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Determinants of Participation versus Consumption in the Nordic Swan Eco-labeled Market

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Keith Brouhle
Department of Marketing, Business Economics and Law
University of Alberta

Madhu Khanna
Department of Agricultural and Consumer Economics
University of Illinois at Urbana-Champaign

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Determinants of Participation versus Consumption in the Nordic Swan Eco-labeled Market

This paper uses data on purchases of Nordic Swan Eco-labeled toilet paper and paper towels by individual Danish households to analyze the determinants of demand for eco-labeled goods and the decision process underlying it. Among several models that are estimated, a double-hurdle model that distinguishes between factors influencing the discrete decision to participate by purchasing an eco-labeled good and the continuous decision about the quantity of the eco-labeled good to be purchased is found to fit the data best. We find that prices as well as consumer tastes and preferences, proxied by their socio-demographic characteristics, have a much stronger impact on the participation decision than on quantity consumed for both Swan-labeled toilet paper and paper towels. The quantity consumed of Swan-labeled goods, on the other hand, is strongly affected by factors such as availability of Swan goods in shops, discount sales on Swan goods, and household size.

Key Words: eco-labeling, green goods, double hurdle models

JEL codes: C24, D12, Q58

1 Introduction

Eco-labels, or labels certifying the environmental friendliness of goods, are increasingly appearing on a wide range of goods, such as wood products, dolphin safe tuna, organically grown produce and paper goods, in countries all over the world [43]. Interest in eco-labels grew in the 1990s, in tandem with the growing demand for environmentally-friendly goods.[1] By providing information about the environmental attributes of goods, eco-labels attempt to correct the informational asymmetry between producers and consumers about the unobservable environmental attributes of goods. They allow product differentiation and create market incentives for producers to switch to environmentally sound goods to capitalize on the demand from environmentally conscious consumers. Consumers can now make informed choices about the extent to which they internalize the negative externalities of their consumption. Market shares of eco-labeled goods have been growing over time but rates of growth and levels differ widely across goods and regions.[2]

The demand for eco-labeled goods is a voluntary decision by consumers and the purpose of this paper is to understand the factors that influence this demand and the decision-making process underlying it. In particular, we analyze the determinants of the demand for Nordic Swan eco-labeled toilet paper and paper towels in Denmark. Since eco-labeled goods, such as toilet paper and paper towels, are private goods with a label that communicates their environmentally-friendly attributes, consumer decision-making for such goods involves considerations about the label as well as about

[1]The percentage of consumers who bought at least one good that was advertised as "environmentally safe" grew from 22% in 1993 to 52% in 1999 in the US [20].

[2]For example, in Italy, the share of eco-labeled toilet paper more than doubled between 2001 and 2003 while shares of EU's "Flower" eco-labeled goods rose from 16% in 2001 to 35% by 2003. In 1987, eco-labeled paints represented approximately 16% of the total market for solvent-based paints; by 1995 this figure had risen to just under 25%. Market shares of eco-labeled goods differ across regions. For example, the share of kitchen towels and toilet tissue made from recycled paper were 25% and 23% respectively in Finland, 16% and 14% respectively in Austria, and 7.2% and 10.2% respectively in Germany in 1989 [37].

the specific good itself. Unlike eco-labeled foods, where consumers may derive some private health benefits, eco-labeled paper goods provide environmental benefits that are nonexcludable and are pure public goods. Despite this, consumers may be willing to pay for these environmental benefits if they attach some use or non-use value to those benefits or if they experience a warm glow from contributing to a public good [3, 4] and if price and income considerations permit purchase of the good. On the other hand, skepticism about the environmental claims of the label,[3] uncertainty about what the label means, and the incentive to act strategically believing that others will pay for adequate provision could lead consumers to under-represent their environmental preferences in the marketplace and not purchase an eco-labeled good regardless of relative prices or income levels.[4]

Zero consumption of an eco-labeled good by a consumer could, therefore, represent a corner solution to the consumer's utility maximization problem, that is an economic decision determined by prices and income, or it could be the result of non-economic factors such as environmental preferences, lack of trust in the eco-label or free-riding behavior, which is uncorrelated with the levels of prices and income.[5] Since non-economic factors may influence demand, Pudney [33] suggests that zero consumption is best modeled by means of a discrete shift variable altering the nature of individual preferences. This approach implies that a consumer buying an eco-labeled good has a different preference structure than a consumer who does not buy such a good. The

[3] A large number of studies have found that consumers tend to be skeptical towards "green" product claims (see [32]).

[4] A 1990 survey carried out for Tesco, a British supermarket chain, found that about 50% of consumers said that they were willing to pay extra for environment friendly goods; however, Tesco store receipts suggest that, of the total spent on goods in categories for which green goods were available, only about 10% went on those green goods. While 75% of consumers were willing to pay a premium price for environmentally sound goods in 1990, only 35% of consumers acted on their intentions by 1993 [20].

[5] Zero consumption may also occur if the observation window for gathering data from a consumer is very short, particularly in the case of nonperishable items which may be stocked. As discussed in the data section, we avoid this problem by taking a rather long window of 4 years and repeated observations for most respondents.

demand for eco-labeled goods should then be modeled as a two stage process. The first stage is a discrete decision to participate in the market and the second stage decision is a choice about the quantity to consume.

We examine the appropriateness of modeling demand for eco-labeled toilet paper and paper towels as a two stage process by estimating four models: Tobit model, Cragg Market Participation model, Complete Dominance model, and Heckman model. These models differ in their underlying assumptions about the reasons for zero consumption of a good, the differential determinants of demand in the two stages, and the extent of dependence between the decisions in the two stages, as explained in Section 3. Determination of the model that best fits the data provides insights about the decision process underlying consumer demand for these eco-labeled goods. We estimate these models using micro-level data of household purchases of Nordic Swan eco-labeled toilet paper and paper towels in Denmark between 1997 and 2001. These data were provided by consumers over multiple shopping trips over the four year period. The Nordic Swan environmental label originated in Norway, Sweden, Iceland, and Finland in 1989 with Denmark becoming a full member of the labeling scheme in 1997.[6] In 1997, only 4% of available toilet paper and 15% of paper towels had received the Nordic Swan Eco-label. By 2001, the respective percentages were 35% and 28%. The label was promoted vigorously in Denmark during this time period through newspaper advertisements, leaflets in shops, and public relations efforts. Consumer recognition of the Swan label in Denmark increased from 29% of respondents in 1997 to 40% in 1998 and 52% in 1999 [1, 12]. Despite this, our survey of consumers in Denmark shows that a substantial proportion of

[6]The Nordic Swan Eco-label is designed for use on over one hundred different product groups, including toilet paper and paper towels. The main criteria for granting a label in the case of paper products is to have minimum content of substances harmful to the environment or health, have a high recyclable content, low energy consumption during manufacture and low environmental impact on water, soil and air as determined by a life cycle analysis.

households did not buy any eco-labeled toilet paper and paper towels. Including the zero demand decision together with the positive consumption decision in a single stage demand model for an eco-labeled good could lead to an overly restrictive model [6]. On the other hand, ignoring the large number of households with zero consumption of eco-labeled goods in our data when estimating demand for eco-labeled goods would lead to biased estimates [15].

Our empirical model includes explanatory variables that capture the economic factors that might influence demand such as prices of eco-labeled and non-labeled goods, household income, and availability of Swan goods (which affect its search costs). We also incorporate proxies for non-economic considerations, such as awareness and beliefs about Swan goods, by including advertising effort, and for the household's environmental attitudes, tastes, and preferences by including household socio-demographic characteristics. We estimate the elasticities of demand at each stage with respect to each of these factors. An understanding of the responsiveness of demand of eco-labeled goods to these factors can have useful policy implications. To the extent that demand can be explained by variables such as prices, availability of goods, and product awareness, policies may be designed to manipulate these factors to increase demand. In addition, if certain socio-demographic characteristics, such as age, education, gender, and income, are found to be important determinants of demand for eco-labeled goods, then information campaigns can be better targeted across heterogeneous consumers so that they are more effective in promoting demand.

2 Previous Research

The existing empirical literature on eco-labels has largely relied on stated preference data gathered using consumer surveys. Some of these studies use contingent valuation methods to assess rankings

for green electricity [36] and eco-labeled wood [31] and bread [29]. Other papers examine the discrete choice for eco-labeled seafood [22, 45] and apples [25] or the willingness to pay for organic produce [14].[7] All of these papers use a single stage framework to explore stated preference demand for eco-labeled goods. A few studies such as Blend and van Ravenswaay [7] and Moon et al. [28] use stated preference data to estimate two stage models of demand for eco-labeled apples and agricultural products produced in an environmentally-friendly fashion. The former study focuses on the decision to buy eco-labeled apples and how many to buy during a single shopping trip and finds that the factors influencing the two stages differ. On the other hand, in explaining the willingness to pay a premium and the amount of the premium, Moon et al. [28] find that a two stage model is indistinguishable from a single stage model.

Several of these studies find that non-economic factors such as high environmental awareness/food safety concerns [28, 31, 41, 45] and female respondents [22, 25, 31, 45] explain consumer preferences for eco-labeled goods. Among economic factors, a low price premium [22, 45] and a small family size [14, 25] were more likely to induce demand for eco-labeled goods. The effect of other socio-demographic variables is less clear. In particular, studies differ in their findings about the direction and significance of the effect of income, age, education, and presence of children on demand for eco-labeled goods. Blend and Ravenswaay [7] find that the signs associated with the variables age, gender, and education change across the two stages of their model. The differential effect of these factors across two stages along with differences in the specification of the dependent variable across studies might be the source of the observed inconsistency in the signs and significance of the explanatory variables across studies that estimate single stage models.

[7]Some of these studies estimate willingness to pay and find that it varies considerably, from 4.4% for eco-labeled wood products [31] to over 100% for environmentally-friendly bread [29].

A few studies have combined observed choice and contingent valuation techniques to examine consumer demand for eco-labeled goods. These include Gumpper [17] and Anderson and Hansen [2]. These studies find that the presence of a label positively affects consumer demand but that consumer willingness to pay may be relatively small.[8] Gumpper [17] also finds that while socio-demographic factors such as income and education do not affect contingent choices, they do affect observed choices.[9]

In a recent study, Bjørner et al. [5] use observed data on demand for various brands of toilet paper, paper towels, and detergents to estimate a mixed multinomial logit model of the impact of labeling on the choice of brands. The multinomial logit model allows them to control for the effects of unobserved brand characteristics on brand choice. They find that the effect of the Swan label differs across the three products. While the choice of brand for toilet paper is significantly affected by the Swan label, the choice among brands of paper towels is weakly or insignificantly affected by the label. They also find a price premium between 13-18% for toilet paper but do not find a statistically significant positive premium for paper towels. They attribute this difference in consumer behavior to the possibility that "green" consumers prefer to use reusable dishcloths instead of purchasing paper towels that are thrown out.

Our paper uses the same data as the Bjørner et al. [5] study but we focus on explaining the demand for the Swan label and the quantity of eco-labeled goods consumed. Unlike the multinomial logit model used in their study, the two stage model in our paper allows us to control for differences

[8]For example, Anderson and Hansen [2] conduct a market experiment that shows a price premium of only 2% on eco-labeled plywood products has a significant negative effect on sales of such goods.

[9]A number of studies have used market or aggregate level data to estimate hedonic price functions for green goods and have found a positive willingness to pay for eco-labeled goods [27, 30, 39]. Teisl, Roe, and Hicks [40] use aggregate market data on canned tuna and other meat products to estimate a demand system and find that dolphin-safe labeling of tuna did increase its market share.

in the quantity consumed between choice situations and allows for shifts in the utility function across choices. It also allows us to examine the effects of consumer heterogeneity on demand more systematically than the random parameters model used by Bjørner et al. [5]. We find remarkable similarity in most of the economic and non-economic determinants of demand for Swan labeled toilet paper and paper towels. An exception is the effect of gender on demand. Female shoppers were significantly more likely to purchase Swan labeled toilet paper but not Swan labeled paper towels. This could imply that it is specifically the environmentally-conscious female shoppers that were likely to switch to reusable dishclothes instead of purchasing paper towels. Moreover, we show that there are considerable differences in the factors that induce a demand for the label and those that affect the quantity of the Swan labeled good purchased.

3 Econometric Models and Tests

3.1 Econometric Models

In two stage models, households decide whether or not to participate in the market for eco-labeled goods (participation hurdle) followed by the quantity decision of the amount of eco-labeled goods to consume (consumption hurdle). Define d_i^* as the latent participation variable and y_i^* as the latent consumption variable where

$$d_i^* = \alpha' z_i + \nu_i, \tag{1}$$

$$y_i^* = \beta' x_i + \varepsilon_i. \tag{2}$$

Note, $d_i = 1$ if $d_i^* > 0$ and zero otherwise. Observed consumption of eco-labeled goods is

$$y_i = \begin{cases} y_i^* & \text{if } d_i^* > 0 \text{ and } y_i^* > 0 \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

Within this framework, we can describe several different types of econometric models such as the Tobit, Cragg, Heckman, and Complete Dominance models. The differences between these models revolve around the assumptions about consumer behavior at each stage of the model.

The Tobit model assumes that everyone participates in the market for eco-labeled goods (i.e. $d_i^* > 0$) and hence does not allow for separate market participation and consumption level decisions. Zero consumption, then, is due to an individual being censored by economic factors in the consumption equation. By assuming that everyone participates in the market, the Tobit model ignores the possibility that some consumers may choose not to consume eco-labeled goods for non-economic reason, such as lack of trust in the label or lack of willingness to pay for public goods, regardless of prices or consumer income. It focuses only on the quantity consumed decision. As a result, it assumes that the effect of an independent variable is the same on the probability of purchase and the distribution of quantity consumed [9, 23, 44]. If we assume the marginal distribution of the error term ε_i is normal, it is straightforward to define the probability of having positive consumption given market participation and the conditional and unconditional means (see Table 1) [15, 21, 42]. The probability of market participation is assumed to be one in the Tobit model.

The Heckman model can also be described by equations (1)-(3). Rather than assuming everyone participates in the market, the Heckman model recognizes that consumers may decide not to participate in the market. However, once consumers pass the participation hurdle they are assumed to have positive consumption [6]. The Heckman model assumes

$$(\nu_i, \varepsilon_i) \sim BVN(0, \Gamma), \quad \Gamma = \begin{bmatrix} 1 & \rho\sigma \\ \rho\sigma & \sigma^2 \end{bmatrix}, \tag{4}$$

where $BVN(0, \Gamma)$ denotes the bivariate normal distribution with mean zero and standard deviation

Γ, ρ is a correlation coefficient, and σ is the standard error. Given these assumptions, we can define the overall probability of positive consumption as well as the conditional and unconditional means (see Table 1) [15, 18]. In the first stage of the Heckman model, we use all observations to estimate a probit model of d_i on z_i to obtain estimates of $\hat{\alpha}$ from which we are able to compute the inverse Mills ratio, $\hat{\lambda}_i = \lambda_i(\frac{\hat{\alpha}' z_i}{\sigma_\nu})$. Since households with zero consumption represent nonparticipants in the market, the conditional mean is determined in the second stage regression of y_i on x_i and $\hat{\lambda}_i$ for only those individuals with positive consumption [18].

Similar to the Heckman model, the Complete Dominance model focuses on the selection decision in the first stage and assumes that consumers who pass the participation hurdle have positive consumption. Thus, the probability of positive consumption is the same in the two models (see Table 1). However, the Complete Dominance model differs from the Heckman model in that the two decisions are independent (i.e. $\rho = 0$ and $\nu_i \sim N(0,1)$ and $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$). This additional assumption changes the determination of conditional mean, as seen in Table 1 [21]. The first stage of the Complete Dominance model uses all observations to estimate a probit model of d_i on z_i to obtain estimates of $\hat{\alpha}$. The conditional mean is determined through the second stage OLS regression of y_i on x_i for those individuals with positive consumption only, because this model assumes that all zeros represent nonparticipants [18, 26, 44]. The probability of nonzero purchases given market participation is assumed to be one in both the Heckman and Complete Dominance models.

The final model we consider is the Cragg model. This model is perhaps the most flexible of the two stage models as it allows for censoring at either stage of the model. This is a double hurdle model which postulates that to observe positive consumption, the consumer must pass two hurdles: (1) be a potential buyer of an eco-labeled good (participation hurdle) and (2) actually

buy an eco-labeled good (consumption hurdle) [8, 10]. The first hurdle allows for the possibility that zero consumption is due to non-economic considerations while the second hurdle allows for the possibility that zero consumption could be a corner solution. Another advantage of the Cragg model over the Tobit model is that the former allows variables to have differing effects on the participation and the consumption decisions [9, 23, 44].

In the Cragg model, equations (1) and (2) are assumed to be independent, and therefore, the error terms are randomly and independently distributed, $\nu_i \sim N(0,1)$ and $\varepsilon_i \sim N(0,\sigma_\varepsilon^2)$. In the first stage we run a probit model to capture the decision to participate or not in the market for eco-labeled goods. Since nonparticipants may be potential consumers of eco-labeled goods, they are included in the sample in the second stage truncated regression [6]. Given the normality of the marginal distribution of the error terms ε_i and ν_i and the independence between the two equations, we can again define the overall probability of positive consumption and the conditional and unconditional mean (see Table 1) [10, 15, 21]. The probability of nonzero purchases is a combination of the probability of market participation and the probability of not being at a corner solution (that is, non zero purchases).

[Place Table 1 here]

3.2 Tests

As shown in Table 1, several of the above models are nested within each other, and we can therefore compare the models through different likelihood ratio tests. When $\Phi(\frac{\alpha' z_i}{\sigma_\nu}) = 1$ and $x_i \equiv z_i$, the Cragg model collapses to the Tobit model. Lin and Schmidt [24] and Green [15] propose the

following test to compare the Tobit and Cragg models:

$$\chi^2_{R+1} = -2\left(\log\ L_{tobit} - \log\ L_{cragg}\right) \tag{5}$$

$$= 2\left(\log L_{probit} + \log L_{trunc} - \log L_{tobit}\right), \tag{6}$$

where χ^2_{R+1} is distributed as chi-square with $R+1$ degrees of freedom (R is the number of independent variables). We can also use a likelihood ratio test to compare the Cragg model with the Complete Dominance model [21, 35]. The test statistic is

$$\chi^2_{R+1} = -2\left(\log\ L_{complete\ dominance} - \log\ L_{cragg}\right) \tag{7}$$

$$= 2\left(\log L_{trunc} - \log L_{ols}\right). \tag{8}$$

Finally, the Complete Dominance model is nested within the Heckman model when $\rho = 0$. The likelihood ratio test is

$$\chi^2_{R+1} = -2\left(\log\ L_{complete\ dominance} - \log\ L_{heckman}\right) \tag{9}$$

$$= 2\left(\log L_{ols/\lambda} - \log L_{ols}\right). \tag{10}$$

Since the Heckman model is not nested within either the Cragg or Tobit models, a simple t-test is done on $\hat{\lambda}_i$ to determine if sample selection is a problem and to choose between the Heckman model and the Complete Dominance model.

4 Data

4.1 Determinants of Demand

Equations (1) and (2) define our two stage model of demand, where z_i is the set of regressors that influence the participation decision and x_i is the set of regressors that affect the consumption decision. In the Complete Dominance model and the Cragg model, different variables can affect the

participation and consumption decision (i.e. x_i does not necessarily equal z_i) or a variable common across both stages can have a differential impact across the two stages. In the case of the Heckman model where the error terms of the two equations are assumed to be correlated and the structure of the model is recursive, identification requires that there be at least one variable in z_i that does not appear in x_i.[10]

In general, we expect that demand for eco-labeled goods will depend on non-economic factors that influence environmental beliefs and concerns, proactiveness of attitudes, awareness of the label, and trust in the label, and on economic factors that determine affordability of the eco-labeled good, which is typically more expensive than the non-labeled good. We hypothesize that non-economic factors can be proxied by the socio-deomographic characteristics of consumers (education, age, gender, and presence of children) and by the advertising effort on eco-labeled and non-labeled goods. We expect advertising effort to affect the participation decision only. Since advertising informs consumers about the meaning of the Nordic Swan label or the availability of goods with the label, it is likely to affect a household's awareness of and trust in the label which influences the decision to participate in the market for eco-labeled goods. Since toilet paper and paper towels are not impulse or luxury purchases, we do not anticipate advertising will affect the quantity decision. The economic factors considered include household income, prices and availability of price discounts for the eco-labeled and non-labeled goods, and availability of Swan labeled goods in shops.

Education is hypothesized to have a positive effect on demand for eco-labeled goods. Educated individuals may be more likely to understand the consequences of environmental problems [11, 41],

[10]Willis and Rosen [46] point out that because the Mills ratios $\hat{\lambda}_i = \lambda_i(\frac{\hat{\alpha}' z_i}{\sigma_\nu})$ are nonlinear functions of the measured variables, it may still be possible to estimate the model even if z_i and x_i are identical. In any particular application, however, the amount of nonlinearity in the range of $\alpha' z_i$ may not be large enough.

may have longer time horizons and lower discount rates which imply greater utility from environmental improvements [13], and may be more likely to understand and use information embodied in an eco-label [17]. Goetz et al. [13] find that states with more highly educated populations have better environmental conditions, even after controlling for income, population density, and industrial composition. The empirical evidence on the effect of education on demand for green goods, however, is mixed. Blend and van Ravenswaay [7] and Gumpper [17] find a positive effect of education on the probability of purchasing eco-labeled apples and eco-labeled notebooks. Moon et al. [28] and Wessells et al. [45] find no effect on demand for agricultural goods produced in an environmentally sound manner and eco-labeled seafood, respectively. Johnston et al. [22] and Govindswamy and Italia [14] find that consumers in higher educational categories were less willing to pay the premium for organic produce and certified seafood products, respectively. The latter suggest that individuals with low education may overestimate the extent of environmental problems and therefore be more willing to buy eco-labeled goods. We include both education and the square of education to capture any nonlinearities in its effect on demand, particularly in the first stage.

Younger individuals are hypothesized to be more aware of environmental issues [16] and hence more likely to demand green goods. Moon et al. [28] find evidence that younger individuals support markets for agricultural goods produced in an environmentally sound manner. Wessells et al. [45] and Loureiro et al. [25], however, find no effect of age on the demand for eco-labeled seafood and apples. Blend and van Raveswaay [7] find no effect of age on the probability of buying eco-labeled apples but find that age positively impacts the quantity of eco-labeled apples bought. We estimate a specification with both age and the square of age to examine if the effect of age on demand for an eco-labeled good varies with age.

The effects of children and gender on demand for eco-labeled goods are theoretically ambiguous. While the presence of children may imply a greater bequest motive and hence increased demand for environmental quality, the presence of children also implies a larger household size, which may lead to a more economizing mind-set and hence reduced demand for high priced eco-labeled goods. Loureiro et al. [25] and Govindswamy and Italia [14] find that willingness to pay for organic produce decreases with household size.[11] Regarding the role of gender, there is some evidence that females are more environmentally conscious. According to the Hartman Group, 23% of the US population can be described as "New Green Mainstream" and consist of consumers that are either dedicated to purchasing environmentally-friendly goods or those not as dedicated but have the discretionary income to buy them if convinced about their value. Seventy eight percent of this group is female. Another study finds that 57% of women and 41% of men were more likely to switch brands if they felt that a good damages the environment [20]. Blend and van Ravenswaay [7], Wessells et al. [45], and Moon et al. [28] consistently find that women are more likely to buy eco-labeled goods.

Among the economic factors that are hypothesized to affect both stages of the demand model, we expect income to positively impact demand for environmental quality. While numerous contingent valuation studies for non-market environmental services like clean air and water affirm this position [19, 38], it is difficult to find evidence that higher incomes lead to greater demand for environmentally-friendly goods in a market setting. Studies fail to find a significant, positive effect of income on the demand for agricultural goods produced in an environmentally sound manner [28], eco-labeled apples [7, 25] and seafood [45]. The absence of an effect of income may reflect the fact that expenditures on green goods is a relatively small share of total income and hence is not

[11] Among the hedonic studies, Maguire et al. [27] find that organic baby food receives a price premium, but Nimon and Beghin [30] find no additional price premium for baby apparel made with organic cotton.

a consideration in the decision-making process of most consumers.

Additionally, we hypothesize that price of the eco-labeled good and its non-labeled substitute will have the expected effects on demand. In addition to including each price separately (price of Swan and price of regular goods), we test an alternative specification that includes the ratio of the price of Swan to the price of regular goods to examine whether the two were considered substitutes by consumers. Since toilet paper and paper towels are durable goods that can be stored, we anticipate that the on-sale variable may have a large impact on consumer demand with consumers stocking up on these goods during sales and not buying much at other times. Also, the availability of Swan goods across different shops and hence across households may differ, which may also affect consumer demand because it affects the search costs a consumer may have to incur to find the eco-labeled good. Availability of the Swan-labeled good in a store where a consumer makes a purchase increases the likelihood of consumer awareness of that good and its entering the consumer's choice set.

4.2 Data Construction

Data on consumer purchases of toilet paper and paper towels in Denmark were provided by GfK Marketing Services.[12] The data include weekly surveys of consumer purchases for four years between 1997-2001. In addition, information about basic household socio-demographic characteristics was gathered from annual surveys. An average of 1596 weekly surveys were returned from a broad range of Danish households. Households completed surveys for different lengths of time; the average number of purchase observations or shopping trips per household for toilet paper is 15.4 and 10.2 for paper towels. For each purchase observation, households reported the brand and quantity they

[12] A more complete description of the original data from GfK and the preparation of the data for use can be found in Bjørner et al. [5].

purchased,[13] the price they paid, and the store they shopped at. Information on the other brands and prices available during the same week of purchase was constructed from the completed surveys of other households in the sample. In addition, each consumer reported if the good they purchased on each shopping trip was on-sale. Eco-labeling Denmark (the Danish labeling authority) provided information on whether a given brand had qualified for the Nordic Swan Eco-label. Finally, Danish Gallup Adfacts kindly provided an index for the weekly marketing effort of different brands. The index measures the marketing effort of brands based on the number of ads (and price of these ads) placed on Danish television and in Danish newspapers and weekly magazines and ranges from zero to one.

Data from all purchase observations for a household over the four year period is aggregated to construct a variable of the total quantity of eco-labeled goods purchased. We normalize this variable based on the number of shopping trips of each household to get an average number of eco-labeled goods purchased per shopping trip. Finally, due to the skewed nature of the distribution, we add one and take the log of this expression [47]. This expression, the log of the average number of eco-labeled goods purchased per trip plus one, serves as our dependent variable. By taking the average over a four year purchase window, we rule out the possibility of zero consumption for a non-perishable item like toilet paper and paper towels because the observation window is too short. A long window also makes it reasonable to assume that quantity purchased is similar to quantity consumed and avoids the need for considering inventories and price expectations influencing observed demand. In order to check if our empirical results are sensitive to the length of the time period used to

[13]The raw data denotes the number of packages of toilet paper (from 6-10 rolls per package) and paper towels (from 3-4 rolls per package) purchased. This is used to determine the total number of rolls of toilet paper or paper towels purchased by a household. The price variable is similarly adjusted and reflects the price per roll of toilet paper or paper towel. Prices per roll are denoted in Danish Kroners. In 1997, 1 U.S. dollar equaled approximately 7 Danish Kroners.

determine average consumption, we also estimate annual averages per shopping trip and estimate a pooled specification model, as described in the next section.

From the weekly survey data, we construct for each household the average price of labeled and non-labeled goods, the average number of goods on-sale for labeled and non-labeled goods, and the average level of advertising of labeled and non-labeled goods. These variables are constructed in sightly different ways. For the price and on-sale variables, we simply calculate the average price among purchased goods and the average number of shopping trips in which the household purchased a good that was on sale. For advertising, we anticipate the amount of advertising of purchased as well as non-purchased brands may affect an individual's consumption choice. Advertising by any eco-labeled brand, for example, may inform the individual of the presence and benefits of eco-labeled goods, which may lead the consumer to purchase an eco-labeled brand (although not necessarily the brand which the advertisement was based on). Since an individual's choice to buy an eco-labeled good may be influenced by the advertising done by either the purchased or non-purchased brand, we calculate the average advertising done by eco-labeled and non-labeled brands for each purchase observation. We then average these values across all purchase trips.

To capture the increased availability of eco-labeled goods from 1997 to 2001, we calculate for each household the percentage of shopping trips in which at least one Swan labeled good was available. Based on the annual surveys conducted by GfK, household income, age, education, presence of children, and gender of primary shopper is identified (ranges of these categorical variables are defined in Table 2). In most cases, the range of these variables is such that the value of an observed variable over the four year time period is constant for a given household. If there is any change in these variables for a household across the sample, we simply use the average of the values. Table

3 provides sample means of the variables. Even after aggregating all purchase observations over four years per household, 49% of households did not consume any eco-labeled toilet paper and 46% did not consume any eco-labeled paper towels. Among the households that did purchase an eco-labeled good at least once, the average share of quantity of eco-labeled purchases is 37% for toilet paper and 47% for paper towels. Summary statistics show that households that purchase eco-labeled toilet paper and paper towels are, on average, richer, older, and have a woman as the primary shopper.

[Place Tables 2 and 3 here]

5 Results

5.1 Parameter Estimates

Tables 4 and 5 present the first stage probit results for toilet paper and paper towels. We test four different specifications of the probit model. Model I is the base model and includes the standard set of economic (price, on-sale, availability of Swan goods, income) and non-economic (advertising, age, education, children, gender) variables. We also include education squared to account for the possible different effects of education on demand. Model II adds age squared. Model III replaces the price of Swan and price of regular goods with the relative price of Swan to regular goods. Model IV is similar to Model I, but the data are aggregated over each of the four years rather than once over the four year period to determine how consumption changed over time.

Among the economic factors, all four models across both goods show that higher prices of Swan goods (and lower prices of regular goods) make it less likely that the household will buy Swan goods. Model III shows that the alternative specification of a higher relative price ratio of Swan

to regular goods also decreases the probability of consuming an eco-labeled good. The more Swan goods are on-sale (and the less regular goods are on-sale) will result in more households buying Swan goods. The greater availability of Swan goods over the course of a household's shopping history also has a positive impact on the probability that a household buys a Swan good. Finally, income has a positive effect on the probability of purchasing eco-labeled goods.

All four models for both toilet paper and paper towels consistently show that non-economic factors proxied by the socio-demographic characteristics of households, with the exception of household size, have a significant effect on the discrete decision to purchase Swan labeled goods. In particular, we find that age and education have a positive effect on the participation decision but one that diminishes for higher age and education categories. The only effect that differs across toilet paper and paper towels is that of gender. If the primary shopper is female, this significantly increases the likelihood of purchasing Swan toilet paper but has no impact on the purchase of Swan paper towels. A higher level of advertising of regular goods reduces the likelihood of a household buying Swan goods. Model IV shows that there is an upward time trend in the probability of purchasing Swan goods irrespective of household characteristics, prices, and income.

[Place Tables 4 and 5 here]

We choose to use Model I for the second stage estimation of the Cragg, Heckman, and Complete Dominance models. Model I is weakly preferred over Model II for toilet paper and strong preferred for paper towels by the Bayesian Information Criterion [34]. Model III would be preferred over both models by the same criteria but is not chosen as it precludes us from calculating individual price elasticities. The different sample size between Model IV and the other models makes it difficult to compare them directly. In results not reported, we also used the specifications of Models II and IV

to estimate the second stage regressions. The results were not substantively different from those obtained using the specification in Model I. For brevity, we only report the results using Model IV for the Cragg model.

We then estimate the Tobit model and the second stage models of the Heckman, Complete Dominance, and Cragg models. For reasons discussed in the Section 4.1, advertising is excluded from the second stage regressions. In results not shown, we find that education squared is not important in the second stage decision and therefore is excluded as well. Tables 6 and 7 present results from the second stage models. Results across the Heckman, Complete Dominance, and Cragg second stage models are broadly consistent. Across most models, household income, product prices, the level of discounting (on-sale), and the availability of Swan goods are significant in the consumption decision. While the three second stage models are similar, there are differences with the single stage Tobit model. For example, the effect of age is positive in the Tobit model for both toilet paper and paper towels but is insignificant in most second stage models. If consumption of eco-labeled goods follows a two stage process, this indicates the limitations of using a single stage model such as the Tobit model.

Similar to the first stage probit models, economic factors like household income, availability of Swan goods, and if the good is on-sale positively affect consumption of eco-labeled goods. Higher prices of regular goods also increase consumption of eco-labeled goods. In terms of non-economic factors, the presence of children has a negative effect on the propensity to consume eco-labeled goods. Although one may hypothesize that children would have a positive effect on demand for eco-labeled goods, the negative sign may reflect the larger family size and greater economizing mind-set of larger families, especially in the decision of how many eco-labeled goods to buy. Other

socio-demographic variables of interest like age, education, and if the primary shopper is female generally seem to be insignificant. Recall, in the first stage probit models, several of these variables were significant. Education and age were positive and significant for toilet paper and paper towels while female buyer was positive and significant for toilet paper. This indicates an interesting result that socio-demographic variables have a differential effect across the two stages of demand. The fact that socio-demographic variables seem to be more significant in the decision to buy eco-labeled goods compared to the quantity decision confirms our hypothesis that consumer tastes are important in the decision whether to participate in the market for eco-labeled goods.

[Place Tables 6 and 7 here]

With the Tobit model and both stages of the two stage models estimated, we can compare the models using the likelihood ratio tests previously defined. For the likelihood ratio test defined in (5), the test statistic is 483.53 for toilet paper and 475.17 for paper towels.[14] Both of these values are greater than the corresponding chi-squared critical value of 29.14 at 1 percent significance with fourteen degrees of freedom, and we can therefore strongly reject the null hypothesis that the Tobit model is the true model in favor of the Cragg model. This implies that the two stage model is preferred as households make decisions on whether to purchase eco-labeled goods and then decide how much to purchase. Comparing the Cragg and Complete Dominance models, the likelihood ratio test statistic in (7) is 148.05 for toilet paper and 86.53 for paper towels. Again, we reject the null hypothesis that all participants have positive purchases (Complete Dominance) in favor of the Cragg model.

[14]For the test statistic to be valid, the models must rely on the same set of explanatory variables. For the purpose of this test, we include income, age, education, children, female buyer, price Swan, price regular, adv Swan, adv regular, on-sale Swan, on-sale regular, and Swan availability.

The appropriateness of the Heckman model is tested through a t-test on the coefficient of the inverse Mills ratio and a likelihood ratio test. We note that the coefficient on the inverse Mills ratio is significant for toilet paper but insignificant for paper towels (see Tables 6 and 7). From the likelihood ratio test defined in (9), we compare the Heckman model against the Complete Dominance model. The test statistic is 2.92 for toilet paper and 0.65 for paper towels. Both values are less than the critical value, which implies we can not reject the null hypothesis that the Complete Dominance model fits the data better than the Heckman model. These results, coupled with the insignificant coefficient on the inverse Mills ratio (at least for paper towels), suggest the Complete Dominance model is preferred over the traditional Heckman model. Since the previous results favored the Cragg model over both the Tobit and Complete Dominance models, we conclude that the Cragg model fits the data the best. As a point of comparison, we also report the results for Model IV of the Cragg model, which aggregates the data for each of the four years. In general, the results are similar between the two specifications of the Cragg model. Model IV indicates that households consumed more eco-labeled paper towels over the four years and did so at an increasing rate. The pattern of increasing consumption appears less significant for toilet paper, as most of the year dummies are insignificant. Regardless of the model and the aggregation method, results are robust between the second stages of the different models.

5.2 Elasticity

From the parameter estimates of the Cragg model, we calculate elasticities for each stage to give us a better understanding of the responsiveness of consumer demand for eco-labeled goods to different economic and non-economic factors. The first elasticity we consider is the elasticity of participation. This elasticity relates how a change in an exogenous variable affects the probability

that one overcomes the first stage participation hurdle. It is defined as

$$\zeta^{\Pr} = \left[\frac{\partial \Pr(d_i^* > 0)}{\partial z_j}\right]\left[\frac{z_j}{\Pr(d_i^* > 0)}\right]. \tag{11}$$

We can also define the conditional elasticity of consumption. The conditional elasticity focuses on the second stage and considers the impact of a change in an exogenous variable on the quantity of Swan goods for households that already consume Swan goods:[15]

$$\zeta^{c} = \left[\frac{\partial E(q_i \mid q_i > 0)}{\partial x_j}\right]\left[\frac{x_j}{E(q_i \mid q_i > 0)}\right]. \tag{12}$$

Since these elasticities are not well defined for categorical variables, we instead calculate the percentage change in the probability of participation and the percentage change in the quantity consumed as the value of the categorical variable changes from one category to the next. For each categorical variable (such as income, age, and education), we measure the percentage impact of an increase in the variable from one category to the next. In order to examine whether the impact varies across categories, we measure these impacts for changes at two different category levels, the lowest category and the second highest category, for each variable. The values of the variables represented by these categories are defined in Table 2. All other variables are measured at their mean values.

[Place Table 8 here]

Elasticity expressions for continuous variables and percentage change expressions for categorical variables are presented in Table 8.[16] One can not directly compare the elasticity and percentage change values for the different types of variables. Comparing the relative impacts of the various

[15] We are interested in the conditional elasticity with respect to quantity, q_i. Our regression analysis, however, is based on y_i $(\log(\frac{q_i}{\#\ of\ trips} + 1))$. It is easy to show that the expected conditional value is $E(y_i \mid y_i > 0) = \beta' x_i + \sigma_\varepsilon \frac{\phi(\beta' x_i/\sigma_\varepsilon)}{\Phi(\beta' x_i/\sigma_\varepsilon)}$ [15]. Transforming this expression in terms of q_i yields $E(q_i \mid q_i > 0) = (\#\ of\ trips)\left(\exp\left(\beta' x_i + \sigma_\varepsilon \frac{\phi(\beta' x_i/\sigma_\varepsilon)}{\Phi(\beta' x_i/\sigma_\varepsilon)}\right) - 1\right)$ from which we can take the derivative to find the marginal change in q_i.

[16] Standard errors for the point estimates are calculated by the bootstrap method. Each estimate is bootstrapped with 1000 replications.

continuous variables, we find the price elasticities of participation are all close to or greater than one, indicating that the decision to participate in the market is heavily influenced by economic considerations, much more so than the consumption decision. The consumption decision is relatively price inelastic, as might be expected for necessities like toilet paper and paper towels. The positive signs of all cross price elasticities indicate that consumers consider a Swan good and its counterpart non-Swan good to be substitutes. Consumption decisions, on the other hand, are more strongly affected by the availability of Swan goods. Swan availability elasticities for consumption are substantially larger than one for both toilet paper and paper towels as opposed to the corresponding elasticities for participation, which are less than one. The effect of an increase in advertising effort for Swan goods and any impact it has on awareness of the label or trust in the label is statistically insignificant.

Among the categorical variables, we find that the decision to participate in the market for Swan goods is strongly influenced by whether or not these goods and the non-Swan goods were on sale. The effect of the on-sale variable on consumption decisions, however, is even stronger. Since paper products are non-perishable, this could indicate stocking up of Swan goods when on sale by households and very limited purchases when these goods are not on sale. We also find that non-economic factors proxied by socio-demographic characteristics (such as age, education and gender) have a much larger impact on the participation decision than on the consumption decision. In fact, the percentage change in the consumption decision due to changes in age and education is statistically insignificant. The probability of those below 25 years of age purchasing more Swan goods as their age increases to the 25-29 category increases by 14% for toilet paper and by 11% for paper towels. The percentage increase in probability of participation as age increases from the

60-69 year category to over 70 years is 8% and 7% for Swan toilet paper and paper towels. This suggests that the effects of an increase in age on the probability of participating in the labeled good market are larger at younger ages and diminish at older ages. An increase in education from a high school degree to an associates degree has a positive (though insignificant) effect on the probability of participation in the market. However, at higher levels of education, such as a college degree, further education reduces the probability of purchasing an eco-labeled good. Although this is surprising, it is consistent with other studies that show that more educated consumers were less likely to purchase eco-labeled seafood [22] and organic produce [14]. Having a female shopper for the household increases the probability of participation in the Swan toilet paper market by 15%. The effect on Swan paper towels market is positive but not significant. The quantity consumed, however, is not affected by gender.

In contrast to the effects of these socio-demographic factors that affect the participation but not the consumption decision, we find that family size (or the presence of children) affects the decision of how much eco-labeled goods to consume but not the participation decision. This suggests that the presence of children does not make households more environmentally friendly, possibly because it constrains their ability to spend on more expensive environmentally-friendly goods. The percentage change in the probability of participation and in consumption due to changes in income is small and does not vary much across income levels. An increase in income by about 50,000 Danish Kroners (approximately 7,000 US dollars), whether it is for the low income group or the high income group, increases the probability of participating in the Swan toilet paper market by 2% and in the Swan paper towels market by 4%. It increases consumption by about 3% and 2% respectively. The small effect of income on the participation decision could be because expenditure on toilet paper and

paper towels is a small portion of the household's budget and even though eco-labeled goods are relatively more expensive than regular goods, the decision to buy them is not highly constrained by income. The small impact of income on the percentage change in consumption also suggests that demand for these Swan goods is income inelastic.

6 Conclusion

This paper analyzes the determinants of demand for two Swan eco-labeled products, toilet paper and paper towels, using purchase data from Danish households. It explores the validity of modeling the consumer's purchase decision as a two stage process using four econometric models that differ in their assumptions regarding the relation between decisions made in the two stages. We find that the double hurdle Cragg model fits the data best. This indicates that factors influencing the decision of whether or not to purchase an eco-labeled good and participate in an eco-labeled market differ considerably from the factors that influence the subsequent decision of how many eco-labeled goods to buy. Additionally, it shows that the decisions in the two stages are independent of each other.

Our results show that the determinants of demand for toilet paper are very similar to those for paper towels. For both goods, we find that socio-demographic characteristics are more important in the participation stage than the consumption stage. In particular, age and education have a significant effect on the decision to participate in the market for eco-labeled goods, but these variables have little to no impact on the decision of how much of the eco-labeled good to consume. Households with a female as the primary shopper are found to be significantly more likely to buy Swan toilet paper, but not Swan paper towels. This suggests that women are more environmentally

conscious and may prefer reusable dishclothes to paper towels of any kind. The price of Swan goods affects participation substantially but has an insignificant effect on quantity consumed as may be expected for goods that are necessities. However, a decrease in the price of regular goods does have a substitution effect and increases consumption of Swan goods. This suggests that consumption decisions are sensitive to the relative prices of Swan and non-Swan goods. On the other hand, economic factors such as availability of eco-labeled goods, discount sales on eco-labeled goods, and lack of sales on regular goods have a larger impact on the quantity consumed decision than on the participation decision. Elasticity estimates show that demand in both stages is fairly inelastic to income changes.

These results have several policy implications. They suggest greater environmental consciousness among the younger, less educated and female consumers. Providing these groups with information about environmentally-friendly goods, while targeting information that educates other groups about the environmental impacts of their consumption decisions, could increase participation in eco-labeled markets. The importance of economic factors, such as own and cross prices, availability and discounts, for demand at both stages, suggests that markets for eco-labeled goods can not solely rely on green preferences of consumers. These goods must compete with regular products in terms of prices and ease of purchase as well. Policy efforts targeted towards keeping prices of eco-labeled goods low, offering discounts on such goods as compared to regular goods and making eco-labeled goods more easily accessible to consumers, thereby reducing their search costs for such goods, can have a significant impact on demand for eco-labeled goods.

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Table 1: Comparison of Tobit, Heckman, Complete Dominance, and Cragg Model

Measure	*Tobit*	*Heckman*	*Complete Dominance*	*Cragg*
Probability of market participation	1	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$
Probability of nonzero consumption given market participation	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right)$	1	1	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right)$
Overall probability of nonzero consumption	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right)\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right)$
Conditional mean, $E(y_i \mid y_i > 0)$	$\beta' x_i + \sigma_\varepsilon \frac{\phi(\beta' x_i/\sigma_\varepsilon)}{\Phi(\beta' x_i/\sigma_\varepsilon)}$	$\beta' x_i + \rho\sigma_\varepsilon \frac{\phi(\alpha' z_i/\sigma_\nu)}{\Phi(\alpha' z_i/\sigma_\nu)}$	$\beta' x_i$	$\beta' x_i + \sigma_\varepsilon \frac{\phi(\beta' x_i/\sigma_\varepsilon)}{\Phi(\beta' x_i/\sigma_\varepsilon)}$
Unconditional mean, $E(y_i)$	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right) E(y_i \mid y_i > 0)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right) E(y_i \mid y_i > 0)$	$\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right) E(y_i \mid y_i > 0)$	$\Phi\left(\frac{\beta' x_i}{\sigma_\varepsilon}\right)\Phi\left(\frac{\alpha' z_i}{\sigma_\nu}\right) E(y_i \mid y_i > 0)$

Table 2: Description of Variables

Variable	*Definition*
income	categorical variable from 1-9 for income[1]
age	categorical variable from 1-7 for age[2]
age squared	square of age
education	categorical variable from 1-4 for educational attainment[3]
education squared	square of education
children	1 if household has children, otherwise zero
female buyer	1 if the primary shopper was female, otherwise zero
price Swan	price per roll of Swan labeled good (Danish Kroners)
price regular	price per roll of regular (non-labeled) good (Danish Kroners)
P_{Swan} / P_{reg}	ratio of price of Swan good to price of regular good (Danish Kroners)
on-sale Swan	1 if Swan labeled good is on sale; otherwise zero
on-sale regular	1 if regular (non-labeled) good is on sale; otherwise zero
adv Swan	index from zero to one of advertising expenditure on Swan labeled goods
adv regular	index from zero to one of advertising expenditure on regular (non-labeled) goods
Swan availability	percent of purchase observation in which Swan good was available in shop from which a purchase occurred.

[1] Income ranges from 0-100, 100-150, 150-200, ..., 350-400, 400-450, and over 450 in thousands of Danish Kroners.

[2] Age ranges from less than 25, 25-29, 30-39, 40-49, 50-59, 60-69, and 70 and over.

[3] Education ranges from the equivalent of high school education, associates degree, college degree, and graduate degree.

Table 3: Sample Means

	Full Sample		*Buy eco-label*		*Buy regular*	
Variable	*TP*	*PT*	*TP*	*PT*	*TP*	*PT*
income	5.175	5.327	5.217	5.462	5.130	5.171
age	4.261	4.371	4.549	4.567	3.957	4.144
age squared	12.120	21.941	23.338	23.374	18.776	20.284
education	1.379	1.366	1.372	1.366	1.396	1.365
education squared	3.213	3.124	3.133	3.053	3.298	3.207
children	0.337	0.340	0.311	0.321	0.365	0.362
female buyer	0.891	0.896	0.906	0.903	0.875	0.889
price Swan	2.699	4.872	2.647	4.816	2.755	4.936
price regular	1.996	3.505	2.122	3.643	1.863	3.345
P_{Swan} / P_{reg}	1.444	1.443	1.306	1.364	1.591	1.534
on-sale Swan	0.176	0.243	0.218	0.278	0.133	0.202
on-sale regular	0.203	0.217	0.209	0.220	0.197	0.214
adv Swan	0.007	0.022	0.007	0.022	0.007	0.022
adv regular	0.003	0.003	0.003	0.002	0.003	0.003
Swan availability	0.724	0.946	0.823	0.965	0.619	0.925
number of observations	2933	2483	1507	1331	1426	1152

We abbreviate toilet paper as *TP* and paper towel as *PT*.

Table 4: First Stage Probit Models - Toilet Paper

Variable	*Model I*	*Model II*	*Model III*	*Model IV*
income	0.0251**	0.0140	0.0225*	0.0332***
	(0.0117)	(0.0124)	(0.0119)	(0.0076)
age	0.1382***	0.3480***	0.1349***	0.0743***
	(0.0162)	(0.0799)	(0.0165)	(0.0114)
age squared		-0.0259***		
		(0.0097)		
education	0.1420*	0.1173	0.1525**	0.0062
	(0.0725)	(0.0732)	(0.0739)	(0.0470)
education squared	-0.0457**	-0.0404**	-0.0486***	-0.0126
	(0.0184)	(0.0185)	(0.0187)	(0.0123)
children	-0.0280	-0.0684	-0.0113	-0.0631
	(0.0637)	(0.0656)	(0.0648)	(0.0434)
female buyer	0.2592***	0.2703***	0.2617***	0.3540***
	(0.0856)	(0.0857)	(0.0870)	(0.0603)
price Swan	-0.5801***	-0.5758***		-0.1553***
	(0.0622)	(0.0622)		(0.0429)
price regular	0.6275***	0.6276***		0.5489***
	(0.0446)	(0.0446)		(0.0282)
P_{Swan} / P_{reg}			-1.2965***	
			(0.0680)	
on-sale Swan	1.2259***	1.2273***	1.1402***	1.5181***
	(0.1951)	(0.1953)	(0.1995)	(0.1091)
on-sale regular	-0.8914***	-0.9108***	-0.6355***	-0.8577***
	(0.2364)	(0.2367)	(0.2426)	(0.1438)
adv Swan	-1.3589	-1.1396	-1.8293	2.4543**
	(1.9749)	(1.9700)	(2.0389)	(1.0698)
adv regular	-9.8084**	-9.7224**	-10.1938**	-7.2569**
	(4.8644)	(4.8768)	(4.9991)	(3.0658)
Swan availability	1.4971***	1.5040***	1.5656***	0.9266***
	(0.1086)	(0.1089)	(0.1108)	(0.0819)
1998				0.2055***
				(0.0681)
1999				0.6182***
				(0.0696)
2000				0.9382***
				(0.0672)
constant	-1.4797***	-1.7540***	0.0124	-2.7880***
	(0.2138)	(0.2378)	(0.1586)	(0.1565)
no. of observations	2933	2933	2933	7019
log likelihood	-1645.871	-1642.258	-1570.959	-3601.597
BIC	-668.233	-667.476	-826.040	-1829.123

Standard errors are in parenthesis.

* indicates significance at 10%, ** indicates significance at 5%, and *** indicates significance at 1%.

Table 5: First Stage Probit Models - Paper Towels

Variable	*Model I*	*Model II*	*Model III*	*Model IV*
income	0.0467***	0.0384***	0.0457***	0.0350***
	(0.0123)	(0.0130)	(0.0124)	(0.0079)
age	0.1206***	0.2796***	0.1222***	0.0882***
	(0.0176)	(0.0850)	(0.0177)	(0.0124)
age squared		-0.0195*		
		(0.0102)		
education	0.2240***	0.2089***	0.2342***	0.1047**
	(0.0767)	(0.0772)	(0.0774)	(0.0491)
education squared	-0.0680***	-0.0646***	-0.0696***	-0.0303**
	(0.0195)	(0.0196)	(0.0197)	(0.0128)
children	-0.0981	-0.1297*	-0.0965	-0.0677
	(0.0665)	(0.0686)	(0.0670)	(0.0445)
female buyer	0.0880	0.0928	0.0894	0.0892
	(0.0906)	(0.0906)	(0.0912)	(0.0613)
price Swan	-0.2090***	-0.2082***		-0.1655***
	(0.0409)	(0.0409)		(0.0284)
price regular	0.3415***	0.3396***		0.2795***
	(0.0348)	(0.0348)		(0.0215)
P_{Swan} / P_{reg}			-1.1585***	
			(0.0896)	
on-sale Swan	1.2275***	1.2277***	1.1248***	1.5916***
	(0.1550)	(0.1552)	(0.1564)	(0.0956)
on-sale regular	-0.3557*	-0.3527*	-0.2487	-0.5520***
	(0.2059)	(0.2062)	(0.2072)	(0.1208)
adv Swan	-0.0181	-0.0036	-0.2028	0.3209
	(0.8294)	(0.8304)	(0.8338)	(0.4742)
adv regular	-10.1992**	-10.0345**	-10.4291**	0.1303
	(4.5876)	(4.5896)	(4.6698)	(2.8774)
Swan availability	1.0943***	1.0919***	1.1767***	0.8998***
	(0.2072)	(0.2075)	(0.2096)	(0.1353)
1998				0.3524***
				(0.0563)
1999				0.4894***
				(0.0567)
2000				0.5309***
				(0.0583)
constant	-2.1411***	-2.3384***	-0.3696	-2.4705***
	(0.3201)	(0.3369)	(0.2496)	(0.2162)
no. of observations	2483	2483	2483	5742
log likelihood	-1551.086	-1549.253	-1520.415	-3486.298
BIC	-225.458	-221.307	-294.616	-693.778

Standard errors are in parenthesis.

* indicates significance at 10%, ** indicates significance at 5%, and *** indicates significance at 1%.

Table 6: Second Stage Regression - Toilet Paper

Variable	*Tobit*	*Heckman*	*CD*	*Cragg*	
				Model I	*Model IV*
income	0.0419***	0.0377***	0.0246***	0.0293***	0.0234***
	(0.0104)	(0.0083)	(0.0068)	(0.0083)	(0.0055)
age	0.1170***	0.0630***	0.0019	0.0038	0.0013
	(0.0149)	(0.0127)	(0.0102)	(0.0125)	(0.0090)
education	-0.0182	-0.0058	0.0066	0.0058	-0.0012
	(0.0218)	(0.0174)	(0.0145)	(0.0176)	(0.0119)
children	-0.0758	-0.1168**	-0.1014***	-0.1200**	-0.0885**
	(0.0579)	(0.0462)	(0.0389)	(0.0475)	(0.0330)
female buyer	0.2255***	0.1417**	0.0330	0.0513	0.0516
	(0.0787)	(0.0635)	(0.0537)	(0.0652)	(0.0484)
price Swan	-0.4566***	-0.2959***	-0.0341	-0.0412	-0.0624**
	(0.0499)	(0.0420)	(0.0280)	(0.0346)	(0.0232)
price regular	0.6226***	0.4417***	0.1595***	0.1863***	0.0343
	(0.0398)	(0.0394)	(0.0276)	(0.0332)	(0.0219)
on-sale Swan	1.8681***	1.9979***	1.7132***	1.9156***	1.2802***
	(0.1797)	(0.1605)	(0.1395)	(0.1664)	(0.0906)
on-sale regular	-1.2522***	-1.3365***	-1.1470***	-1.3095***	-0.5438***
	(0.2214)	(0.1932)	(0.1687)	(0.2088)	(0.1232)
Swan availability	1.7929***	1.6350***	1.1288***	1.5220***	1.1064***
	(0.1089)	(0.1023)	(0.0936)	(0.1269)	(0.0923)
constant	-1.9060***	-1.3036***	-0.1859	-0.6629***	0.3197**
	(0.1833)	(0.1590)	(0.1203)	(0.1586)	(0.1178)
lambda		0.7322***			
		(0.0473)			
1998					-0.2719***
					(0.0683)
1999					-0.0160
					(0.0668)
2000					0.1040
					(0.0664)

Standard errors are in parenthesis.

* indicates significance at 10%, ** indicates significance at 5%, and *** indicates significance at 1%.

Table 7: Second Stage Regression - Paper Towels

Variable	*Tobit*	*Heckman*	*CD*	*Cragg*	
				Model I	*Model IV*
income	0.0456***	0.0098	0.0131**	0.0155**	0.0135***
	(0.0093)	(0.0064)	(0.0058)	(0.0067)	(0.0045)
age	0.0845***	-0.0049	0.0024	0.0027	0.0048
	(0.0137)	(0.0107)	(0.0089)	(0.0104)	(0.0075)
education	-0.0108	0.0170	0.0150	0.0165	0.0032
	(0.0198)	(0.0127)	(0.0125)	(0.0146)	(0.0098)
children	-0.1129**	-0.0716**	-0.0767**	-0.0900**	-0.0826***
	(0.0508)	(0.0322)	(0.0318)	(0.0372)	(0.0261)
female buyer	0.0674	-0.0192	-0.0131	-0.0122	0.0270
	(0.0697)	(0.0448)	(0.0442)	(0.0517)	(0.0368)
price Swan	-0.1381***	0.0164	0.0034	0.0027	-0.0207*
	(0.0283)	(0.0180)	(0.0147)	(0.0174)	(0.0120)
price regular	0.2793***	0.0609***	0.0803***	0.0924***	0.0031
	(0.0252)	(0.0219)	(0.0157)	(0.0180)	(0.0128)
on-sale Swan	1.4923***	1.1796***	1.2486***	1.4011***	1.0280***
	(0.1212)	(0.1035)	(0.0878)	(0.1022)	(0.0635)
on-sale regular	-0.4069**	-0.0968	-0.1218	-0.1109	-0.1315
	(0.1599)	(0.1157)	(0.1133)	(0.1327)	(0.0802)
Swan availability	1.1289***	0.6223***	0.6995***	0.9488***	0.6733***
	(0.1758)	(0.1599)	(0.1479)	(0.1951)	(0.1321)
constant	-2.0201***	-0.1883	-0.4044**	-0.7860***	0.1095
	(0.2449)	(0.2406)	(0.1704)	(0.2196)	(0.1486)
lambda		-0.1098			
		(0.0857)			
1998					0.1097***
					(0.0318)
1999					0.2010***
					(0.0322)
2000					0.2026***
					(0.0322)

Standard errors are in parenthesis.

* indicates significance at 10%, ** indicates significance at 5%, and *** indicates significance at 1%.

Table 8: Elasticities from Cragg Model

	Participation Elasticity		*Conditional Elasticity*	
Variable	*TP*	*PT*	*TP*	*PT*
Continuous Variables[1]				
price Swan	-1.2314***	-0.7521***	-0.1268	0.0190
	(0.1386)	(0.1461)	(0.1196)	(0.1311)
price regular	0.9848***	0.8844***	0.4598***	0.4846***
	(0.0849)	(0.1124)	(0.0790)	(0.0798)
adv Swan	-0.0077	-0.0003		
	(0.0114)	(0.0136)		
adv regular	-0.0218*	-0.0194**		
	(0.0125)	(0.0089)		
Swan availability	0.8523***	0.7651***	1.4572***	1.3181***
	(0.0612)	(0.1282)	(0.1347)	(0.2532)
Categorical Variables[2]				
on-sale Swan	40.2899***	40.4823***	155.0775***	136.0525***
	(4.6091)	(3.8745)	(7.4514)	(6.7138)
on-sale regular	-62.6500***	-19.8496	-128.8717***	-13.6626
	(21.8288)	(13.2828)	(18.0894)	(17.5796)
income (low)	2.1119*	3.9789***	3.2296***	1.9314**
	(1.1174)	(1.2148)	(0.9604)	(0.8646)
income (high)	1.8408**	3.0355***	3.1863***	1.8816**
	(0.8405)	(0.7118)	(0.9337)	(0.8193)
age (low)	14.3876***	11.6220***	0.4192	0.3327
	(2.1410)	(2.1350)	(1.4010)	(1.2708)
age (high)	8.3135***	7.0968***	0.4187	0.3264
	(0.7321)	(0.8053)	(1.3966)	(1.2648)
education (low)	0.3654	1.3856	0.6313	2.0222
	(2.1625)	(2.0700)	(2.0421)	(1.8138)
education (high)	-15.3967***	-21.1136***	0.6309	2.0069
	(6.6818)	(6.9834)	(2.0397)	(1.7876)
children	-1.4782	-4.9522	-13.1039***	-11.0525***
	(3.5769)	(3.4948)	(5.5067)	(4.5700)
female buyer	15.2229***	4.5084	5.6080	-1.4981
	(5.7815)	(5.0537)	(6.9429)	(6.7486)

Standard errors are in parenthesis.

[1] Expressions for continuous variables are true elasticities: $\frac{\%\triangle q}{\%\triangle x}$.

[2] Expressions for categorical variables measure the $\%\triangle q$ for a unit change in x.

* indicates significance at 10%, ** indicates significance at 5%, and *** indicates significance at 1%.