews and questionnaire tests, the reported trip savings seemed to be in a reasonable range. These statistics would bear validation from trip report data. Such validation, however, is expensive, tedious, time consuming, and beyond the scope of this project.

The sampling method introduced a potentially troubling bias. Since we asked respondents to report on their most recent online shopping experience, we are assuming that frequency of purchase is fairly uniform across different groups. This is particularly important when we are projecting future trip savings by changing the weighting of innovation adopter groups. There is reason to believe that earlier adopters may be inclined to buy online more frequently than would later adopters. This would be more of a concern if there were a much more pronounced shift toward earlier adopter groups than actually

appears in the data. In that case, when we assumed an ideal distribution of adopter categories in 2004, we would have shifted more of the weighting away from the innovators and early majority. As it was, the shift in weights for adopter groups was relatively minor. The largest influence on the increase in trips saved came from eMarketer's projected growth in retail sales.

The question of weighting shifts also would be more of a concern if the impact of online shopping on trip savings were larger. As it is, when we assume extremely high trip savings in the calculations, the impact on traffic is still minor. Even though the projection calculations did not allow for changes in the frequency of purchase, any huge shifts in weighting by adopter group would still have had minor impact.

Another area for reflection is the conversion of trip savings from round trips to trip segments. We discovered the need to make such a conversion late in the process. If we were to do this research again, we would try to obtain data to support our assumptions in this area. However, given the interview data, the ability of respondents to make the conversion themselves is questionable.

The data raise an interesting question on Rogers' innovation diffusion model. The distribution of innovation adopter types in both samples was quite close to what we would expect in a more mature technology. One possible explanation would be that online shopping is already approaching maturity, but this does not seem likely. The technology is still evolving and poses significant perceived risks for more conservative adopters. An alternative explanation is that the adopter categories are not as well-defined as theory would tell us they should be. Rogers makes the case that individuals will tend to adopt new products in a fairly consistent manner: If they are in the early majority for one product, they will tend to be for other products. However, in this case we seem to have a significant number of early adopters who normally would adopt later in the adoption process. This suggests that either this technology is unique or that people are not as consistent in their adoption patterns as theory implies. More inquiry would seem to be in order, both on adoption characteristics of online shopping and on the innovation diffusion model.

All in all, the results are somewhat disappointing. It would have been exciting to be able to say that online shopping was likely to have an appreciable impact in the near future on transportation resource allocations, but that seems unlikely at this juncture. Over time, the adoption of online shopping probably will have a significant impact. It is apparent, though, that for online shopping to make a rapid change in shopping patterns, significant technology

breakthroughs must occur and be assimilated into the shopping infrastructure in the near future. This could well happen. The convergence between television, telecommunications, and the Internet may produce online shopping experiences that are far more useful and convenient than those produced by current technology. The convergence between online retailing and physical retailing also may begin shifting consumers' shopping patterns. After the current downturn in the economy, including the Internet economy, plays out, we may indeed see commercialization of radical technological advances that bring about the impacts we were looking for.

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ACRONYMS AND ABBREVIATIONS

DOT	Department of Transportation
FHWA	Federal Highway Administration
MTI	Mineta Transportation Institute

APPENDIX A: EXPLORATORY QUESTIONS

Name

Age

Gender

Highest Education Degree Completed

Annual Family Income

How many people are there in your household?

How many vehicles do you have in your household?

How accessible is public transport for you?

How often do you use it (public transport)?

How long have you been using a computer?

How long have you been using a computer connected to a network?

How many years have you been using Internet?

How many hours per week do you use a computer at work? At home?

ONLINE SHOPPING EXPERIENCES

- Describe your most recent online shopping experience, time spent and process? Why did you decide to buy online?
- How would you have shopped for the same thing offline, time spent, process, trips? Would you do this offline again given your online experiences?
- During the past week, how much time do you think you have spent shopping online? Was this week typical or did you spend more/less time than usual?

- What kinds of products or services do you think you will try shopping for online in the near future? How will this affect time and trips spent shopping for these items? Why these?
- What is the online shopping site that you use most frequently? What do you like/not like about it? Is this the first site you go to when you connect?
- How often do you go to a bricks-and-mortar store for the type of purchases you make at the site you just described?
- When shopping online, do you sometimes include shopping trips to real stores as part of the process? Which parts were these and why?

SHOPPING BEHAVIOR

- How would you describe yourself as a shopper in general—time spent, common items bought, easiest items to buy?
- How does this compare to your online shopping behavior?
- What products/services do you generally have delivered to your home? How long does it take to have them delivered?

PROJECTIONS

- How many shopping trips and how much time have you saved by doing at least part of the shopping online?
- What else do you think might tend to change your shopping trip patterns in the near future?
- What are the 3 top reasons why you would shop for an item online? How would an ideal shopping site address these?

APPENDIX B: FIRST ONLINE SURVEY AND RATIONALE

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1. Please think about your most recent shopping experience in which at least SOME of your shopping activity was done ONLINE.

   Also, please make sure that you choose a shopping experience that you FINISHED -- you either bought something or decided not to buy.

   If you bought something, this could be either an offline or online purchase. You may have been shopping for several things all at once.

   Which of the following would best describe the product(s) or service(s) for which you were shopping? (please check all that apply)

   - ☐ books/ music/ videos/ games/ toys
   - ☐ consumer electronics/ computer/ software/ peripherals/ computer games
   - ☐ furniture/ consumer durables (appliances)/ art/ antiques/ jewelry
   - ☐ groceries/ small household/ pet supplies/ beauty supplies/ healthcare/ vitamins
   - ☐ financial services/ securities/ insurance
   - ☐ collectibles/ gifts (flowers, candy, gourmet foods)
   - ☐ automobile
   - ☐ hardware/ auto parts/ tools/ garden /sporting goods
   - ☐ real estate
   - ☐ travel/ lodging/ entertainment/ dining/ tickets or reservations
   - ☐ other

2. Did you purchase a product or service as a result of your shopping activity? (if applicable you can check both "yes, online" and "yes, offline")

   - ☐ Yes, online
   - ☐ Yes, offline
   - ☐ No

3. Consider the most important product or service for which you were shopping. How familiar were you with this type of product or service before you started the process?

   Very Familiar ○ ○ ○ ○ ○ ○ ○ Not At All Familiar

4. Consider again the most important product or service for which you were shopping.

InsightExpress.com

Does this item represent a major or minor purchase for you?

Very Major ○ ○ ○ ○ ○ ○ ○ Very Minor

5. Still considering the most important item for which you were shopping, how important is it for you to be able to examine items like this before purchasing?

(rate the importance only if the item is a product, not a service).

○ 1 Very Important
○ 2
○ 3
○ 4
○ 5
○ 6
○ 7 Not At All Important
○ Item is a service

6. As part of this most recent shopping process, did you take any trips by automobile or public transportation to physically visit one or more stores?

○ Yes
○ No

Next Question

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7. How many trips by automobile or public transportation did you take as part of this most recent shopping process?

(please estimate as close as you can and enter only a whole number)

8. Please estimate how many trips using a car or public transportation **you saved** in this most recent shopping activity by shopping online?

(please estimate as close as you can and enter only a whole number)

9. What was the approximate price of the most important item for which you were shopping?

(Please enter only a whole number. Do not enter the $ sign).

10. Think about how your online shopping activities might change in the next six months. Identify categories from the list below that you might start shopping for online six months from today.

Please check all categories that could possibly be targets of your online shopping activities six months into the future.

- ☐ books/ music/videos/ games/ toys
- ☐ consumer electronics/ computers/ peripherals/ software/ computer games
- ☐ furniture/ consumer durables (appliances)/ art/ antiques/ jewelry
- ☐ groceries/ small household/ pet supplies/ beauty supplies/ healthcare/ vitamins
- ☐ financial services/ securities/ insurance
- ☐ collectibles/ gifts (e.g. baskets, flowers, candy, gourmet foods)
- ☐ automobile
- ☐ hardware/ auto parts/ tools/ garden/ sporting goods
- ☐ real estate
- ☐ travel/ lodging/ entertainment/ dining/ tickets or reservations

☐ other

11. What is your age?

○ below 18
○ 18 to 25
○ 26 to 35
○ 36 to 45
○ 46 to 55
○ 56 to 65
○ above 65

12. What is your annual household income?

Not Selected

13. What is your gender?

Not Selected

14. Which of the following best describes what kind of shopper you are?

Please read each; check all that apply:

☐ Shopping is a kind of entertainment or a pleasant experience for me
☐ I like to see, touch, and try products before I buy them
☐ Shopping has to be really convenient; I won't go out of my way to shop unless I absolutely have to
☐ Being a smart shopper is important to me; I'm driven to find the best value for my money

15. Which of the following best describes how quickly you adopt new products?

Read each and pick the **one** that best describes what you usually do.

○ I usually get new products before everyone else does

○ I get new products a little before most people, but I'm definitely not the first

○ I tend to get new products when everyone else does, maybe even a little later

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than average

○ I get new products after everyone else, if I get them at all

Submit

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RATIONALE

In Question 1, we obtained the categories of products or services for which the respondent shopped. We were looking to weight the trip savings data by transaction data from the market researcher's forecast that we would choose. However, we were unable to obtain forecasts that gave average transaction size by product type, so our model for projecting trip savings would not work.

Question 2 obtained purchase information—whether the respondent purchased products or services from the shopping activity and whether the purchases were online, offline, or both.

We asked about the most important item shopped for during this session. The interviews suggested that this was what drove the shopping behavior. Question 3 used a 7-point scale to assess familiarity. Question 4 assessed whether the purchase was major or minor. Question 5 assessed whether products sought needed to be inspected physically. Questions 6 asked whether the person phycically took any trips as part of the shopping process. Question 7 asked how many trips were taken.

Question 8 asked how many trips were saved by the shopping activity in question. Question 9 asked for the price of the most important product.

Question 10 concerned the categories in which consumers believe they will begin shopping within the next six months. We had hoped to use this question as an aid in projecting future sales and trip savings.

Questions 11 to 13 were designed to seek demographic data that interviews suggested would be associated with differences in shopping behavior.

Question 14 asked the respondent to categorize his or her shopping orientation. Prior research by Li, Kuo, and Russell[1] suggests that the consumer's shopping style affects online shopping behavior. The prior research put people in categories based on cluster analysis of several variables. Based on our interviews, we believed that people display multiple shopping styles simultaneously, so we allowed for multiple responses.

---

[1] Li, Hairong, Cheng Kuo, and Marth G. Russell. "The Impact of Perceived Channel Utilities, Shopping Orientations, and Demographics on the Consumer's Online Buying Behavior," *Journal of Computer-Mediated Communication*, Vol. 5, No. 2 (December 1999). Available at http://www.ascusc.org/jcmc/vol5/issue2/hairong.html

Question 15 asked the respondent to characterize his or her tendencies for adoption of new products or services. We realized that people would vary from their preferred mode of new product adoption; however, the theory suggests a certain consistency that will affect buying behavior. Accordingly, we asked respondents to characterize their typical adoption behavior.

APPENDIX C: SURVEY 2 AND RATIONALE

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1. Please think about your most recent purchase online (the purchase could be for one or more things from the same company).

   Now think about the product or service in this purchase that was most important to you. Which of the following categories best describes this product or service?

   Not Selected

Next Question

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2. What was the approximate price paid for this most important item, in whole dollars?

   (Please enter the number without the dollar sign.)

3. Considering the most important item purchased in question #1 above, please estimate the total number of physical trips to stores or other locations you saved by shopping for, and purchasing this on the web? (Please estimate the **total** number of trips related to **both** searching for information and buying this product or service online.)

4. For the most important item you mentioned in #1, suppose you had to buy it **offline** instead of online. How do you think you might have purchased it?

   Not Selected

5. In the same online session that you made this purchase mentioned in #1 above, how many other products or services did you purchase (from one or more sites)?

   Not Selected

Next Question

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6. You indicated that you purchased more than one product (or service) in the session mentioned in #1 above. In what category was your **next** most important purchase?

Not Selected

7. What was the approximate price of this second most important item in your purchase (in whole dollars)?

(Please enter the number without the dollar sign.)

8. Considering the second most important item in your purchase, please estimate the **total number** of physical trips to a store or other location you saved by searching for information and purchasing this product or service on the web.

9. How many physical trips do you think you saved – the total of both shopping (searching for information)and buying trips – by making the purchases you made in this session?

10. How much did you pay, **in total**, for all the transactions you made in this one session (Please estimate -- in whole dollars)?

(Please enter the number without the dollar sign.)

11. From how many web sites did you purchase in this single session?

Next Question

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InsightExpress.com

Done with preview

12. What is your age?
Not Selected

13. What is your gender?
Not Selected

14. What is your annual household income?
Not Selected

15. Which of the following best describes how quickly you adopt new products?

Read each and pick the **one** that best describes what you usually do.

O I usually get new products before everyone else does

O I tend to get new products when everyone else does, maybe even a little later than average

O I get new products after everyone else, if I get them at all
O I get new products a little before most people, but I'm definitely not the first

Submit

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RATIONALE

As in the first survey, we asked what product or service was purchased, but we identified first the most important item in the purchase (Question 1). In Question 2, we asked what the price was for this particular product, something we did not do in the first survey. Question 3 covered the estimated number of trips saved by purchasing this particular item. Question 4 provided insight into what kinds of purchase behaviors are being altered (catalog shopping, offline shopping, etc.).

Question 5 determined whether this was a combination purchase or single-item purchase. If it was a combination purchase, the respondent answered Questions 6 through 11. Otherwise the respondent moved on to Question 12.

In Question 6, the category for the next most important product was obtained. We had hoped to find common combinations and determine the amount spent per transaction and total trips saved, and use this information to translate the eMarketer data. Common combinations did not emerge, however, so we had to treat all combination purchases as a single group. Therefore, Questions 7 and 8, which obtained price and trips saved for the second most important product or service, produced data that were not central to the analysis.

Question 9 obtained the total trips saved for combination purchases. In the analysis, these data had to be combined with data from Question 3, total trips saved from purchase of the most important product (the only product for single purchases), to obtain the total trips saved from all purchases.

Question 10 obtained the total amount spent on all purchases in the combination purchases. As with Questions 3 and 9, data from Question 10 must be combined with data from Question 4 to obtain data on total dollars spent online.

Question 11 obtained data on how many Web sites were purchased from. This helps to understand how online shopping is being done.

Questions 12 through 14 obtained demographic data that can be compared to data on the population of online shoppers. Question 15 determined the respondent's adoption category.

APPENDIX D: FREQUENCIES AND MEANS FOR SURVEYS

Frequencies and Means for First Survey

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Products or services shopped. (Multiple responses allowed)	*278*			
Books/music/videos/games/toys	176	63.3		
Consumer electronics/ computer/software/peripherals/ computer games	115	41.4		
Furniture/consumer durables/ art/antiques/jewelry	25	9.0		
Groceries/small household/ pet supplies/beauty supplies/ health care/vitamins	103	37.1		
Financial services/securities/ insurance	28	10.1		
Collectibles/gifts (flowers, candy, gourmet foods)	57	20.5		
Automobiles	28	10.1		
Hardware/auto parts/tools/ garden/sporting goods	37	13.3		
Real estate	6	2.2		
Other	48	17.3		
Purchased anything from shopping activity? (Multiple responses allowed)	*278*			
Yes, online	234	84.2		

Frequencies and Means for First Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Yes, offline	92	33.1		
No	18	6.5		
Familiarity with the most important item prior to shopping? (1 = Very Familiar; 7 = Not at all Familiar)	278		2.4856	1.5523
Was most important item a major or minor purchase? (1 = Very Major; 7 = Very Minor)	278		4.0863	1.17163
Importance of being able to examine most important item before buying? (1 = Very Important; 7 = Not at all Important)	212		3.3538	1.7286
Were physical trips to the store part of this shopping process?	*278*			
Yes	106	38.1		
No	172	61.9		
How many physical trips did you take as part of this shopping process?	278		1.1906	2.3738
How many trips in this shopping process did shopping online save?	278		2.9065	2.6461
Approximate price of the most important item?	276		$1,505	$7,469

Frequencies and Means for First Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Categories of online shopping six months hence? (Multiple responses allowed)	*278*			
Books/music/videos/games/toys	230	82.7		
Consumer electronics/ computer/software/peripherals/ computer games	177	63.7		
Furniture/consumer durables/ art/antiques/jewelry	92	33.1		
Groceries/small household/ pet supplies/beauty supplies/ health care/vitamins	167	60.1		
Financial services/securities/ insurance	91	32.7		
Collectibles/gifts (flowers, candy, gourmet foods)	141	50.7		
Automobiles	62	22.3		
Hardware/auto parts/tools/ garden/sporting goods	99	35.6		
Real estate	37	13.3		
Travel/lodging/entertainment/ dining/tickets or reservations	178	64.0		
Other	67	24.1		
Respondent's age?	*277*			
Below 18	0	0.0		
18–25	48	17.3		
26–35	72	25.9		

Frequencies and Means for First Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
36–45	92	33.1		
46–55	44	15.8		
56–65	19	6.8		
Above 65	2	0.7		
Annual household income?	*278*			
Less than $15,000	17	6.1		
$15,001–$30,000	46	16.5		
$30,001–$45,000	47	16.9		
$45,001–$60,000	65	23.4		
$60,001–$75,000	38	13.7		
$75,001–$90,000	33	11.9		
$90,001–$105,000	13	4.7		
$105,001–$125,000	4	1.4		
$125,001–$150,000	4	1.4		
$150,001–$200,000	9	3.2		
$200,001–$250,000	0	0		
$250,001–$300,000	0	0		
More than $300,000	2	0.7		
Gender	*278*			
Male	89	32		
Female	189	68		

Frequencies and Means for First Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Shopping Style (Multiple responses allowed)	*278*			
Shopping is entertainment	126	54.7		
See, touch, try before buying	76	27.3		
Shopping has to be convenient	109	39.2		
Being a smart shopper is important	198	71.2		
Adoption Category	*278*			
Usually get new products before everyone else	31	11.2		
Get new products a little before most people, but definitely not first	129	46.4		
Get new products when everyone else does, maybe a little later	74	26.6		
Get new products after everyone else; maybe not at all	44	15.8		

Frequencies and Means for Second Survey

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Most recent products or services purchased online–most important item	*275*			
Apparel & footwear	28	10.2		

Frequencies and Means for Second Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Travel	27	9.8		
Books	28	10.2		
Health/drugs/beauty	25	9.1		
Home-related	24	8.7		
Food/beverages/groceries	5	1.8		
Most recent products or services purchased online–most important item	*275*			
Apparel & footwear	28	10.2		
Travel	27	9.8		
Books	28	10.2		
Health/drugs/beauty	25	9.1		
Home-related	24	8.7		
Food/beverages/groceries	5	1.8		
Gifts/flowers	19	6.9		
Music	17	6.2		
Computer-related	46	16.7		
Other	40	14.5		
Don't remember purchasing	16	5.8		
Price of most important item?	259		$235	$633
Trips saved for most important item?	259		3.61	3.37

Frequencies and Means for Second Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
If you had to buy the most important item offline, how would you have done it?	*259*		*4.0863*	*1.17163*
Physical trip to store	164	63.3		
Catalog purchase	20	7.7		
Phone call (not a catalog purchase)	31	12.0		
Some other way	9	3.5		
Would not have purchased	21	8.1		
Would have purchased, but don't know how	14	5.4		
How many other items were purchased in the same online session?	259		1.20	1.59
Next most important item – what category?	*127*			
Apparel & footwear	13	10.2		
Travel	9	7.1		
Books	14	11.0		
Health/drugs/beauty	14	11.0		
Home-related	11	8.7		
Food/beverages/groceries	4	3.1		
Gifts/flowers	10	7.9		
Music	11	8.7		
Computer-related	18	14.2		

Frequencies and Means for Second Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Other	23	18.1		
No other purchases	148	53.8 (of sample)		
Price of second most important item?	127		$127	$295
Trips saved from shopping for second item online?	127		2.68	2.12
Total trips saved from online shopping session?	259		3.4942	3.2498
Total paid for all items purchased in this session?	259		$420	$2562
From how many Web sites were purchases made? (Only those who purchased multiple items)	127		1.65	1.12
Respondent's age?	*275*			
Below 18	1	0.4		
18–25	45	16.4		
26–35	72	26.2		
36–45	89	32.4		
46–55	42	15.3		
56–65	26	9.5		
Above 65	0	0		

Frequencies and Means for Second Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Gender	*275*			
Male	91	33.1		
Female	184	66.9		
Annual household income?	*275*			
Less than $15,000	27	9.8		
$15,001–$30,000	41	14.9		
$30,001–$45,000	54	19.6		
$45,001–$60000	50	18.2		
$60,001–$75,000	45	16.4		
$75,001–$90,000	26	9.5		
$90,001–$105,000	6	2.2		
$105,001–$125,000	5	1.8		
$125,001–$150,000	7	2.5		
$150,001–$200,000	7	2.5		
$200,001–$250,000	1	0.4		
$250,001–$300,000	1	0.4		
More than $300,000	5	1.8		
Adoption Category	*275*			
Usually get new products before everyone else	46	16.7		
Get new products a little before most people, but definitely not first	107	38.9		

Frequencies and Means for Second Survey (Cont.)

Question	*Frequency (n=?)*	*Valid Percent*	*Mean (if applicable)*	*Std Dev.*
Get new products when everyone else does, maybe a little later	68	24.7		
Get new products after everyone else; maybe not at all	54	19.6		

APPENDIX E: THE MODEL FOR PROJECTING TRIP SAVINGS

As noted earlier, the exploratory interviews suggested that the number of trips saved would vary by the products purchased and the extent to which combination of products were purchased. In this section, we lay out the calculation method for arriving at trip savings projections. The first subsection (below) shows how calculations were done for 2000. The second subsection (beginning on page E-7) shows how calculations were done for 2004.

CALCULATION OF 2000 TRIP SAVINGS

The model for which we wanted to estimate parameters is as follows:

$$TS_{2000} = T^{SP}{}_{2000} + T^{CP}{}_{2000} + T^{OFLP}{}_{2000} + T^{NOP}{}_{2000}$$

Where

TS_{2000} = the number of trips saved in the year 2000 resulting from online shopping activity;

TSP2000 = the number of trips saved in 2000 in single purchases;

$T^{CP}{}_{2000}$ = the number of trips saved in 2000 in combination purchases;

$T^{OFLP}{}_{2000}$ = the number of trips saved from online shopping in 2000, when the purchase was made offline;

$T^{NOP}{}_{2000}$ = the number of trips saved from online shopping in 2000, when no purchase was made.

Each element of the model requires expression as a calculation of variables that can be produced by the data that can be collected. Accordingly, a model for each element of trip savings was produced. The trips saved from single online purchases in the year 2000 was calculated as the sum of trips saved from single online purchases in each product category:

$$T^{SP}{}_{2000} = \sum_{1,n}^{P} Tr_P^{SP} * \overline{T_P^{SP}}$$

Where

$\mathbf{T^{SP}_{2000}}$ = the number of trips saved in the year 2000 in single purchases;

Tr_P^{SP} = the number of single purchase transactions for product category P;

$\overline{T_P^{SP}}$ = the average number of trips saved per transaction for product category P.

The number of trips saved from online shopping episodes in which multiple products were purchased was calculated as the product of the number of such transactions and the average trips saved from these combination purchases. Originally, we had wanted to find a series of common purchase combinations and sum the weighted average number of trips saved for these combinations. However, in our data sample, no such common purchase combinations emerged, so we needed to use combined purchases as a single category. Hence the calculation is as follows:

$$\mathbf{T^{CP}_{2000}} = Tr^{CP} * \overline{T^{CP}}$$

Where

$\mathbf{T^{CP}_{2000}}$ = the number of trips saved in the year 2000 in combination purchases;

Tr^{CP} = the number of combination purchase transactions in 2000;

$\overline{T^{CP}}$ = the average number of trips saved per transaction for combined purchases in 2000.

In addition to the trips saved from making purchases online, the total number of trips saved will include the number of trips saved from online shopping when the purchase is made offline or no purchase is made. Calculation for trips saved when the purchase is made offline occurs from the following equation:

$$\mathbf{T^{OLFP}_{2000}} = Tr^{OLFP} * \overline{T^{OLFP}}$$

Where

$\mathbf{T^{OFLP}_{2000}}$ = the number of trips saved from online shopping in 2000, when the purchase was made offline;

Tr^{OLFP} = the number of offline purchase transactions in 2000, when shopping was done online;

$\overline{T^{OLFP}}$ = the average number of trips saved per transaction for offline purchases in 2000.

The number of offline purchase transactions resulting from online shopping cannot be derived directly from either secondary data or survey data. Accordingly, an additional calculation must be made based on the data available. This calculation is shown beginning on page 5.

Some consumers will decide not to purchase anything based on their online shopping experience. Considering that they would have made physical trips to stores, with the same results, had they not shopped online, trips are saved in this mode as well. The expression for calculating trips saved when no purchase is made at all is as follows:

$$\mathbf{T^{NOP}_{2000}} = Tr^{NOP} * \overline{T^{NOP}}$$

Where

$\mathbf{T^{NOP}_{2000}}$ = the number of trips saved from online shopping in 2000, when no purchase was made.

Tr^{NOP} = the number of online shopping sessions resulting in no purchases, but in which trips were saved, in 2000;

$\overline{T^{NOP}}$ = the average number of trips saved per nonpurchase online shopping session in 2000.

Just as $\mathbf{T^{OFLP}_{2000}}$ cannot be derived directly from secondary data or the survey sample, neither can we directly derive $\mathbf{T^{NOP}_{2000}}$. The calculation to

derive the number of online sessions resulting in no purchase, yet saving physical trips, is shown beginning on page E-5.

Calculation of the Number of Transactions Made Online in 2000

The simple equation for estimating trip savings in 2000 requires the determination of the number of transactions made by online shoppers. Furthermore, it requires the separation of these transactions into transactions in which single items were purchased and transactions—sessions, really—involving the purchase of multiple items. As explained in the "Methodology" section, trip savings for these two types of occurrences are different enough that we wish to treat them separately. Given the projections from eMarketer of total dollars spent in online purchases, and given the data collected in our survey, we can obtain an estimate of the number of both single-purchase transactions and combination-purchase transactions. The equation for calculating the estimate of the single-purchase transactions is shown first.

$$Tr_P^{SP} = \left(\frac{S^{SP}}{S_T} S \right) \div \overline{D_P^{SP}}$$

Where

Tr_P^{SP} = the number of single-purchase transactions for product category P;

S_P^{SP} = the sum of dollars spent on single purchases for product category P in the survey sample;

S_T = the dollars spent on all online transactions in the survey sample;

S = the dollars spent on all online transactions in 2000, estimated by eMarketer;

$\overline{D_P^{SP}}$ = the average dollar amount spent on a single purchase in product category P in the sample survey.

The estimation of the number of combination-purchase transactions is as follows:

$$Tr^{CP} = \left(\frac{S^{CP}}{S_T} S \right) \div \overline{D_{CP}}$$

Where

Tr^{CP} = the number of combination purchase transactions in 2000;

S^{CP} = the dollars spent on combination purchases in the survey sample;

S_T = the dollars spent on all online transactions in the survey sample;

S = the dollars spent on all online transactions in 2000, estimated by eMarketer.

$\overline{D_{CP}}$ = the average dollar amount spent on a combination purchase in the survey sample.

Calculation for Trip Savings from Online Shopping Resulting in Offline Purchases or in No Purchases

Just as the number of transactions for online purchases was estimated, the number of sessions resulting in offline purchases or no purchase whatsoever needs to be estimated. For this calculation, the first survey data were used. It was assumed that the survey sample would produce the same proportion of sessions leading to offline purchases or no purchases as the proportions that occurred in the population as a whole. Accordingly, the calculation of these proportions is as follows, starting with the proportion of total sessions leading to offline purchases.

$$Tr^{OLFP} = \left(\frac{Tr^{OLFP}_{Sample}}{Tr_{Sample}} \left(Tr^{CP} + \sum_{1,n}^{P} Tr_P^{SP} \right) \right)$$

Where

Tr^{OLFP} = the number of offline purchase transactions in 2000, when shopping was done online;

Tr_{Sample}^{OFLP} = the number of offline purchase transactions, when shopping was done online, in the survey sample;

Tr_{Sample} = the total number of transactions in the survey sample, that is, the total number of respondents (after removing outliers);

$Tr^{CP} + \sum_{1,n}^{P} Tr_{P}^{SP}$ = the total number of online transactions in 2000, derived from the eMarketer projections.

Similarly, the calculation of the number of shopping sessions resulting in no purchase is shown below.

$$Tr^{NOP} = \left(\frac{Tr_{Sample}^{NOP}}{Tr_{Sample}} \left(Tr^{CP} + \sum_{1,n}^{P} Tr_{P}^{SP} \right) \right)$$

Where

Tr^{NOP} = the number of online shopping sessions in 2000, when shopping resulted in no purchase at all;

Tr_{Sample}^{NOP} = the number of online shopping sessions, when shopping resulted in no purchase at all, in the survey sample;

Tr_{Sample} = the total number of transactions in the survey sample, that is, the total number of respondents (after removing outliers);

$Tr^{CP} + \sum_{1,n}^{P} Tr_{P}^{SP}$ = the total number of online transactions in 2000, derived from the eMarketer projections.

CALCULATION FOR TRIP SAVINGS FROM ONLINE SHOPPING, PROJECTED TO 2004

Calculation of trip savings for 2004 involves finding trip savings by adopter categories, for both single-product and combination purchases, and adjusting for an assumed distribution of adopter categories in 2004. The main equation is:

$$TS_{2004} = T^{Innov}{}_{2004} + T^{Early}{}_{2004} + T^{Late}{}_{2004} + T^{Lagr}{}_{2004} + T^{OFLP}{}_{2004} + T^{NOP}{}_{2004}$$

Where

TS_{2004} = the number of trips saved in the year 2004 resulting from online shopping activity;

$T^{Innov}{}_{2004}$ = the number of trips saved in 2004 by Innovators in making online purchases;

$T^{Early}{}_{2004}$ = the number of trips saved in 2004 by Early Adopters in making online purchases;

$T^{Late}{}_{2004}$ = the number of trips saved in 2004 by Late Adopters in making online purchases;

$T^{Lagr}{}_{2004}$ = the number of trips saved in 2004 by Laggards in making online purchases;

$T^{OFLP}{}_{2004}$ = the number of trips saved from online shopping in 2004, when the purchase was made offline;

$T^{NOP}{}_{2004}$ = the number of trips saved from online shopping in 2004, when no purchase was made.

The calculation of trips saved in all the adopter categories is broken down into trips saved in single purchases and in combination purchases. It was expected that the distribution of adopter categories would be skewed toward earlier adopters in 2000. The data proved this to be true. It was then assumed that the numbers of buyers from each of the adopter categories would shift to a normal distribution, as posited by Rogers in his work on the diffusion of innovations.[1]

It was further assumed that the purchasing behavior—the transactions per person, the expenditure per transaction, and the distribution between single purchases and combination purchases—would remain the same in 2004 as it was in 2000. Accordingly, the calculation of trips saved for each adopter category is as follows:

$$T^{Cat\ a}{}_{2004} = T^{Cat\ a}{}_{SP2004} + T^{Cat\ a}{}_{CP2004}$$

Where

$T^{Cat\ a}{}_{2004}$ = the number of trips saved in the year 2004 in Adopter Category A in making online purchases;

$T^{Cat\ a}{}_{SP2004}$ = the number of trips saved in the year 2004 in Adopter Category A making online single purchases;

$T^{Cat\ a}{}_{CP2004}$ = the number of trips saved in the year 2004 in Adopter Category A making online combination purchases.

The number of trips saved for single purchases in Adopter Category A, then, is an adjustment from trips saved in 2000 for single purchases in the category, as shown below. The number of trips saved for combination purchases in Category A is calculated in the same way.

$$T^{Cat\ a}{}_{SP2004} = Tr^{CatA}_{SP2004} * \overline{T^{CatA}_{SP2000}}$$

Where

$T^{Cat\ a}{}_{SP2004}$ = the number of trips saved in the year 2004 in Adopter Category A making online single purchases;

Tr^{CatA}_{SP2004} = the number of single-purchase online transactions in the year 2004 in Adopter Category A;

[1] Rogers, Everett M. *Diffusion of Innovations*, 4th ed., New York: Free Press, 1995.

$\overline{T^{CatA}_{SP2000}}$ = the average number of trips saved per single-purchase transaction in the year 2000 in Adopter Category A, calculated from Survey B.

While the average number of trips saved per transaction for type of purchase (single or combination) is taken directly from Survey B, the number of online transactions must be calculated. The calculation is shown below, done for single-purchase transactions in Adopter Category A. The dollars spent per transaction are assumed to be the same in 2004 as they were in 2000.

$$Tr^{CatA}_{SP2004} = S^{CatA}_{SP2004} * \overline{D^{CatA}_{SP2000}}$$

Where

Tr^{CatA}_{SP2004} = the number of single-purchase online transactions in the year 2004 in Adopter Category A;

S^{CatA}_{SP2004} = the total dollars spent in online, single-purchase transactions in the year 2004 in Adopter Category A;

$\overline{D^{CatA}_{SP2000}}$ = average dollars spent per single-purchase transaction in the year 2000 in Adopter Category A, calculated from Survey B.

The total dollars spent by Adopter Category A on single purchases, of course, must be estimated as well, since eMarketer does not provide such data. eMarketer does provide the total dollars anticipated to be spent in online purchases in 2004. We need to estimate the proportion of this total expenditure that will be spent on each type of purchase in each Adopter Category. As in the above equations, the calculation shown below is for the single-purchase transactions in Adopter Category A.

$$S^{CatA}_{SP2004} = C^{CatA}_{2000 \varnothing 2004} * S_{2004}$$

Where

S^{CatA}_{SP2004} = the total dollars spent in online, single-purchase transactions in the year 2004 in Adopter Category A;

$C^{CatA}_{2000 \varnothing 2004}$ = the conversion factor, translating proportion of single purchases, Adopter Category A, in the 2000 survey to its assumed proportion in the year 2004;

S_{2004} = the dollars spent on single purchase transactions in the year 2004 as estimated by eMarketer.