EVALUATING THE EFFECTS OF ECO-LABELS IN EUROPE

THESIS

Presented to the Graduate Council of
Southwest Texas State University
in Partial Fulfillment of
the Requirements

For the Degree

Master of Applied Geography

By

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San Marcos, Texas
December 2000

ACKNOWLEDGEMENTS

I wish to acknowledge and thank the Environmental Affairs department and the MTI Research department at Dell Computer for their assistance in obtaining the data used in this study. I would also like to thank Dr. Craig Colten, Dr. Pamela Showalter, and Dr. David Stea for their assistance and input. My special thanks go to Drs. Fred and Arlene Shelley for their encouragement, guidance, and friendship.

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ABSTRACT

Environmental seals of approval or "eco-labels" inform consumers which products are less harmful to the environment because of how they were made, what they are made of, or how they are used. Eco-labeling programs are typically sponsored by governments who oversee the development of label standards for individual product groups by expert industry and environmental working groups. Eco-labeling programs are more popular in Western Europe and Japan than in the U.S. In fact, the U.S. is one of the few developed countries without a government-sponsored eco-label.

Eco-labels can help implement environmental policies,.; reward manufacturers in the marketplace for improved environmental performance,.; and allow environmentally-oriented consumers to align their purchases with their values. Eco-labels can help move economies toward sustainability using the power and creativity of the marketplace rather than government regulation.

One of the promises of eco-labels is increased market share for labeled products—but do eco-labels deliver? Surveys indicate there are many consumers who will choose eco-labeled products, but there are few studies of actual buying behavior. My research uses market data for shipments of one type of eco-labeled product, desktop computers, to see if eco-labels confer a marketplace advantage.

Data were obtained for shipments of desktop computers in Europe by brand and country for a period of three years (1995 through 1997). Desktop computer brands were coded as eco-labeled or not. Countries were divided into two groups: those which sponsor eco-labels for

desktop computers ("eco-label" countries) and those which do not ("control" countries). For each group, two-sample t-tests were used to compare mean shipments of labeled computer brands with shipments of unlabeled brands to see if labeled brands in the eco-label countries have a greater market share than in the control countries.

This research found mean shipments of labeled desktop computers is significantly greater than shipments of unlabeled desktop computers in both groups of European countries, with almost one third of the European desktop computer market belonging to eco-labeled brands.

These results can be interpreted in several ways. Perhaps manufacturers are obtaining labels for their best selling desktop computers. These manufacturers may have the resources to obtain labels, while other manufacturers may consider eco-labels a luxury. The results could also mean that the eco-labels do provide increased market share. Eco-labels may be effective across country borders, with consumers purchasing a computer in France because it has an eco-label in Germany. Countries that are part of the European Union may have a higher awareness of all eco-label programs because of the European Union eco-label program.

Although the statistical analysis used in this research cannot be used to conclude cause and effect, market share and eco-labels appear to be positively related. Eco-labels may truly provide governments with another tool for implementing environmental policies while rewarding environmentally responsible manufacturers. With increased growth in consumer activity and associated environmental problems, governments should investigate and use all possible tools to implement policies for protecting the environment. These tools should include not only traditional command-and-control style regulations, but also non-regulatory, market-based tools such as eco-labels.

CHAPTER I INTRODUCTION AND RESEARCH QUESTION

Simple daily consumer activities like heating and air-conditioning homes, driving cars, cleaning our homes, and buying groceries can contribute to environmental problems such as global warming, depletion of the ozone layer, acid rain, excess concentration of nutrients in both water and soil, decreases of available fresh water, diffusion of dangerous chemicals, and increases in solid waste. For example, burning fossil fuels for heating homes and driving cars increases greenhouse gases which contribute to global warming and ozone depletion as well as acidification. Using various cleaning products and solvent-containing products contributes to acidification, while using other products and appliances (such as home and car air-conditioners that utilize ozone-depleting substances) contributes to ozone depletion. Consuming meat and dairy products contributes indirectly to acidification via agricultural ammonia emissions, and consumption of other agricultural products supports agricultural practices which contribute to the excess concentration of nutrients in soil and water. Households in developed countries are substantial users of water for bathing, toilets, and laundry, decreasing the amount of available fresh water. The diffusion of dangerous chemicals and the increase in the growth of waste are also partly the result of consumer activities (Ölander and Thøgersen 1995).

The contributions of any single consumer to environmental problems such as those cited above are insignificant. However, when multiplied by the number of consumers in the world's industrial economies, the negative effects of consumers on the environmental are substantial. Moreover, population, income, and economic activity are increasing in the U.S. and other developed nations. According to the U.S. Council on Environmental Quality (USCEQ),

" . . . from 1970 to 1995 U.S. population rose from about 205 million people to 263 million people, or 30 percent" (USCEQ 1995, 10). U.S. gross domestic product almost doubled in the same time period, growing " . . . (in constant 1992 dollars) from about $3.4 trillion in 1970 to more than $6.7 trillion in 1995," while disposable income per person in the U.S. increased " . . . from $12,022 to $18,000 (also in constant 1992 dollars)" (USCEQ 1995, 10). In the European Union, gross domestic product grew about 10 percent while private consumption increased about 11 percent in the three decades between 1961 and 1991 (European Environmental Agency 1994). According to Euromonitor data for 1990, " . . . average expenditure in Western Europe is about ECU [European Currency Unit, or Euro] 14 000 per capita" (European Environmental Agency 1994, 507). Although Europe's growth rate is lower than in the U.S., the number of households in Europe increased about 10 percent from 1980 to 1990, and the Global Environmental Outlook forecasts Europe's population will be 862 million in 2015 (European Environmental Agency 1994, 1998).

Increasing consumption means more environmental problems related to consumption. In the U.S., "from 1960 to 1994, waste generation increased from 88 million tons to 209 million tons, and projections indicate that it will rise to 262 million tons by the year 2010" (USCEQ 1995, 14). Twenty to 25 percent of this waste is produced by households (Ölander and Thøgersen 1995). In addition, transportation energy consumption, the U.S.'s largest source of air pollution, rose by about 50 percent from 1970 to 1995. Twenty percent of this energy consumption is from cars and trucks; overall vehicle energy use will probably continue to rise during the beginning of the next century (USCEQ 1995). Household car ownership in Western Europe has increased more than 20 percent in the past ten years (European Environmental Agency 1994). The World Resources Institute (1998) reports that developed countries such as the U.S. and the European Union make up less than 20 percent of global population but account for about 70 percent of carbon dioxide (CO2) emissions.

These increases in solid waste, air, and other forms of pollution can be conceptualized as the "back end" of consumption—the output from consumers using the goods produced by industrial economies. On the "front end" of industrial economies are inputs to production—resources used to create goods and services. These resources are also affected by increases in population, economic activity, and income. European households are responsible for from 5 to 30 percent of their total water usage and 15 to 50 percent of final energy consumption (European Environmental Agency 1994). The European Environmental Agency (1994, 509) states " . . . most industrial production (70 percent) supplies the domestic market, so that domestic consumption is responsible for a considerable proportion of industry's resource use and water production." The World Resources Institute's (1998, 139) 1998 annual report states that the industrialized economies of Germany, Japan, the Netherlands, and the U.S. require a very large volume of natural resources, " . . . in the range of 45 to 85 metric tons per person annually when all materials (including soil erosion, mining wastes, and other ancillary materials) are counted." Describing natural resource demands in another way, the same World Resources Institute (1998, 139) report explains:

> It currently requires about 300 kilograms of natural resources to generate US$100 of income in the world's most advanced economies. Given the size of these economies, this volume of materials represents a truly massive scale of environmental alteration.

New Approaches to Solving Environmental Problems

Recognizing that consumers play critical roles in world environmental problems, many government programs now designate consumers as a target group for environmental policies. According to the World Resources Institute " . . . if long-term environmental protection is to be achieved, consumption patterns themselves will need to change" (WRI 1998, 39). Ölander and Thøgersen (1995, 345) point out that the role of consumers is also addressed in Agenda 21, (the Rio Conference document), where:

> . . . one of the chapters deals with the need to change consumption patterns. To reach more sustainable consumption patterns, Agenda 21 envisages a variety of measures, including promoting environmentally sound technologies, encouraging environmentally sound use of renewable natural resources, encouraging recycling in industrial processes as well as at the level of individual consumption, and a reduction in wasteful packaging.

In presenting the ideas contained in Agenda 21, Ölander and Thøgersen use terms like "promoting" and "encouraging" and avoid terms such as "regulating" and "controlling." This wording reflects changes in approaches to environmental problems which now include prevention and innovation in addition to regulation and clean-up. The U.S. Council on Environmental Quality (1995, 5) explains the U.S. has " . . . learned that it is better to prevent an environmental problem before it happens rather than clean it up later."

The emphasis on prevention contrasts with previous methods for solving environmental problems, when the U.S. and other industrialized nations used so-called command-and-control methods " . . . in which federal agencies issued directives to the states and industries and expected them to obey" (USCEQ 1995, 9-10). Accompanied by enforcement and monitoring, these methods helped control large individual sources of pollution such as industrial facilities. However, command-and-control methods do not work well to solve environmental problems caused by the diverse economic activities of millions of consumers.

Today, both industry representatives and economists criticize command-and-control methods as inefficient, unwieldy, and prescriptive, with no incentive for innovative approaches to reduce pollution further, once regulatory standards are met (Hunter, Salzman, and Zaelke 1998). The U.S. Council on Environmental Quality (1995, 9-10) explains that " . . . as the strengths and weaknesses of this [command-and-control] approach have become clearer, a host of new approaches have emerged that can be an effective complement to the traditional approach." The European community is also moving away from command-and-control and starting to use market forces and incentives (EC Takes Eco-Summit Cue 1992; Fouhy 1996).

What are these new approaches? In the last few years, the U.S. government has started emphasizing "goal-setting, economic incentives, pollution prevention, a more holistic approach to environmental problems, . . . more flexible problem-solving, and a more interactive approach with stakeholders and the community at large" (USCEQ 1995, 26). The U.S. recognizes that economic systems can be used to help solve environmental problems, having successfully used one tool of the economic system—emissions trading. Another tool of the economic system is the power of consumers. The U.S. Environmental Protection Agency (EPA) believes " . . . market incentives and the power of consumers can lead to significant improvements in environmental performance at less cost" (USCEQ 1995, 30).

European governments are also aiming toward influencing consumers' behavior to minimize their effects on the environment, even though according to Vermeulen (1992), European companies and governments have been more successful than the U.S. in building friendly relationships. European environmental programs expect "a greater degree of cooperation and shared responsibility among business, governments, and consumers than in the U.S." and European environmental policy includes consumer activities, which are expected to reflect environmental priorities (Vermeulen 1992, 41).

Research Question

Can governments and industry rely upon consumers to make environmentally friendly choices? One of the market approaches used in Europe to encourage consumers to make environmentally friendly choices is environmental labels, also known as environmental certifications or seals of approval. Environmental labels are one way to harness consumer power by informing consumers of products that are certified by a reputable labeling program to have fewer negative effects on the environment. Environmentally aware consumers are then more likely to purchase these labeled products, rewarding manufacturers with increased market share. Some manufacturers see environmental labels as a way to distinguish themselves in the

marketplace and boost their global competitiveness, while governments see environmental labels as a way to implement environmental policies via the label criteria. Whether labels are used as an enticement to buy a product or as a method to solve environmental problems, both manufacturers and governments need to know if environmental labels actually affect market share. This research study attempts to determine the effect of environmental labels on market share by comparing sales of eco-labeled brands in one product group with sales of non-labeled brands in the same product group.

CHAPTER II LITERATURE REVIEW

The Green Consumer Market

Studies in the last 10 years report various high levels of consumer demand for environmentally sensitive products. This demand is typically called the green consumer market. In an article in *Advertising Age*, the publisher of *Green MarketAlert,* Carl Frankel, says "the green consumer products market last year [1992] totaled $110.1 billion and is expected to grow 10.4 percent to $121.5 billion this year [1993]" (Lawrence 1993, 12). This article projected the U.S. green consumer market would be at $154 billion by 1997. Outside the U.S., a 1993 report estimates the market for environmental goods and services in Organization for Economic Cooperation and Development (OECD) countries at more than $700 billion per year (Church 1994).

Consumers Say They Purchase Environmental Products

The majority of Americans believe protecting the environment should take precedence over economic growth and this majority appears to be growing. The percentage of people who agree with this statement: "protection of the environment should be given priority even at the risk of curbing environmental growth" went from 61 percent in 1984 to 70 percent in 2000 (Gallup Organization 2000). In other surveys, respondents rank environmental protection as one of the U.S.'s most important issues, and they express this concern for the environment by saying they would like to purchase products that are safer for the environment. Nearly half of U.S. consumers have changed their purchasing habits to help the environment (Church 1994). Gallup's Earth Day

2000 poll found that 83 percent of Americans said they "avoided environmentally harmful products" and 73 percent said they "bought environmentally beneficial products" (Dunlap 2000).

Describing the results of a 1993 national survey, a U.S. EPA (1994, 88) document states " . . . 55 percent of the respondents claimed that in the three months previous to the survey, they had 'very often' or 'somewhat often' purchased products specifically because of some benefit offered to the environment." The consumer desire to purchase environmental products is substantiated by increases in market share for both environmental cleaning products and paper products, even when the ordinary market share for those products is down. The Advertising Age article cited above reports that:

> Nielsen Marketing Research figures show that total household cleaner supermarket sales for the 52 weeks ended March 20 [1993] were down 6.2 percent to $444.6 million, but at the same time, environmental household cleaning brand sales grew 8.5 percent to $9.2 million. . . . In green paper goods, Fort Howard Corp.'s Green Forest line is leading the way with a 50 percent share of the $40 million segment (Lawrence 1993, 12).

Some governments also believe there is a substantial green consumer market. The European Commission anticipates "greater numbers of 'educated' consumers who make environmentally friendly choices" (Vermeulen 1992, 43).

Many Consumers Say They Will Pay More

Numerous surveys say the majority of U.S. and European respondents not only want to purchase environmentally friendly products but also would be willing to pay more for them (Bukro 1991; Church 1994; Raines 1992; Staffin 1996; Wynne 1991). For example, Raines (1992, 692) states " . . . approximately 94 percent of the [U.S.] population would make an effort to purchase goods from companies they believed were attempting to help the environment. Of those, 89 percent would be willing to pay higher prices for these products." A 1991 survey conducted for the *Wall Street Journal* and NBC News found:

> . . . more than eight out of 10 voters say protecting the environment is generally more important than keeping prices down; 67 percent of those polled say they would be willing to pay 15 to 20 cents a gallon more for a gasoline that causes

> much less pollution than current blends. . . . Fifty-four percent say they have bought a more expensive product rather than less expensive one because of environmental concerns, while 53 percent say they have avoided buying something because of environmental fears about the product (Gutfeld 1991, A1, A4).

European consumers have responded similarly. According to a 1992 survey of European Union countries, " . . . 70 percent of respondents said they had bought or were prepared to consider buying 'environmentally friendly' products even if they were more expensive" (European Environmental Agency 1994, 508).

Most of the people polled for the 1991 *Wall Street Journal*-NBC News survey expect changes in manufacturing and consumer lifestyles to be the answers to environmental problems, with " . . . nearly seven in 10 voters say[ing] the best way to deal with the nations' trash crisis is to require manufacturers to use less packaging and consumers to do more recycling" (Gutfeld 1991, A1).

But Consumers May Not Purchase What They Say They Will

Even though many consumers say they want to buy environmental products and will pay more for them, those who say they actually make such purchases is lower. A 1990 Roper poll found that " . . . 85 percent of consumers consider themselves 'environmentalists,' but only 22 percent . . . altered their buying habits" (Donaton and Fitzgerald 1992, 49). The *Wall Street Journal* - NBC News poll cited above found "while three-fourths of those surveyed say a product's or manufacturer's environmental reputation is important to them in deciding what to buy, 46 percent say they have actually bought any item for those reasons within the last six months, while 45 percent say they haven't" (Gutfeld 1991, A1). A U.S. EPA (1994, 88) document reports similar findings from a 1990 survey where:

> . . . slightly more than half of consumers considered the environmental attributes of a product and/or company (and could name product [sic] and its environmental attributes) when selecting a product in the past six months. The study also found that consumers do not necessarily pay more for environmentally-oriented products than they do for conventional products; approximately 63 percent of

> those who bought an environmentally-oriented product said that it cost the same as or less than the conventional alternative.

Consumers Are Skeptical of Green Marketing Claims

Perhaps the discrepancy between consumer intentions and actions is caused by problems with manufacturers' environmental marketing claims. How can consumers determine which products are environmentally friendly? Many consumers are skeptical of green marketing claims from product manufacturers, with 42 to 56 percent mistrusting such claims (Church 1994). A 1992 *Advertising Age* poll found "about 52 percent of those polled said so many companies are making environmental claims about their products that they find themselves paying less attention to the messages" (Chase and Smith 1992, S-4). However, the same poll also found that "more than 70 percent of respondents said environmental messages in labeling or advertising 'sometimes' or 'very often' influence their purchase decisions" and " . . . 60 percent of respondents are more likely to purchase a product because of its green claims today than they were three years ago" (Chase and Smith 1992, S-4). According to Raines (1992) and Bukro (1991), advertisements containing questionable environmental claims increased 400 percent between 1989 and 1991.

Environmental Labels

Environmental labeling is one way governments, manufacturers, consumer groups, and environmental organizations are addressing consumer demand for environmentally sensitive products as well as consumer skepticism of green marketing claims. Staffin (1996, 209-210) writes that environmental labels:

> . . . identify for the consumer those products that are environmentally less harmful than other competing goods within the same product category, either because of their ingredients, the PPMs [production or process method] by which they were generated, or both, so that the consumer will become motivated to purchase only these "green" goods, thereby increasing the "green" producer's market share to the detriment of its competitors. . . . In theory, . . . the producer of the more environmentally harmful good will be forced to alter its PPMs or

ingredients to create a more environmentally benign product . . . to compete . . . in the same marketplace.

Staffin (1996) categorizes environmental labels into four types:

- Mandatory "negative content" labels required by law, such as warning labels on products containing ozone-depleting ingredients.
- Mandatory "content neutral" labels which provide information but are also required by law, such as Energy Guide labels for major appliances or mileage information labels for vehicles.
- Voluntary "single attribute" labels such as the recyclable logo or a biodegradable claim made by manufacturers.
- Voluntary "multi-criteria" labels such as the seals of approval awarded by Germany's Blue Angel program. These labels are more common outside the U.S.

The U.S. EPA (1993) describes environmental labels similarly, as follows:

- The label programs are conducted by third parties such as governments, non-profit organizations, environmental groups, or consumer groups—not manufacturers. (They would be considered "first parties.")
- Participation by manufacturers in the label program can be voluntary or mandatory.
- The information provided by the label can be positive, neutral, or negative.

For the purposes of this research, environmental labels are called "eco-labels," and they are defined as third-party, voluntary, positive, multiple-criteria environmental labels. While other types of environmental labels exist, they are outside the scope of this paper.

Eco-labeling encourages manufacturers to internalize the environmental costs of producing their goods, reduce their impacts on the environment, and reap financial rewards. Used as a long-term measure along with other methods, eco-labels can be an effective way to let

market forces find efficient solutions to environmental problems (Staffin 1996). Eco-labeling has several goals:

- Directing manufacturers to account for the environmental impact of their products.
- Providing accurate information.
- Raising the awareness of consumers.
- Improving the sales of a labeled product.
- Protecting the environment (USEPA 1993).

Many countries have voluntary eco-labeling programs to help consumers choose environmental products. According to Staffin (1996, 210-211), "third party eco-labeling programs . . . have proliferated in developed countries in recent years." These eco-labeling programs are more popular in Western Europe and Japan than in the U.S. In fact, the U.S. is one of the few developed countries without a government-sponsored eco-label. Eco-labeling programs are typically sponsored by governments who oversee the development of label standards for individual product groups by expert industry and environmental working groups. Eco-labels cover a variety of product groups, from paints and toilet paper to washing machines and computers.

Twenty-one of the 24 Organization for Economic Cooperation and Development (OECD) member countries have eco-labeling programs, including Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, and the United Kingdom (Staffin 1996). In 1977, Germany was the first country to sponsor an eco-labeling program with its Blue Angel label. Some current product categories for the Blue Angel label include: recyclable paper, vacuum cleaners, washing machines, oil and gas heating appliances, and personal computers

(Blue Angel 2000). Other labels, such as the Nordic Swan, were introduced in later years, with a European Union eco-label being one of the most recent.

Why care about these labels in the U.S.? According to the U.S. EPA (1994, 10), eco-labels (which the EPA calls environmental certification programs or ECPs):

> . . . are becoming an increasingly common marketplace approach to pursuing environmental policy goals. . . . In the context of an increasingly global marketplace, U.S. manufacturers may need to meet the award criteria of foreign ECPs in order to compete effectively overseas; thus, foreign ECPs could be "'exported" to the U.S. market.

An article in *Business Europe* echoes this idea, stating "if consumer responses in countries like Germany, Norway, and Sweden (where eco-labels have a higher profile) are anything to go by, promotion of the eco-label across the single market [the European Union] is likely to make participation a necessity for companies operating in many markets" (Re-evaluating eco-labels 1995, 5). At the least, U.S. companies may want to obtain European eco-labels to stay competitive in a global market; but if eco-labels are effective in Europe, the U.S. government may want to consider developing a government-sponsored eco-labeling program as a domestic environmental policy tool.

Research on Effectiveness of Eco-Labels

To be effective, eco-labels must benefit environmental consumers, manufacturers, and the environment. That is, consumers must recognize the label and purchase labeled products; manufacturers need to know whether eco-labels provide any market advantage and if this market advantage is enough to justify the costs of obtaining labels; and finally, the environment must benefit—labeling programs must specify criteria that decrease the negative effects of that product on the environment. The current research on eco-labels can be grouped into three categories: studies of consumer awareness of eco-labels; studies of market effects of eco-labels; and studies of environmental effects of eco-labels. Each category is discussed in the following section.

Studies of Consumer Awareness of Eco-Labels

Most research in the area of eco-labels addresses consumer attitudes and recognition of labels (USEPA 1994). Two studies of German consumers found approximately 80 percent recognized the Blue Angel label (USEPA 1994; Lathrop and Centner 1998). Another survey of German consumers found " . . . 75 percent of German consumers preferred to buy products carrying the [Blue Angel] label" (Re-evaluating eco-labels 1995, 5). Other studies reported by the Organization for Economic Cooperation and Development (OECD) (1997) found the Nordic Swan label is known by 72 percent of consumers in Norway, by more than 80 to 95 percent in Sweden, and by 80 percent in Finland.

Discussing research on U.S. consumers and hypothetical eco-labels, a U.S. EPA (1994, 21) report states " . . . that consumers are willing to accept a label if they can be convinced of its impartiality and credibility." The same U.S. EPA (1994) report states that 80 percent of respondents would accept an eco-label if awarded by an independent group they trusted.

Studies of Market Effects of Eco-Labels

One of the most practical ways to study eco-labels is to examine their effect on the market, yet there are few reports of such studies. A Canadian envelope company reported sales of its recycled paper envelopes increased from 10 to 40 percent during the two years after receiving the Canadian EcoLogo, and Korea's Eco-Mark label program reported recycled paper sales increased by 30 percent (no time period was specified) after receiving the Korean label (USEPA 1994). Two reports of the low-solvent paint market in Germany state that the Blue Angel label boosted market share from a small percentage to nearly 25 percent (no time period was specified) (USEPA 1994; Staffin 1996). The first manufacturer to be awarded the European Union's eco-label, Hoover, says its sales increased dramatically because of the label (no time period was specified), tripling their market share in Germany and doubling it in the premium sector of the UK automatic washing machine market (Re-evaluating eco-labels 1995).

Studies of Environmental Effects

It is extremely difficult to evaluate the environmental effects of eco-labels. One study cited by the U.S. EPA (1994, 24) found no "objective, quantifiable evidence, one way or the other, as to the impact of ecolabelling [sic] on the environment." However, the same U.S. EPA (1994) report states that the German Blue Angel program was responsible for decreasing the amount of organic solvents released into the atmosphere by 40,000 tons.

The environmental effects of single-criteria labels may be easier to measure, yet I found no such studies, only the following prediction. Tristram (1994, 78) reports that the EPA "predicts the Energy Star program will reduce carbon emissions by five million metric tons by the year 2000, [which is equivalent to] taking five million cars off the road for one year." Energy Star is a single-criteria label program of the U.S. government that indicates a certain level of energy efficiency for home appliances, office equipment, windows, and other energy related items. As a single-criteria label, the Energy Star label is not covered in this paper, however each multi-criteria label that is covered in this paper includes Energy Star power consumption requirements.

Research on Other Types of Third Party Labels

Research on the effectiveness of other third-party, positive labeling programs is also comprised of consumer surveys and studies of market share. Surveys show other third-party, positive labeling programs are often effective, especially when combined with information campaigns (Salzhauer 1991). A survey cited by Wynne (1994, 110) found consumers rate "certification marks as more credible sources than advertisements, salespeople, and friends in terms of perceived expertise and impartiality."

Two studies report the market effects of the American Dental Association's certification of Crest toothpaste in the 1960s. One study states that Crest's " . . . sales doubled by 1961 and tripled by 1962" (Salzhauer 1991, 35). Another states Crest's market share increased " . . . from about 12 percent to 35 percent in the period after endorsement" (LaBarbera 1982, 227).

LaBarbera (1982, 227) also explains "the result was not the function of growing interest in teeth or fluoride at the time because sales remained flat in Canada." Reporting on a study of the market effects of the Good Housekeeping seal, Salzhauer (1991, 35) states that " . . . controlled studies report that the sales of products bearing the [Good Housekeeping] seal increase" but does not state the amount of increase or over what period of time the increase occurred.

In addition to studies of actual third-party labels, studies of hypothetical third-party labels show they too are effective. LaBarbera's (1982) study of college students and a fictional brand of adhesive bandages supposedly approved by the American Medical Association (AMA) found a high correlation between students' intention to purchase and the fictional AMA seal of approval. LaBarbera (1982, 223) also cites two other studies confirming the power of third-party seals of approval:

> Parkinson (1975) found that third-party seals of approval strongly influence consumer evaluations of a firm's expertise and trustworthiness. A nationwide study of female heads of households found that more than 80 percent rated three familiar third-party seals as having at least some impact on their selection of particular products (Crossley Surveys, Inc. 1977).

Problems with Existing Research

Most eco-label research depends on surveys of consumer opinions or knowledge of labels rather than measuring whether an eco-label increases market share. Surveys are good for determining awareness of a label, but not for measuring market effects of a label—information important to manufacturers who need to decide whether to obtain a label. Manufacturers need to know about possible beneficial effects of eco-labels on their market share, as well as consumer awareness of various labels.

Some research on the effects of eco-labels on market share examines changes in market share for one product after first obtaining an eco-label. However, research on one product cannot control for other effects on sales such as economic climate, advertising campaigns, or price changes (for the product being studied and/or competing products). Studying the market effects of

an eco-label using a single brand is probably too narrow for determining the effectiveness of eco-labels.

This paper investigates the market effect of eco-labels using annual market data for all eco-labeled brands in one product group across multiple countries. Variations in pricing, advertising, and product characteristics can affect market share for any brand of product. Using one product group across multiple countries over multiple years provides a large number of cases and encompasses all these variations to allow the possibility of attributing significant differences to the eco-labels. One product group which lends itself to research at this scale is desktop computers. There are several dozen brands of desktop computers sold in countries with and without eco-label programs, and data on shipment by brand and country for several years is available from market research companies.

Environmental Effects of Computers

The number of desktop computers in homes, businesses, and schools is rapidly increasing. Worldwide shipments of desktop computers rose from 8,874,117 in the first quarter of 1994 to 17,385,595 shipments in the second quarter of 1998, almost doubling in three and a half years (International Data Corporation 1998). Shipments in the third quarter of 1998 were 22.6 million (Auchard 1998). The total number of desktop computers shipped worldwide has increased from 38,953,962 in 1994 to 67,310,164 in 1997 (International Data Corporation 1998), with an estimated total of 324 million desktop computers in existence worldwide as of 1998 (Dell Computer Corporation 1998).

Most analysts expect the computer industry to grow at a rate of 20 percent annually (Auchard 1998). The rapid development and introduction of new brands adds to the proliferation of computer hardware, with "new" computers becoming obsolete after only 18 months, and some manufacturers developing new products as rapidly as every six months. Companies that purchase computers typically fully depreciate them within three years and this lifecycle will soon shorten

to two years, according to International Data Corporation (2000). For companies to maximize their financial investment in computers, they need to replace them toward the end of two to three years, while they still have some value. Computers may not seem to pose many environmental problems, but their increasing numbers and short lifecycles means many of them will end up in landfills. Computers have other effects on the environment, as well. Manufacturing silicon chips and printed circuit boards uses large amounts of water as well as hazardous chemicals and gases. Shipping computers requires paper for product packaging and fuel for transport, while using them consumes electrical energy.

According to Machrone (1993, 87), there were "60 to 80 million personal computers in the U.S. alone" in 1993, consuming up to "16 gigawatts of power nationwide," more power "than Switzerland or Austria can even generate." Consumption of this energy translates into oil, gas, or coal extraction and use, which depletes natural resources, produces acid rain, and warms rivers. Locally, additional electricity is needed to remove the heat created by each computer, roughly equivalent to the heat generated by one or two people, or a 100 or 200 watt light bulb. Wood (1994, 86) reports that "computers now account for about 5 percent of the nation's commercial electrical consumption."

Some consumers are aware of the environmental problems of desktop computers and have started to ask for "green" computers. An employee of one component and system supplier in California (DFI, Co.) says their customers are asking for a green computer system (Wood 1994). Like other companies affected by environmental consumerism, computer companies are seeing opportunities to increase market share with environmentally preferable products. According to Wood (1994, 86), desktop computer "vendors say there's more financial green if their products go green."

Eco-Labels for Desktop Computers

There are currently only three eco-labels for the desktop computer product group: Blue Angel, TCO '95, and Nordic Swan. Following is a summary of each desktop computer eco-label and its requirements.

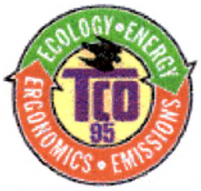
Blue Angel

The oldest and best-known label is Germany's Blue Angel. Started in 1977, the Blue Angel label appears on more than 4,000 products in 71 product groups. The label is awarded by the Umweltbundesamt, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the German equivalent of the U.S. Environmental Protection Agency (Electronic Ecolabel Forum 2000).

The Umweltbundesamt works with the Blue Angel eco-label jury, comprised of industry, environmental associations, trade unions, churches, and public authorities, to review product groups twice a year. Requirements for the Blue Angel label for the desktop computer product group were established in 1994 and extend to 2001. The Blue Angel label for desktop computers is intended to promote these environmental qualities:

- Low power consumption—system components switch to low power modes after a certain amount of idle time.
- Recyclability—manufacturers must have programs for taking their products back after use.
- Longevity—this is achieved using parts that are modular in design so they can be exchanged. This allows the computer to be upgraded when components become obsolete (Electronic Ecolabel Forum 2000).

TCO '95



The TCO label is the only one created specifically for computers. Four Swedish organizations worked together to create and award the TCO label. These organizations are:

- TCO, the Swedish Confederation of Professional Employees, a trade union of 1.3 million Swedish professional employees who use computers in their work. TCO is the largest white-collar union in Sweden.
- NUTEK, the National Board for Industrial and Technical Development in Sweden, a government body focused on energy efficiency.
- The Swedish Society for Nature Conservation, the largest environmental organization in Sweden.
- SEMKO AB, a company that now certifies corporate quality assurance systems and is expanding into environmental certification (TCO Development Unit 2000).

The general requirements for TCO '95 include:

- Improved ergonomic qualities pertaining, for example, to screen contrast, flicker, and luminance.
- Decreased electrical, magnetic, noise, and heat emissions.
- Increased energy efficiency—using the U.S. Energy Star requirements.
- Ecology—environmental adaptation for both the product and the production processes at the manufacturing plant (TCO Development Unit 2000).

Nordic Swan

The Nordic Swan label is awarded in Denmark, Finland, Iceland, Norway, and Sweden and covers about 30 product groups. The label is awarded by the Nordic Ecolabelling [sic] Board, made up of representatives from government, industry, and environmental organizations of the sponsoring countries. This labeling program started November of 1989, with requirements for the personal computer product group established October 1995. The Nordic Swan label for desktop computers were reviewed and updated in June of 1999 (Nordic Ecolabelling 1999).

Nordic Swan's general labeling requirements are intended to promote:

- Reduced number, type, and amount of materials.
- Minimal use of environmentally harmful substances.
- Reduction of energy consumption during use—using U.S. EPA Energy Star requirements.
- Long service life with possibility to update.
- Improved durability (Nordic Ecolabelling 1999).

Other Desktop Computer Labels

Other desktop computer labels include energy labels such as the U.S. Energy Star and Swiss Energy 2000. These two labels are not considered multi-criteria eco-labels because they address only energy conservation and therefore are not included in this study. (Most of the eco-labels studied here consider compliance with Energy Star requirements as fulfillment of their own energy-related requirements. Energy Star requires personal computers to reduce power consumption to less than 30 watts each for a system and monitor when idle.)

The most recent desktop computer eco-label is from the European Union, which issued their criteria for a desktop computer eco-label March 1, 1999 (European Union 1999). According

to the product category list of the Global Ecolabelling [sic] Network (2000) website, the Republic of China (Taiwan - Green Mark), Korea (Environmental Labeling), and Thailand (Thai Green Label) have eco-labels for desktop computers. However, I was not able to find any information about which desktop computers might have these labels.

Other Eco-Labels

There are many other eco-label programs, but none that apply to desktop computers. Some of these other eco-label programs include the Spanish eco-label AENOR Medio Ambiente, the Catalonian eco-label El Distintiu, and the Austrian eco-label Umseltzeichen. Japan and Canada also have eco-label programs. U.S. eco-labels include Green Seal and Scientific Certification Systems, issued by private companies (Global Ecolabelling Network 2000).

CHAPTER III HYPOTHESIS

Are eco-labels related to greater market share for desktop computers? My research examines the primary alternative hypothesis that mean units shipped of eco-labeled desktop computers will be significantly higher than mean units shipped of unlabeled desktop computers in countries recognizing and/or sponsoring those eco-labels. (These countries are called "eco-countries" in this paper.) The null hypothesis is there is no difference between mean units shipped with eco-labels and mean units shipped without eco-labels in eco-countries.

If the first analysis shows mean units shipped with eco-labels is statistically different (and greater) than mean units shipped without eco-labels, then the first hypothesis will be further tested. This additional test will examine the possibility that the eco-labeled brands are coincidentally the best selling brands in those countries for reasons other than the eco-label. The second analysis will compare the same brands shipped in nearby European countries which do not have eco-labeled desktop computers. (These countries are called "control countries" in this paper.) In this test, the null hypothesis is that there is no difference between the mean units shipped with eco-labels and the mean units shipped without eco-labels in control countries. If this null hypothesis can be accepted, it will strengthen the results of the first analysis.

CHAPTER IV DATA COLLECTION AND METHODOLOGY

Data

Data include units shipped (number of desktop computers) by European country, brand, and vendor for 1995, 1996, and 1997. The data were obtained from the Worldwide Quarterly PC Market Tracker from IDC (International Data Corporation) Market Research and are typically used by computer companies to analyze their position in the marketplace. These data were made available by Dell Computer's MTI Research department at the request of Dell's Environmental Affairs department. To determine which brands had eco-labels and when they were obtained, I visited the websites of all computer vendors included in the IDC data and the websites of each label program. I then coded each brand in each country to indicate which eco-label (if any) it carried that year.

This study uses all the data included in the IDC report, not random samples, to analyze the entire population of personal computer shipments in the selected countries. It is unknown if there are any biases in the gathering of the data by IDC. All cases provided were used, so no additional biases were introduced.

Personal computers fall into one of three categories: servers, desktops and workstations, and notebooks. Only desktops and workstations are included in this study because they were the first desktop computer products to receive eco-labels and are most likely to have their shipments affected by the labels. Desktops and workstations are categorized together because it is nearly

impossible to differentiate between them based on features, and that is how IDC Market Research reports the data.

An examination of the data reveals it is not normally distributed. Even the best selling vendors account for only small percentages of total desktop computer shipments with the majority of brands shipped in small amounts. For example, in 1998, the top vendor accounted for only 12.84 percent of market share, while 40.86 percent of market share went to "Others"—dozens of small vendors. The top five vendors together had only 38.62 percent market share (Dataquest 1998).

Although the populations may be large enough to mitigate the problem of a non-normal distribution, the data were transformed using the log 10 function, a standard way of transforming non-normal data which does not alter the resulting analyses. This transformation resulted in a normal distribution. Results throughout this study are presented for transformed data which is labeled Log Units. Figure 1 shows a histogram of the untransformed data for eco-countries in 1997. The Y-axis shows Frequency; the X-axis shows Units Shipped (UNITS97), and the curved line shows the frequency distribution.

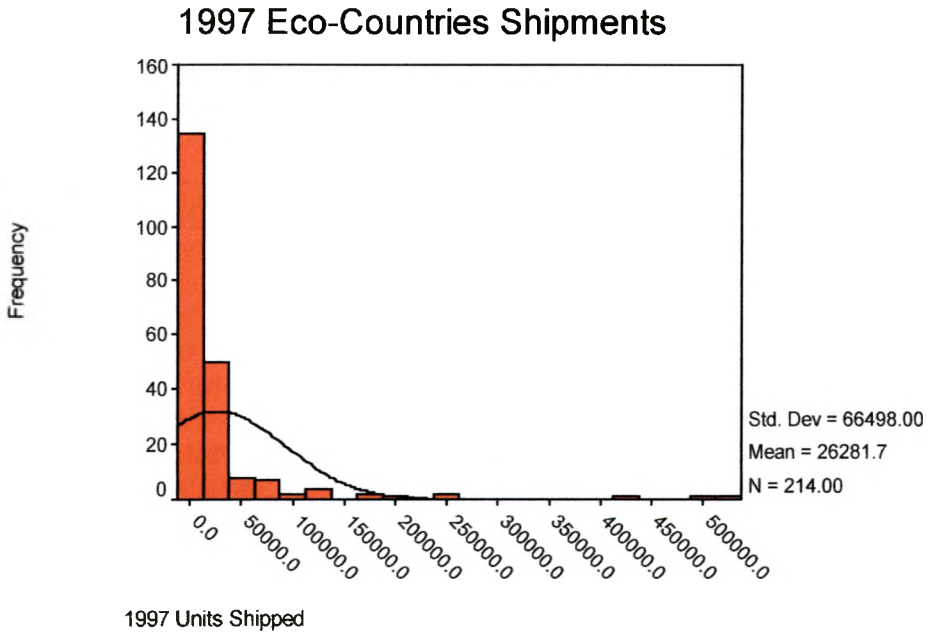


Figure 1. 1997 Eco-Countries Shipments

Transforming the data results in a more normal distribution, shown in the histogram in Figure 2. The Y-axis shows Frequency; the X-axis shows Log of 97 Units, and the curved line shows the frequency distribution.

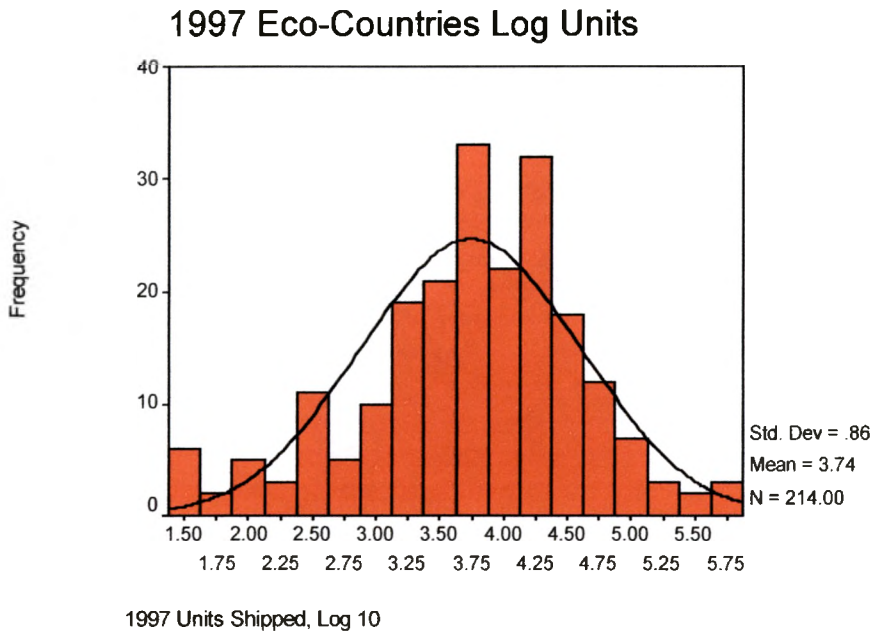


Figure 2. 1997 Eco-Countries Log Units

The dependent variable for both eco-countries and control countries is Log Units (the number of units shipped to a country for each brand each year, transformed using the log 10 function). Independent variables for eco-country data include:

- Brand
- Vendor
- Country (Denmark, Finland, Germany, Norway, and Sweden)
- Blue Angel (dummy variable)
- TCO'95 (dummy variable)
- Nordic Swan (dummy variable)
- Any Label (dummy variable)

Dummy variables can have a value of 1 or 0, where 1 indicates the presence of the label and a 0 indicates the absence of the label. Because there are so few brands with the Nordic Swan label (two), the additional dummy variable Any Label was created to indicate *any* eco-label. Two brands with the Nordic Swan label also had the Blue Angel label. (Perhaps future studies could

analyze an eco-label score giving points for each eco-label. However, the number of cases with these other labels may be too small to give significant results.)

Each brand in each country is coded to indicate which eco-label (if any) it carried that year. Table 1 shows a few rows of typical data for eco-countries in 1997.

Table 1. Sample Data

Brand	Vendor	Country	Units 97	Blue Angel	Nordic Swan	TCO 95	Any Label	97 Log Units
AcerEntra	Acer	Denmark	54	0	0	0	0	1.73
Brio	Hewlett-Packard	Germany	10,138	0	0	0	0	4.01
DeskPro 2000 4000 6000	Compaq	Germany	248,966	1	0	0	1	5.40

Independent variables for control country data include:

- Brand
- Vendor
- Country (Austria, Belgium, France, Ireland, Italy, the Netherlands, Spain, Switzerland, U.K.)
- "Eco-Label" (dummy variable)

Data Coding

In the eco-countries, I coded a brand as having an eco-label only in the country sponsoring the eco-label; however, for the control countries, I coded the same brands as having a "label" in *each* country. For example, I coded shipments of Apple PowerMacs as having eco-labels in Germany, but not the other eco-countries; while I coded shipments of Apple PowerMacs as having "labels" in all the control countries. I did this to preserve a very clear distinction between the data for countries with labels and those without.

The following tables show how the data were coded for each group of countries for each year. Table 2 shows the brands and countries coded with eco-labels for the 1995 data. Denmark, Finland, Norway, and Sweden have no labeled cases in 1995.

Table 2. Vendors and Brands for Eco-Countries 1995

Eco-Countries 1995						
Country	**Vendor**	**Brand**	**Blue Angel**	**Nordic Swan**	**TCO**	**Any Label**
Germany	Apple	Power Mac	1	0	0	1
Germany	Compaq	DeskPro 2000 4000 6000	1	0	0	1
Germany	Compaq	DeskPro XL	1	0	0	1
Germany	Hewlett-Packard	Vectra V	1	0	0	1
Germany	Hewlett-Packard	Vectra X	1	0	0	1
Germany	SNI	Others	1	0	0	1

Table 3 shows the countries and brands coded with "eco-labels" for the 1995 control country data.

Table 3. Vendors and Brands for Control Countries 1995

Control Countries 1995	
Country	**Vendor & "Labeled" Brands 1995**
Austria, Belgium, France, Ireland, Italy, Netherlands, Spain, Switzerland, United Kingdom	Apple Power Mac Compaq DeskPro 2000 4000 6000 and DeskPro XL Hewlett-Packard Vectra V and Vectra X SNI Others

Tables 4 and 5 show the brands and countries coded for the 1996 eco-country and control country data.

Table 4. Vendors and Brands for Eco-Countries 1996

Eco-Countries 1996						
Country	**Vendor**	**Brand**	**Blue Angel**	**Nordic Swan**	**TCO**	**Any Label**
Denmark	SNI	Others	0	1	0	1
Finland	SNI	Others	0	1	0	1
Germany	Apple	Power Mac	1	0	0	1
Germany	Compaq	DeskPro 2000 4000 6000	1	0	0	1
Germany	Compaq	DeskPro XL	1	0	0	1
Germany	Dell	OptiPlex	1	0	0	1
Germany	Hewlett-Packard	Vectra V	1	0	0	1
Germany	Hewlett-Packard	Vectra X	1	0	0	1
Germany	SNI	Others	1	0	0	1
Norway	SNI	Others	0	1	0	1
Sweden	Interaq	Others	0	1	0	1
Sweden	SNI	Others	0	1	0	1

Table 5. Vendors and Brands for Control Countries 1996

Control Countries 1996	
Country	**Vendor & "Labeled" Brands 1996**
Austria, Belgium, France, Ireland, Italy, Netherlands, Spain, Switzerland, United Kingdom	Apple Power Mac Compaq DeskPro 2000 4000 6000 and DeskPro XL Dell OptiPlex Hewlett-Packard Vectra V and Vectra X SNI Others (Note: There is no Interaq Others because it is sold only in Sweden.)

Tables 6 and 7 show the brands and countries coded for the 1997 eco-country and control country data.

Table 6. Vendors and Brands for Eco-Countries 1997

Eco-Countries 1997						
Country	**Vendor**	**Brand**	**Blue Angel**	**Nordic Swan**	**TCO**	**Any Label**
Denmark	SNI	Others	0	1	0	1
Finland	SNI	Others	0	1	0	1
Germany	Apple	Power Mac	1	0	0	1
Germany	Compaq	DeskPro 2000 4000 6000	1	0	0	1
Germany	Compaq	DeskPro XL	1	0	0	1
Germany	Dell	OptiPlex	1	0	0	1
Germany	Fujitsu	ErgoPro	1	0	0	1
Germany	Hewlett-Packard	Vectra V	1	0	0	1
Germany	Hewlett-Packard	Vectra X	1	0	0	1
Germany	SNI	Others	1	0	0	1
Norway	SNI	Others	0	1	0	1
Sweden	Interaq	Others	0	1	0	1
Sweden	SNI	Others	0	1	0	1

Table 7. Vendors and Brands for Control Countries 1997

Control Countries 1997	
Country	**Vendor & "Labeled" Brands 1997**
Austria, Belgium, France, Ireland, Italy, Netherlands, Spain, Switzerland, United Kingdom	Apple Power Mac Compaq DeskPro 2000 4000 6000 and DeskPro XL Dell OptiPlex Fujitsu ErgoPro (Added in 1997) Hewlett-Packard Vectra V and Vectra X SNI Others

Examination of the Data by Case

Figures 3 and 4 show the number of cases for each group of countries for each year. Note that there are only 6 labeled cases for the eco-countries, while there are 54 labeled cases for the control countries in 1995. This pattern of fewer labeled cases for the eco-countries holds for each of the three years studied.

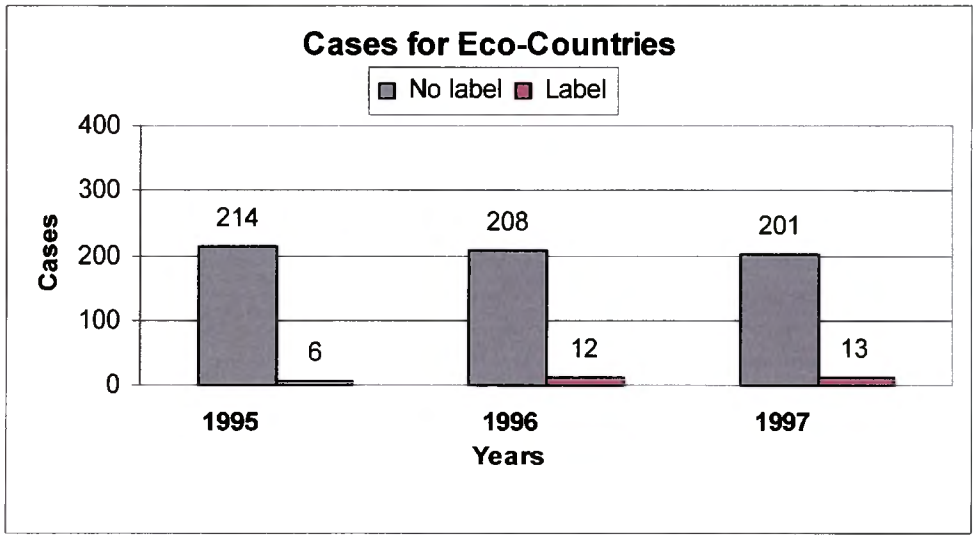


Figure 3. Bar Chart of Number of Labeled and Unlabeled Cases for Eco-Countries

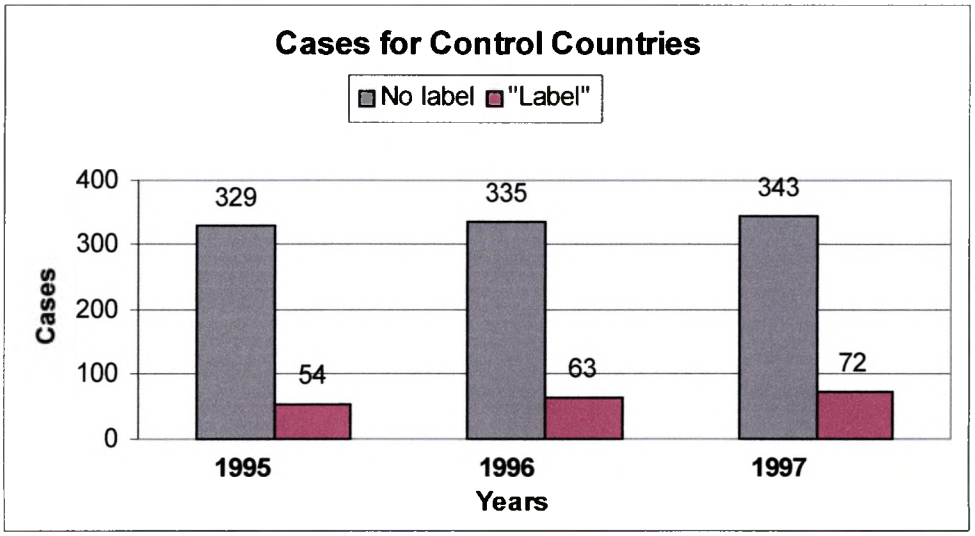


Figure 4. Bar Chart of Number of "Labeled" and "Unlabeled" Cases for Control Countries

Tables 8 through 10 show the number and percent of cases for each group of countries for each year. The percent of labeled cases in eco-countries increases from 2.7 percent to 6 percent, while the percent of labeled cases in the control countries starts at 14 percent and increases to 17.3 percent.

Table 8. Number and Percent of Cases for 1995

	Eco-Countries 1995		Control Countries 1995	
Label	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**
no	214	97.2%	329	85.9%
yes	6	2.7%	54	14.0%
Totals	220	99.9%	383	99.9%

Table 9. Number and Percent of Cases for 1996

	Eco-Countries 1996		Control Countries 1996	
Label	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**
no	208	94.5%	335	84.1%
yes	12	5.4%	63	15.8%
Totals	220	99.9%	398	99.9%

Table 10. Number and Percent of Cases for 1997

	Eco-Countries 1997		Control Countries 1997	
Label	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**	**# of Cases (Brand-Country Pairs)**	**Percent of Cases**
no	201	93.9%	343	82.6%
yes	13	6.0%	72	17.3%
Totals	214	99.9%	415	99.9%

Examination of the Data by Shipments

Figures 5 and 6 show the percentage of shipments for each group of countries. As with the number of cases, the percent of shipments for "labeled" brands is higher for the control countries compared to the eco-countries.

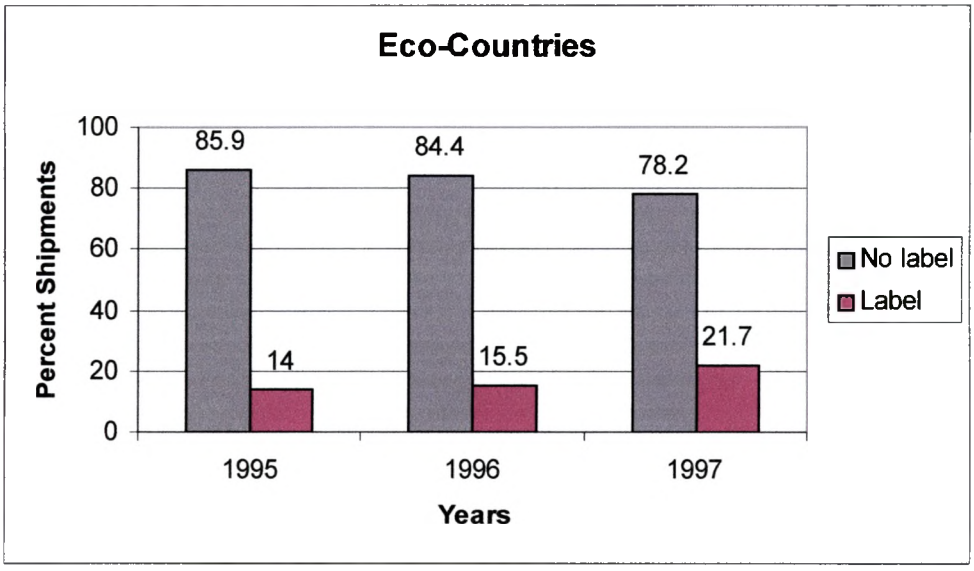


Figure 5. Percent Shipments for Eco-Countries

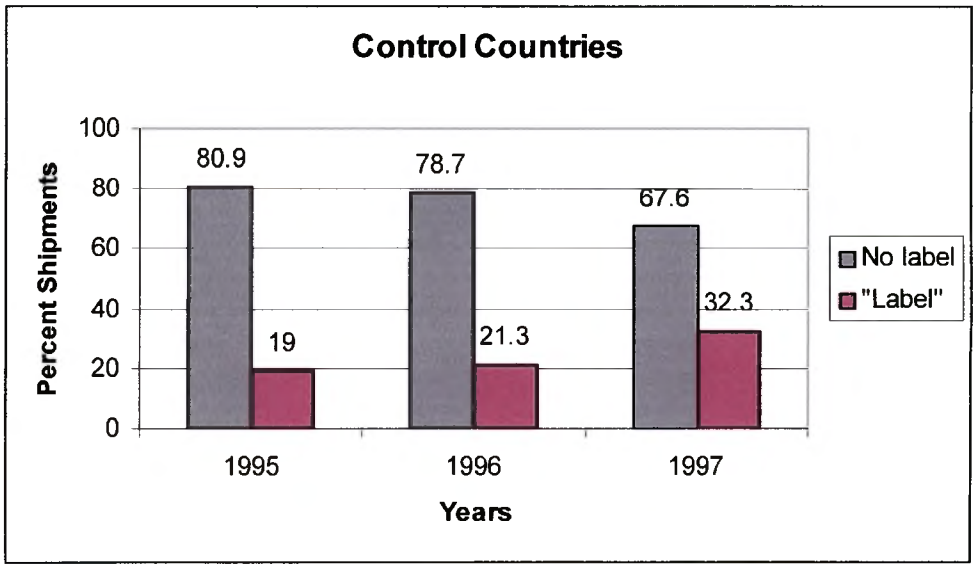


Figure 6. Percent Shipments for Control Countries

Tables 11 through 13 show the number and percent of shipments for each group of countries for each year.

Table 11. Number and Percent of Shipments for 1995

	Eco-Countries 1995		Control Countries 1995	
Label	**Shipments**	**Percent**	**Shipments**	**Percent**
no	4,020,821.0	85.9%	6,499,865	80.9%
yes	656,058.9	14.0%	1,524,746	19.0%
Totals	4,676,879.9	99.9%	8,026,606	99.9%

Table 12. Number and Percent of Shipments for 1996

	Eco-Countries 1996		Control Countries 1996	
Label	**Shipments**	**Percent**	**Shipments**	**Percent**
no	4,247,857.0	84.4%	6,892,223	78.7%
yes	779,890.9	15.5%	1,863,342	21.3%
Totals	5,029,743.9	99.9%	8,757,561	99.9%

Table 13. Number and Percent of Shipments for 1997

	Eco-Countries 1997		Control Countries 1997	
Label	**Shipments**	**Percent**	**Shipments**	**Percent**
no	4,402,483	78.2%	6,914,040	67.6%
yes	1,221,792	21.7%	3,303,404	32.3%
Totals	5,626,272	99.9%	10,219,441	99.9%

Cases and Shipments Compared

Table 14 shows the percent of labeled cases and percent of shipments for each year. For eco-countries, the percent of labeled shipments is much greater than the percent of cases, typically more than three times greater, compared with the control countries' "labeled" cases and shipments. The percent of labeled cases and shipments also increases from 1995 to 1997 for both eco-countries and control countries, indicating a possible trend towards greater market share for the brands with eco-labels in both groups of countries.

Table 14. Percent of Labeled Cases for Each Year

Eco-Countries		
Year	**% Labeled Cases**	**% Labeled Shipments**
1995	2.7	14.0
1996	5.4	15.5
1997	6.0	21.7

Control Countries		
Year	**% Labeled Cases**	**% Labeled Shipments**
1995	14.0	19.0
1996	15.8	21.3
1997	17.3	32.3

Method

The null hypothesis for both my analyses is that there is no difference between mean units shipped with eco-labels and mean units shipped without eco-labels. The statistical method for determining if two means are from the same population is the two-sample t-test. First I examine the data using group statistics, then I transform the data to achieve a normal distribution. I perform a two-sample t-test on products with and without eco-labels in eco-countries for each year. Next I perform a two-sample t-test on products with and without labels in control countries for each year.

CHAPTER V RESULTS

Results for 1995

For each year, this section presents summaries of group statistics showing the number of labeled and unlabeled cases, means, and standard deviations for both eco-countries and control countries. Then this section presents the results of the two-sample t-tests of labeled brands in both eco-countries and control countries.

T-tests for Grouped Eco-Countries 1995

Only Germany had any labeled brands in 1995, even though the eco-country group also includes Denmark, Finland, Norway, and Sweden. The difference in means for the 1995 grouped eco-countries is statistically significant with $p<0.0005$ and is shown in Table 15 next to the "equal variances not assumed" t-test for equality of means. This means that the group of labeled computers is statistically a separate population from the unlabeled computers. In addition, the mean for the six cases of labeled computers is 4.8795, which is greater than the mean of 3.8109 for the unlabeled computers.

Table 15. T-tests for Grouped Eco-Countries 1995

Group Statistics

	Eco-Label	N	Mean	Std Deviation	Std. Error Mean
Log of 95 Units	no label	214	3.8109	5967	4 079E-02
	label	6	4 8795	.3595	1468

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 95 Units	Equal variances assumed	1 755	187	-4 358	218	000	-1 0686	2452	-1 5518	- 5853
	Equal variances not assumed			-7 015	5 802	000	-1 0686	1523	-1 4444	- 6927

T-tests for Grouped Control Countries 1995

The difference in means for the 1995 grouped control countries is also significant with $p<0.0005$ and is shown in Table 16 next to the "equal variances not assumed" t-test for equality of means. As with the eco-countries, the group of "labeled" computers is also statistically separate from the "unlabeled" computer population. The mean for the "labeled" computers of 4.2282 is greater than the mean for the "unlabeled" computers of 3.8298, indicating that average shipments for this group of computers, like their counter-parts in the eco-countries, is higher than average shipments for the "unlabeled" computers.

Table 16. T-tests for Grouped Control Countries 1995

Group Statistics

	Control	N	Mean	Std Deviation	Std Error Mean
Log of 95 Units	no label	329	3 8298	.6743	3.718E-02
	"label"	54	4 2282	4758	6 475E-02

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 95 Units	Equal variances assumed	8 277	004	-4 172	381	000	- 3984	9 549E-02	- 5861	- 2106
	Equal variances not assumed			-5 335	92 089	000	- 3984	7 466E-02	- 5466	- 2501

Results for 1996

T-tests for Grouped Eco-Countries 1996

There are 12 cases of labeled brands for the eco-countries in 1996. Denmark, Finland, and Norway each have one labeled brand, while Germany has seven brands and Sweden has two. The difference in means for the grouped 1996 eco-countries is statistically significant with $p<0.002$ and is shown in Table 17 next to the "equal variances not assumed" t-test for equality of means. The mean for the labeled computers is 4.4732 and is greater than the mean for the unlabeled computers, which is 3.8048. The group of labeled computers is statistically separate from the unlabeled group, and average shipments for the labeled computers are higher than average shipments for the unlabeled computers.

Table 17. T-tests for Grouped Eco-Countries 1996

Group Statistics

	Eco-Label	N	Mean	Std. Deviation	Std Error Mean
Log of 96 Units	no label	208	3 8048	6749	4.680E-02
	label	12	4.4732	5652	.1632

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 96 Units	Equal variances assumed	227	634	-3 361	218	001	- 6685	1989	-1 0604	- 2765
	Equal variances not assumed			-3 938	12 880	002	- 6685	1697	-1 0355	- 3014

T-tests for Grouped Control Countries 1996

The difference in means for the grouped 1996 control countries is also statistically significant with $p<0.0005$ and is shown in Table 18 next to the "equal variances not assumed" t-test for equality of means. The mean for the "labeled" computers is 4.2525 and is greater than the mean for the "unlabeled" computers of 3.8092, indicating that average shipments for the "labeled" computers continue to be greater than those for the "unlabeled" computers, even in the control countries. Results for both groups of countries in 1996 are similar to the results for 1995.

Table 18. T-tests for Grouped Control Countries 1996

Group Statistics

	CONTROL	N	Mean	Std. Deviation	Std. Error Mean
Log of 96 Units	no label	335	3.8092	.7445	4.068E-02
	"label"	63	4.2525	.4654	5.864E-02

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig. (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 96 Units	Equal variances assumed	14 140	000	-4 558	396	000	- 4432	9 724E-02	- 6344	- 2521
	Equal variances not assumed			-6 211	130 427	000	- 4432	7 136E-02	- 5844	- 3020

Results for 1997

T-tests for Grouped Eco-Countries 1997

There are 13 labeled brands for the eco-countries in 1997. Denmark, Finland, and Norway each have one labeled brand, while Germany now has eight brands and Sweden has two. The difference in means for the group of 1997 eco-countries is statistically significant with $p<0.0005$ and is shown in Table 19 next to the "equal variances not assumed" t-test for equality of means. The mean shipments for labeled computers is 4.6115 and is greater than the mean shipments of 3.6845 for the unlabeled computers. Average shipments of labeled computers continue to be greater than average shipments of unlabeled computers for eco-countries in 1997.

Table 19. T-tests for Grouped Eco-Countries 1997

Group Statistics

	Eco-Label	N	Mean	Std. Deviation	Std. Error Mean
Log of 97 Units	no label	201	3.6845	.8478	5.980E-02
	label	13	4.6115	.5983	.1659

Independent Samples Test

		Levene's Test for Equality of Vanances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 97 Units	Equal vanances assumed	1 623	204	-3 876	212	000	- 9270	2391	-1 3984	- 4556
	Equal vanances not assumed			-5 255	15 303	000	- 9270	1764	-1 3023	- 5517

T-tests for Grouped Control Countries 1997

The difference in means for the grouped 1997 control countries is also statistically significant with $p<0.0005$ and is shown in Table 20 next to the "equal variances not assumed" t-test for equality of means. The mean for "labeled" computers is 4.2646 and is greater than the mean of 3.6505 for "unlabeled" computers. The average shipments of "labeled" computers is greater than the average shipments of "unlabeled" computers in control countries for 1997.

Table 20. T-tests for Grouped Control Countries 1997

Group Statistics

	CONTROL	N	Mean	Std Deviation	Std. Error Mean
Log of 97 Units	"no label"	343	3.6505	.8840	4.773E-02
	"label"	72	4.2646	.7670	9.039E-02

Independent Samples Test

		Levene's Test for Equality of Vanances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Log of 97 Units	Equal vanances assumed	5 912	015	-5 476	413	000	- 6141	1121	- 8345	- 3936
	Equal vanances not assumed			-6 007	114 273	000	- 6141	1022	- 8166	- 4116

Summary of Results for Grouped Countries

This section presents results for the eco-countries as a group and the control countries as a group. Table 21 shows that all differences in means for each group for each year are significant. This means that the brands with eco-labels are statistically a separate group from the brands without eco-labels in both the eco-countries and the control countries.

Table 21. Significance of Difference in Means Tests

Significance of Difference in Means Tests		
Year	**Eco-Label Countries**	**Control Countries**
1995	.000*	.000**
1996	.002*	.000**
1997	.000*	.000**

Figures 7 and 8 show bar charts comparing the means for eco-countries and control countries. Even though there are fewer cases and shipments for the labeled brands, their means are greater.

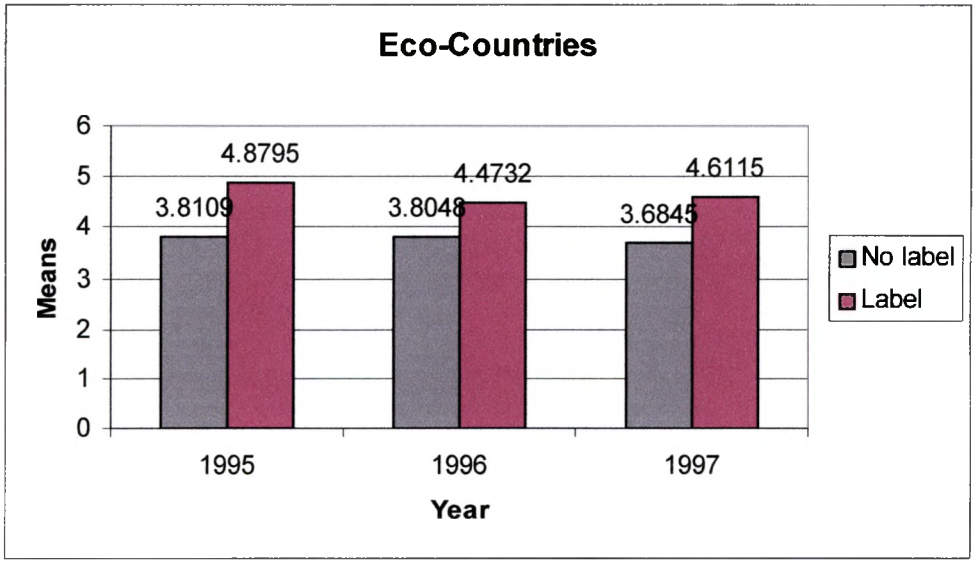


Figure 7. Bar Chart of Means for Eco-Countries

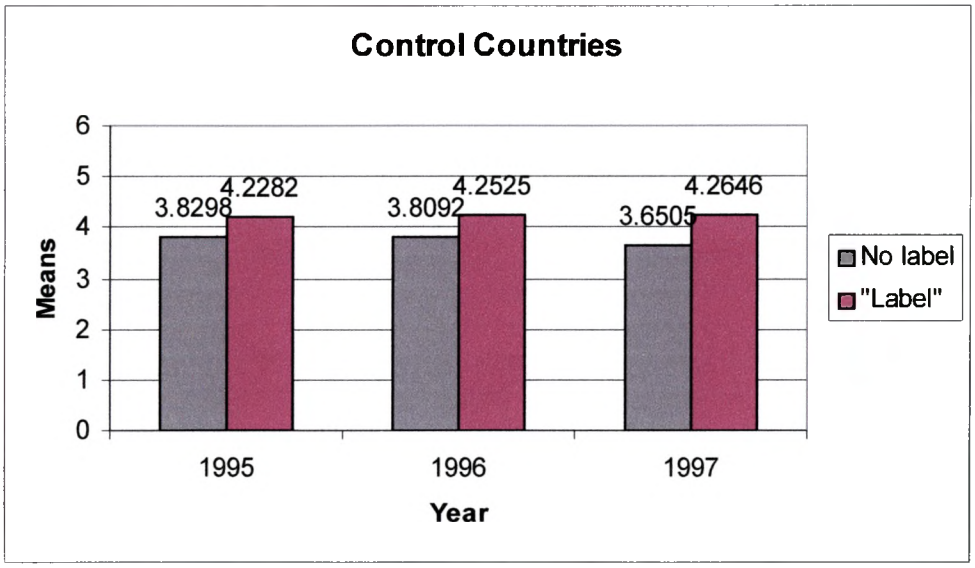


Figure 8. Bar Chart of Means for Control Countries

Table 22 shows the number of labeled and unlabeled cases for each year and their means for both the eco-countries and control countries. The means for labeled cases are greater than non-labeled cases for each year in both eco-countries and control countries. However, the means for labeled cases are even greater for eco-countries. The average shipments for eco-labeled computers are greater in both groups of countries, but they are even greater in the countries sponsoring the labels.

Table 22. Number of Labeled and Unlabeled Cases and Means for Each Year

Eco-Countries				
Year	Cases		Means	
	No label	Label	No label	Label
1995	214	6	3.8109	4.8795
1996	208	12	3.8048	4.4732
1997	201	13	3.6845	4.6115

Control Countries				
Year	Cases		Means	
	No label	Label	No label	Label
1995	329	54	3.8298	4.2282
1996	335	63	3.8092	4.2525
1997	343	72	3.6505	4.2646

CHAPTER VI CONCLUSIONS AND RECOMMENDATIONS

Increasing population, income, and economic activity mean more environmental problems related to water use, energy use, air and water pollution, and increased generation of solid and toxic waste. To mitigate the negative effects of consumers on the environment, many developed countries are including environmental labeling programs as part of their environmental policies.

Environmental labels may enable manufacturers to distinguish themselves in the marketplace and boost their global competitiveness, while enabling governments to implement environmental policies through the label criteria. Both manufacturers and governments need to know if environmental labels actually affect market share. This research study examines the effect of environmental labels on market share by comparing sales of eco-labeled brands in one product group with sales of non-labeled brands in the same product group using market research data and a basic two-sample t-test.

Results of this research show that mean shipments of eco-labeled computers are significantly greater than shipments of unlabeled computers in Europe in the years studied. However, this appears to be true for all countries studied, those sponsoring eco-labels for computers and those which do not. Overall, eco-labeled computers appear to be the best selling computers in Europe with up to one third of the European market belonging to them.

On one hand, these results could mean that the manufacturers of the best selling products decided to obtain eco-labels. That is, these brands may already be members of a distinct population of better selling computers. Their manufacturers may therefore have the resources to

pursue and obtain eco-labels, while other manufacturers may consider them a luxury. The results could also indicate that the eco-labels are correlated with another unknown reason for consumers' purchases, such as lower prices or higher advertising budgets, which caused the brands to sell better than others.

On the other hand, these results could mean that the eco-labels contribute to these brands' popularity, with consumers considering a brand's environmental aspects along with traditional considerations such as price. Eco-labeled brands may be marketed across country borders, for example with French consumers purchasing Fujitsu's ErgoPro because they know it has the Blue Angel label in Germany. Countries that are part of the European Union may have a higher awareness of all eco-label programs because of the European Union eco-label program. (Each country studied is a member of the European Union except for Norway and Switzerland—Norway has its own eco-label program and Switzerland is surrounded by EU countries, France, Germany, Austria, and Italy. Each of these countries, except for Italy, also has its own eco-label program.)

For governments to consider eco-labels as one possible tool for implementing environmental policies, it is important to determine if eco-labels affect market share, so manufacturers can be motivated and rewarded for obtaining the labels. Although the statistical analysis used in this research cannot be used to conclude cause and effect, market share and eco-labels appear to be positively related. Eco-labels may truly provide governments with another tool for implementing environmental policies while rewarding environmentally responsible manufacturers. With increased growth in consumer activity and associated environmental problems, governments should investigate and use all possible tools to implement policies for protecting the environment. These tools should include not only traditional command-and-control style regulations when appropriate, but also non-regulatory, market-based tools such as eco-labels.

Further Research

Further research could broaden the geographic scope of this study by including computers with Asian eco-labels such as Taiwan's Green Mark and Thailand's Green Label. This broader study could be structured into two regional studies, one for Europe and one for Asia, and it would include Asian control countries. Including data for 1998 and 1999 in the European study and/or the Asian study would increase the time period studied to five years which could provide insight into possible trends of increasing market share for the eco-labeled brands. Adding 1998 would also provide at least one more case, Sweden's TCO 95 label which was awarded to Dell OptiPlex late in 1997. Extending the time period studied to a few years before the introduction of eco-labels could show if the best-selling brands in the past were those who later obtained eco-labels. It would also be very helpful to conduct a survey of computer purchasers to find out if eco-labels affected their decision to buy.

Other research could replicate this study using a variety of different product groups such as detergents, appliances, or recycled paper, obtaining the same type of market data used in this research, coding which products have labels, and performing t-tests. This research would help to determine if the labels are equally effective at delivering market share regardless of the product group.

Finally, additional research in environmental labeling could also study a different type of eco-labeling program, such as the Forest Stewardship Council's certification program. The Forest Stewardship Council (FSC) promotes forest stewardship through certification of forest management practices and marketplace labeling of certified forest products. Because they certify specific forest management practices, it may be possible to determine whether this program improves forest eco-systems. A complete study of the Forest Stewardship Council's certification program could examine the effects of their labels in all three areas of eco-label effectiveness—consumer awareness, market share, and environment.

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VITA

Margaret Sealey was born in Berea, Ohio on September 6, 1953, the daughter of David Alfred Sealey and Margaret Marshall Sealey. After receiving her high school diploma from Westport High School in Louisville, Kentucky in 1971, she began her college work at Hanover College in Hanover, Indiana and completed it at Ohio University in Athens, Ohio where she studied journalism. She was awarded a B.S. degree in Communications from Ohio University in 1974.

For most of her professional life, Margaret has worked as a technical writer in the computer industry, developing software user manuals, online help systems, and newsletters, several of which won awards from the Society of Technical Communication. Since 1996, she has worked for Dell Computer in Austin, Texas in communications-related positions, the most recent being that of web technologist. In this position, Margaret is responsible for developing and maintaining several corporate intranet websites aimed at technical audiences.

Margaret began her graduate work at Southwest Texas State University in 1997 and has worked fulltime while pursuing the Masters in Applied Geography degree and maintaining a 4.0 grade point average. She presented a paper at the 2000 meeting of the Southwest Association of American Geographers (SWAAG) and attended the 1998 and 1999 SWAAG meetings. Before starting graduate school, Margaret was an active member of the Lone Star Chapter of the Sierra Club and served as their committee chair for the Texas Water Watch; she was a trail guide at the Heard Museum and Nature Preserve in McKinney Texas; and she was a volunteer Texas Water Watcher.