The California Table Grape Commission's Promotion Program: An Evaluation

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Giannini Foundation Monograph Number 43
•
November 1997

DIVISION OF AGRICULTURE AND NATURAL RESOURCES
CALIFORNIA AGRICULTURAL EXPERIMENT STATION
OAKLAND, CALIFORNIA

ACKNOWLEDGMENTS

Funding for this project has been provided by the California Table Grape Commission (CTGC). The authors are grateful to the CTGC staff for help in assembling the data, to Jennifer James for research assistance and very helpful discussions, to John Crespi, Julie McNamara, and John Lenz for extensive editorial comments on the manuscript, and to Peter Berck for editorial guidance.

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1. INTRODUCTION

The objective of this study was to evaluate the economic impacts of market development and promotion activities financed by the California Table Grape Commission. This promotional program has evolved since the Commission was established in 1968, and is mandatory for all growers. The central question addressed by this study is whether the mandatory program has resulted in an increase in demand and sales, and whether, as a result, industry net revenue has increased enough to cover the costs of the program.

While some concerns can be reduced to questions about whether promotion led to increased sales, the economic value of the program depends on whether the activity was *cost effective*, not just effective. This issue is explored by evaluating not only whether promotion caused a *statistically significant* increase in demand, but also whether it was *economically significant:* How much did demand increase? What were the gross and net benefits from the increase in sales? What were the net benefits after deducting the cost of the check-off? In order to answer these questions, an econometric model of the market for table grapes is developed using time-series data on the key economic variables affecting consumption of table grapes.

An essential first step is to document the history of the main events and developments affecting table grapes, and build a data base for the analysis. Chapter 2 of this report describes the development of the table grape industry in California in the post-World War II era. It documents the changing patterns of production, acreage, yields, and varieties, representing the supply side of the market, as well as the changing markets, prices, and patterns of consumption, both domestically and internationally, representing the demand side. Also described are the roles played by the Commission in attempting to manage the markets.

During the past 45 years, much has changed in the table grape industry. Many of the important changes have taken place more recently, however, since the founding of the Commission, almost 30 years ago. Since many causal factors have tended to change together, it is difficult to identify the specific causes of particular changes in the industry, and to isolate the changes attributable to specific elements of the Commission's work, using just the aggregate data on consumption. Increased consumption is partly a result of population growth, but per capita consumption has also increased. Some of the growth in per capita consumption may be attributable to changes in other demographic variables, such as the age distribution and ethnic mix of the population, or per capita incomes. Also, the growth may reflect a general shift toward healthier diets, including more fruit. In addition, improved technology, both in production and post-harvest handling, has meant that table grapes have become less expensive, in real terms, while, at the same time, consumers are enjoying improvements in quality and a wider range of varieties, available virtually all year long. These changes have almost certainly contributed to rising per capita consumption.

Moreover, significant quantities of table grapes are now sold on export markets. Various factors may have contributed to the growth in export markets. The Commission is engaged in marketing activities, including market promotion programs, in these international markets. Some public support for these activities has been provided by the U.S. government, under various export promotion programs administered by the USDA. The promotional efforts of the Commission, in both domestic and international markets, have worked in parallel with the other changes, and in many ways have been intertwined with them (for example, one role of promotion is to educate consumers about the availability of new varieties and the healthfulness of the product). The challenge is to measure the proportions of the total past changes in consumption that are attributable to these different causes.

In chapter 3, an aggregate econometric model is reported. This aggregate model provides the cornerstone for the economic evaluation of the effects of the Commission's program. This aggregate analysis relates to the total domestic market for California table grapes, where Canada is considered as part of the domestic market. The purpose of this analysis is to partition responsibility for changes in total annual consumption during the years 1969–1993 among prices, income, and CTGC promotional activities. Common trends in many of the aggregate variables sometimes make this difficult with national aggregate time-series data.

Less aggregated analyses are presented in chapter 4. First, monthly aggregate data are analyzed for the period 1972–1993, using a model that is very similar to the annual aggregate model. Second, two years' worth of weekly consumption data (aggregated to monthly observations, to reduce the effects of some potential measurement problems) were modeled for a number of cities. Studying demand in multiple sub-national markets, and using data that are not aggregated to annual figures, are both ways of increasing the amount of information available to be analyzed, mitigating some of the problems associated with aggregate annual time-series data. However, using data collected over shorter intervals involves its own set of problems—monthly observations from within the same growing season are unlikely to be completely independent, for instance—so the main use of the results from the disaggregated monthly models is as a check, to confirm the results from the aggregate annual model.

Chapter 5 deals with the export market for California table grapes. We document the recent growth of sales in the major export markets, examine the California Table Grape Commission's export promotion activities, and consider the support provided by Federal export promotion programs. The econometric analysis parallels that undertaken for the domestic market, focusing on an important subset of total export markets in Asia. Chapter 6 contains a discussion of our main findings. In this chapter, we also provide some interpretation in terms of optimization rules. Chapter 7 is a conclusion and summary.

Appendix A contains the results of various regression and simulation exercises, which were used in the course of the study, but are not central to the discussions of the text. Appendix B contains data that were used in the study.

2. THE POST-WAR ECONOMIC HISTORY OF THE CALIFORNIA TABLE GRAPE INDUSTRY

This chapter documents the recent institutional and economic history of the California table grape industry and the role of the Commission. This account provides the necessary foundation and data for the econometric and market-simulation models reported in later chapters.

2.1 Overview of the Economic Development of the Industry

California has consistently produced approximately 90 percent of total grape output in the United States, and around 97 percent of the country's fresh grapes. Output from Washington and New York, the next largest producers, contributes another six to seven percent. Arizona, which competes most closely with California in terms of the timing of supply, has increased production somewhat in recent years, although it still produces less than one percent of total U.S. output.

Grape production in California is classified by end use into three categories: table grapes, raisin grapes, and wine grapes. Classification is based on the most significant use of the grape variety, although many varieties are suitable for multiple uses. Table 2.1 presents a breakdown of grape acreage and production by end-use classification for three points in time. In 1993, 19 percent of grapes that were classified as raisin-type and 22 percent of those classified as table-type grapes were crushed for use in the wine industry. In the period from 1984–1993, an average of 11.3 percent of raisin-type grape production was sold in the fresh market (Federal-State Market News Service 1993).

Table-type grapes, which are primarily sold in the fresh market, are consistently the smallest segment of the California grape industry, in terms of both acreage and production. The absence of a striking change in the standing of table-type grapes, relative to both raisin- and wine-type grapes, masks the many developments in the fresh market grape industry that have occured over the past several decades.

Table 2.1: California Grape Production and Bearing Acreage, by Variety Type: 1953, 1968, and 1993

	Variety types			
Year	Table	Raisin	Wine	Total
	Bearing Acreage			
	Acres			
1953	83,894	223,676	146,005	453,575
1968	78,112	249,303	128,260	456,175
1993	77,800	271,000	307,000	655,800
	Total Production			
	Millions of Pounds			
1953	890	3,014	1,046	4,950
1968	940	4,270	1,300	6,510
1993	1,264	4,820	4,690	10,774

Source: Federal-State Market News Service, *Marketing California Grapes, Raisins, and Wine*, 1953 Season and 1968 Season. Federal-State Market News Service, *Marketing California Grapes for Fresh Use*, 1992 and 1993 Seasons. Sacramento: California Department of Food and Agriculture and USDA.

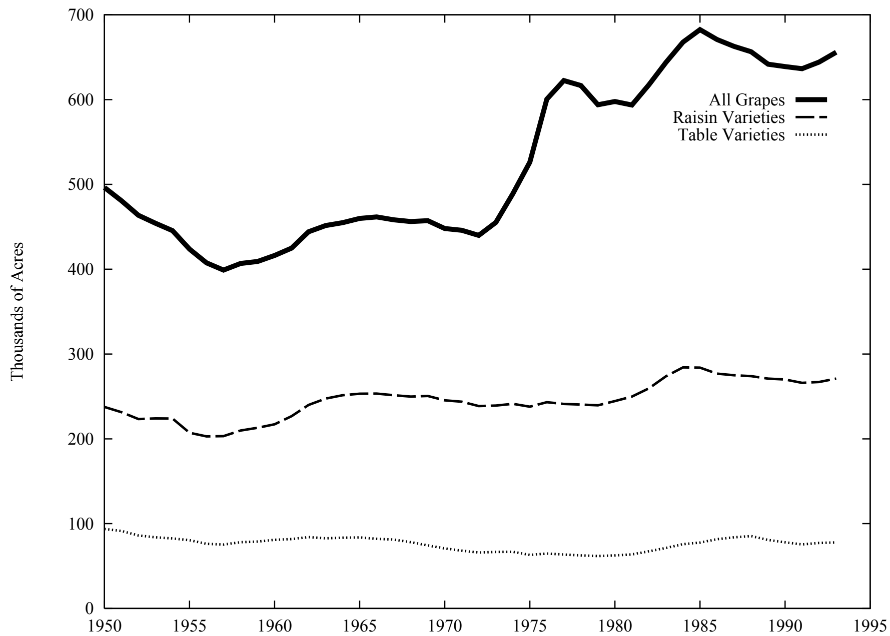

Figure 2.1: California Grape Bearing Acreage, by Variety Type, 1950–93

Significant changes have occurred in the wine and raisin industries as well, but they are not the subject of this study. In the following overview, we focus primarily on table- and raisin-type grapes, as these make up the majority of grapes used in the fresh market. Unless otherwise indicated, wine-type grapes are not included.

Trends in Aggregate Production

Since 1950, most of the changes in grape bearing acreage were accounted for by wine varieties. Since 1950, overall variation in bearing acreage of table- and raisin-type grapes has been quite limited. Bearing acreage trends are shown in figure 2.1.

Figure 2.2 provides information on the changes in yields from 1950 through 1993. Yields of table- and raisin-type grapes show a slight upward trend from 1950 through 1993, with considerable year-to-year variation around the trend. Yields averaged 15,840 pounds per acre (7.92 tons per acre) with a standard deviation of 2,240 pounds per acre (1.12 tons per acre) over this period. Much of the yield fluctuation can be attributed to identifiable climatic conditions, such as those that contributed to favorable yields in both 1982 and 1988.

otal utilized production of table- and raisin-type grapes is presented in figure 2.3. These data represent grape production utilized in the fresh market, the wine crush, and drying. Production followed a gradual upward trend over the past four decades, with a modest increase from 1958 through 1979, and a smaller increase at the generally higher level of production from 1979 through 1993.

Changes in the Varietal Mix

Over the past four decades, both the pool of table grape varieties available for cultivation and the number of varieties actually planted have expanded. Table 2.2 shows bearing acreage for the most widely cultivated table- and raisin-type varieties for the years 1953, 1968, and 1993, to illustrate the varietal expansion that has

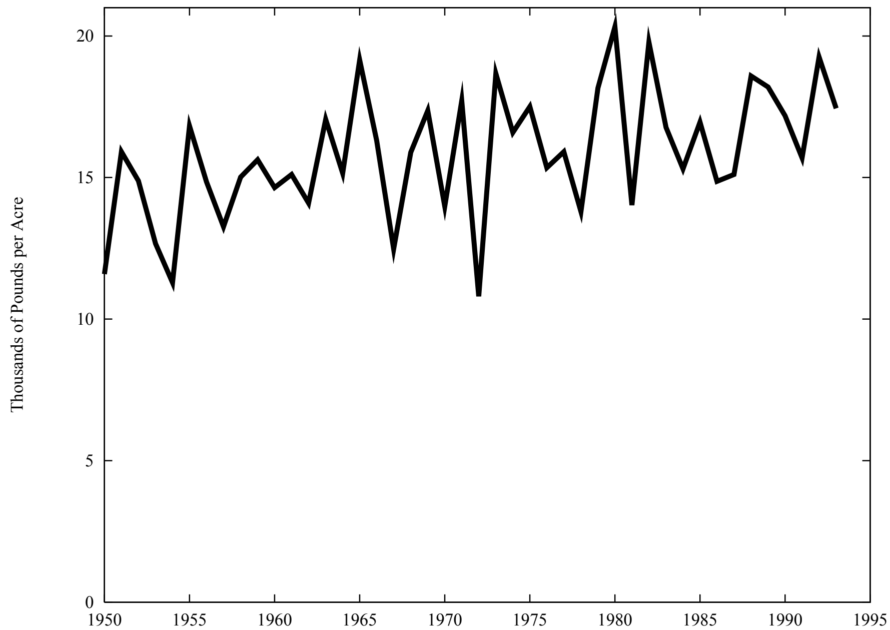

Figure 2.2: Yield of California Table and Raisin Grape Varieties, 1950–93

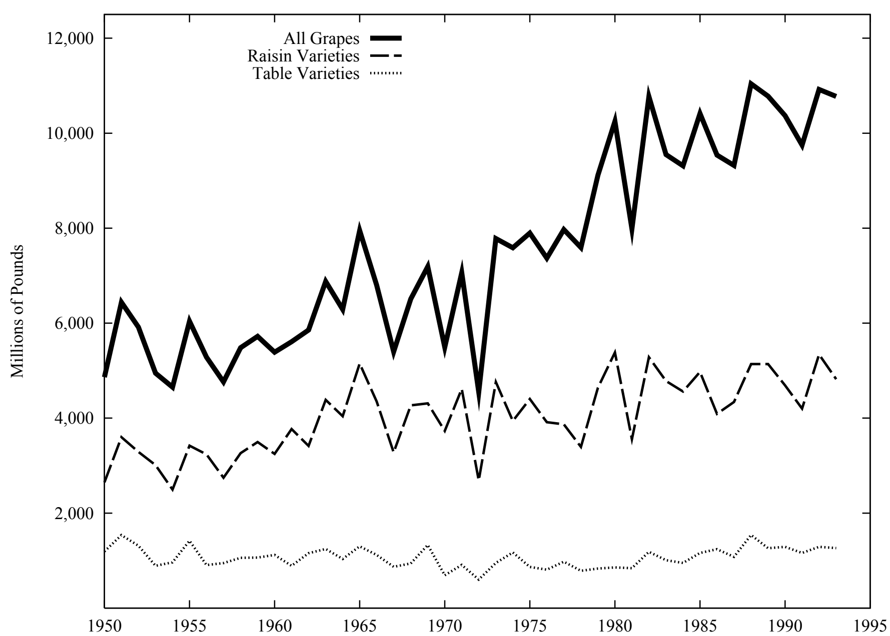

Figure 2.3: Utilized Production of California Grapes, by Variety Type, 1950–93

Table 2.2: Bearing Acreage of California Table and Raisin Grapes, by Variety: 1953, 1968, and 1993

	1953	1968	1993
		Acres	
Table Grape Varieties:			
Flame Seedless	*n.a.*	*n.a.*	25,552
Tokay	24,486	21,279	9,302
Emperor	30,313	27,458	7,106
Perlette	*n.a.*	*n.a.*	6,941
Ruby Seedless	*n.a.*	*n.a.*	6,149
Red Globe	*n.a.*	*n.a.*	6,100
Superior Seedless	*n.a.*	*n.a.*	3,057
Ribier	5,932	8,274	2,316
Calmeria	*n.a.*	2,639	1,973
Malaga	8,354	3,864	*n.a.*
Raisin Grape Varieties			
Thompson Seedless	184,332	231,663	261,993
Muscat	32,169	15,080	4,955
Black Corinth	2,256	1,756	2,406
Fiesta	*n.a.*	*n.a.*	1,396

Source: Federal-State Market News Service, *Marketing California Grapes, Raisins, and Wine,* 1953 Season and 1968 Season. Federal-State Market News Service, *Marketing California Grapes for Fresh Use,* 1992 and 1993 Seasons. Sacramento: California Department of Food and Agriculture and USDA.

occured.

For raisin-type grapes, very little change has taken place in either varieties or acreage allocations. Thompson Seedless, Muscat of Alexandria, and Black Corinth (Zante Currant) are the dominant varieties of those currently cultivated. Of the raisin-type grapes, only one of the varieties with over 1,000 bearing acres in 1993, Fiesta, was not also cultivated forty years ago. Thompson Seedless grapes, originally introduced into the Yuba City area at the beginning of the century, became popular for raisin production in the 1920s, following the adoption of a more appropriate pruning method (Alston, Pardey, and Carter 1994). Although their primary use continues to be in the dried market, Thompson Seedless grapes have also been widely used as a blending grape by the wine industry. Other cultivation improvements contributing to a higher level of resistance to shattering have made the Thompson Seedless easier to ship. It has become a popular grape for fresh-market consumption and is probably the green grape most familiar to consumers (CTGC 1995).

Table-type grape varieties have varied more. With the development and adoption of new varieties, many of them seedless, acreages in older varieties, such as Tokay and Emperor (two seeded red varieties which originally dominated table grape production), have declined substantially. Bearing acreage of Flame Seedless overtook that of both Emperor and Tokay in 1987. Today, the most widely cultivated varieties are seedless. Flame Seedless is currently, by far, the predominant red table grape variety. Other important varieties include Ruby Seedless, Perlette, Red Globe, Superior Seedless, and Emperor.

Trends in Prices and Value of Production

Annual average prices received by growers for fresh grapes are shown in figure 2.4. These prices, given in dollars per pound at the first delivery point, are shown in both real and nominal terms. Nominal values were converted to real values by dividing by the Consumer Price Index (CPI), with 1995 as the base year. Thus, the values we report are in real 1995 dollars. Prices remained flat during the 1950s and the first half of the 1960s, then embarked on an essentially steady upward trend for the following fifteen years, despite the adverse effects of United Farm Workers (UFW) union boycotts at terminal marketing areas in 1968 and 1969, which depressed the prices received by some growers. Subsequent boycotts in the early 1970s and mid-1980s seem to have been less effective. Record high shipments, accompanied by marketing and distribution problems, as well as a high proportion of poor-quality fruit, led to a much more drastic drop in prices to growers in 1985. Although prices rebounded sharply following this record low year, they never returned to their previous high, and have gradually declined since the early 1990s.

We calculated the value of fresh-market grape production, using data on average prices received for all types of grapes sold in the fresh market and total production of table- and raisin-type grapes sold in the fresh market. The value of production, as shown in figure 2.5, was fairly flat, in both nominal and real terms, from the 1950s through the late 1960s. In real terms, the value of production for 1972 was more than double that of 1968. Values of production more than triple that of 1968 were observed in subsequent years. Values were much affected by the price fall in 1985; although they rose from that record low, the real value of production never regained its previous high. A new downward movement began in 1990.

Disposal of Grape Production

The suitability of many grape varieties for multiple uses, regardless of their type classification, gives growers an extra degree of flexibility when securing outlets for their production of some multipurpose grape varieties. However, different trellising requirements for mechanical harvesting and other cultural differences may have re-

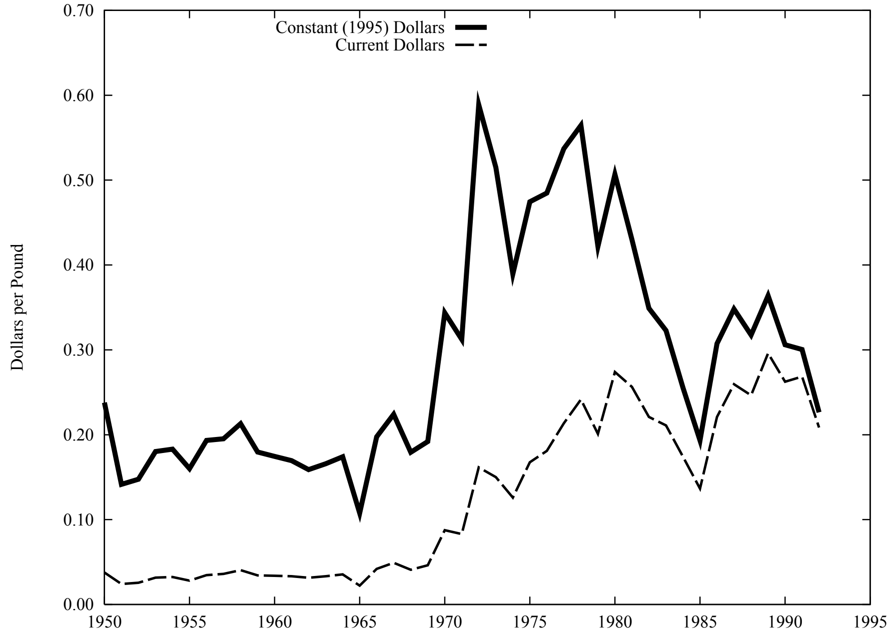

Figure 2.4: Average Grower Price of California Fresh-Market Grapes, 1950–92

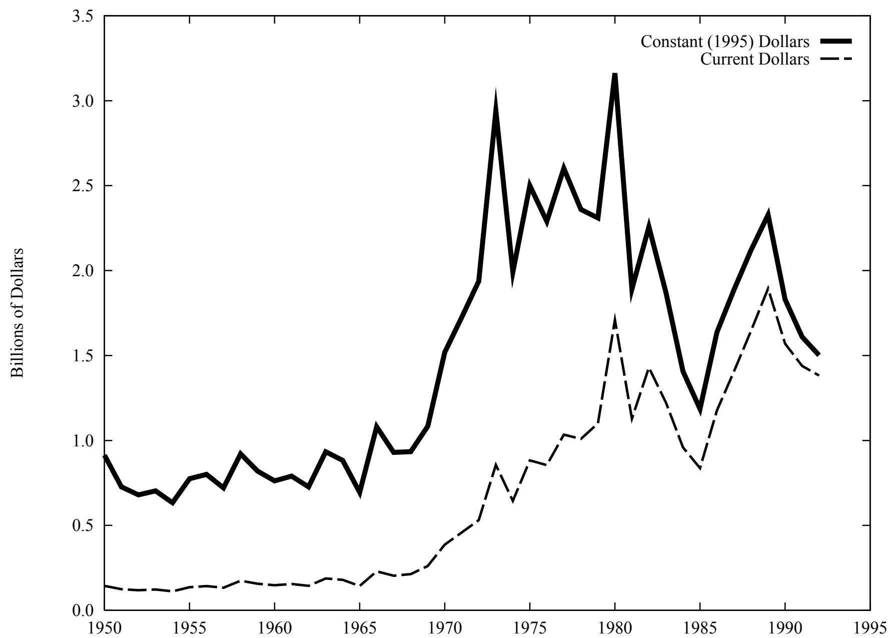

Figure 2.5: Total Value of Fresh-Market Production of California Grapes, 1950–92

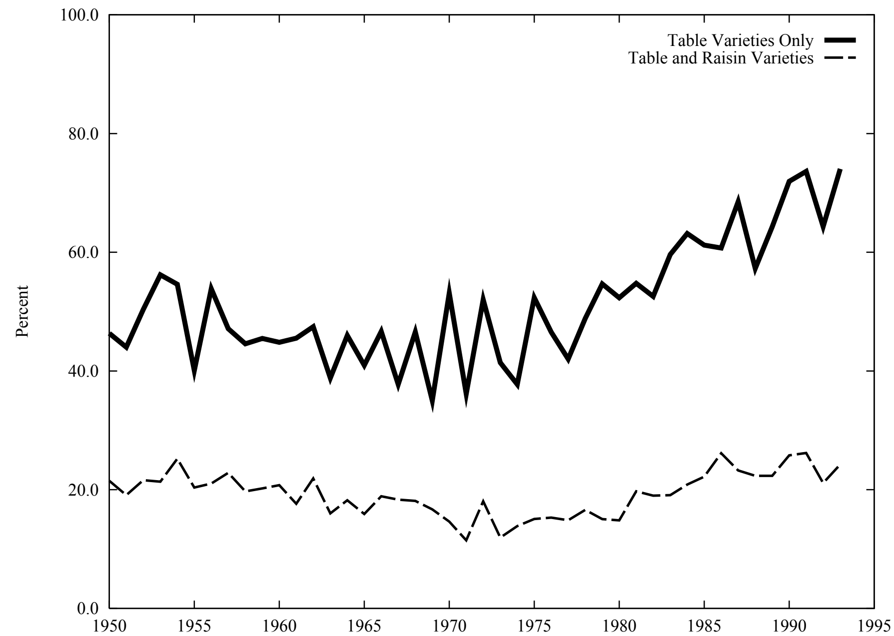

Figure 2.6: Percentages of Fresh-Market Shipments for Table and Raisin Grape Varieties, 1950–92

duced the degree of flexibility in more recent years. Figure 2.6 shows the percentage of total utilized production of table- and raisin-type grapes shipped for fresh-market consumption from 1950 through 1993.

Fresh-market shipments for this period averaged 19 percent of total utilized production of table- and raisin-type grapes. Fresh shipments as a share of production began to decrease in 1955. This downward trend continued throughout the 1960s until, following minor fluctuations, the share began to increase in 1973. The annual percentage of table-type grapes sold in the fresh-market is depicted separately in figure 2.6 for the years 1950–1993. During this period, on average, approximately 51 percent of total table-type grape production was sold for fresh consumption. The bulk of the remaining 49 percent was crushed; only a small percentage was dried for raisins. Fluctuations in the share of table-type varieties sold on the fresh-market were most pronounced from the late 1960s through the mid-1970s. Then the share began to increase steadily, reaching 74 percent in 1993. Decreased shares sold on the fresh market for both table- and raisin-type grapes during 1968 and 1969 may be attributed to UFW-organized boycotts, which resulted in fresh-market supply disruptions and diversion of grapes to alternative uses.

Total fresh shipments have increased steadily since 1971, after remaining essentially constant during the 1950s and declining in the late 1960s. The percentage of fresh shipments allocated to domestic consumption declined until 1971, when it began to increase and the export-market share decreased. After growing slowly from 1951 until 1986, total exports have grown more rapidly. Data on the quantity and value of production shipped to the fresh market are provided in appendix tables B2.1 and B2.2. Further elaboration on consumption trends and developments in imports and exports follows.

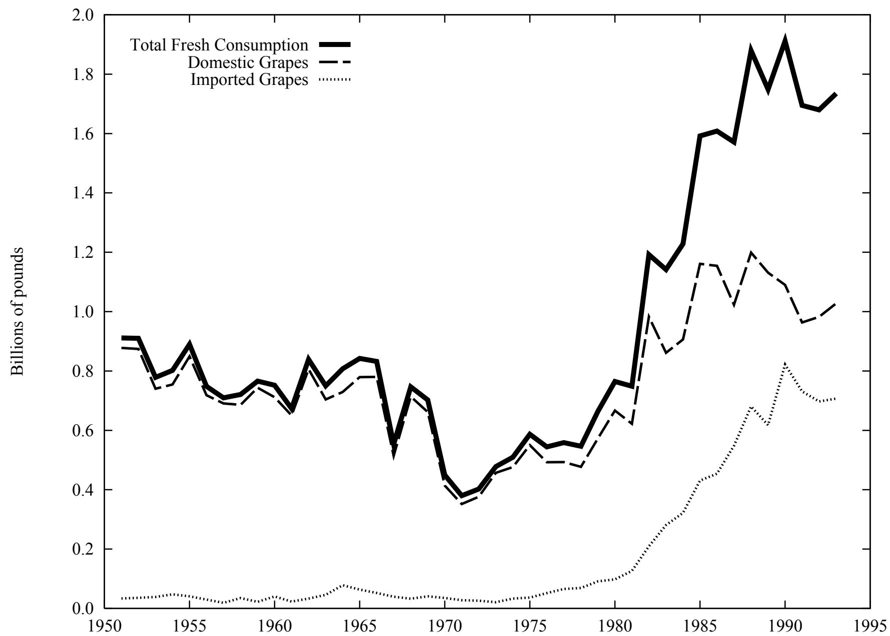

Figure 2.7: Annual Fresh Grape Consumption, 1950–92

Trends in Consumption

Some of the most significant changes in the development of the table grape industry are reflected in the changes in domestic consumption over the past forty years. Total domestic consumption consists of two components: U.S.-produced grapes sold in the fresh market, and grapes imported for fresh-market sales. Figure 2.7 depicts consumption of U.S.-produced fresh-market grapes, total imports of fresh-market grapes, and total U.S. consumption of fresh-market grapes, for the period 1951–1993. Consumption of U.S.-produced fresh grapes is calculated as fresh shipments of table- and raisin-type grapes less total fresh-market exports.

The overall trend from 1951 to 1968 was clearly one of steady decline. Sharper drop-offs occurred from 1968 through 1971, a year in which total table grape consumption reached a low of 352 million pounds (1.7 pounds per capita). The trend then reversed dramatically, with total consumption climbing to over one billion pounds during the early 1980s. Domestic production supplied a large portion of the increased consumption, particularly through 1988; however, the rapidly increasing quantity of imports after 1980 also played an important role. The timing of a large percentage of these imports is significant. Their arrival in the winter months, a period during which U.S. markets previously relied on grapes in storage, has enhanced the year-round availability of good quality fresh grapes.

In figure 2.8, per capita consumption for the United States shows trends similar to those for total consumption. After declining to a low of 1.7 pounds per person in 1971, annual per capita consumption of domestically produced grapes increased to a high of almost five pounds by 1988. Total per capita consumption of both domestic and imported grapes also reached its maximum of over seven pounds in 1988. Per capita consumption of imported grapes likewise increased markedly during the 1980s, attaining its high of over three pounds per person in 1990. Total per capita consumption declined somewhat in the first half of the 1990s, but generally remained over 6.5 pounds per person.

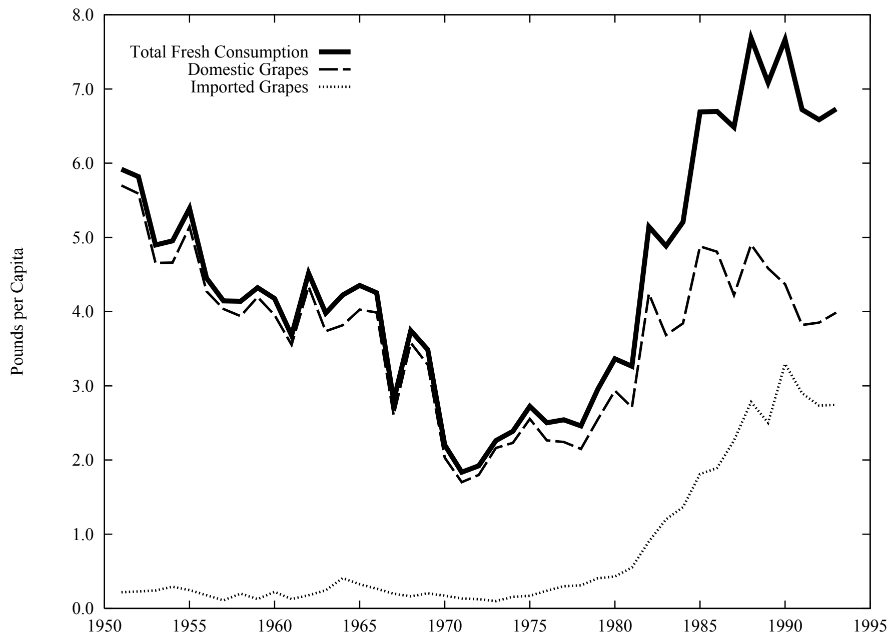

Figure 2.8: Annual Per Capita Fresh Grape Consumption, 1950–92

Changes in Imports and Exports

Some of the recent increases in total and per capita consumption are attributable to a greater availability of imported grapes. Grape imports in the 1950s and 1960s were primarily Concord grapes from Canada, and remained fairly constant and insignificant during the 1950s, 1960s, and much of the 1970s. The majority of imported grapes now come from Chile. Since 1981, the increase in imports from Chile has been the sole factor behind the rise in the total quantity of grape imports. Imports from Chile increased almost eightfold, from 77 million pounds in 1980 to over 619 million pounds in 1994. Chilean shipments begin in December and continue into the spring, usually through May, occasionally into June. The shipping season for the Coachella Valley district, which comprises much of the Californian desert region, takes place from late May through July. Therefore, the conclusion of the Chilean harvest may overlap with the beginning of the harvest in the desert regions of California. The Mexican harvest coincides quite closely with that of the Coachella Valley; however, Mexican imports remain small, relative to Chilean imports, despite dramatic increases since 1980.

Compared with imports, export growth has been less dramatic, although in the last decade it has been considerable (figure 2.9). The very gradual trend of increasing exports did not change noticeably until after 1985, when export quantities began to increase much more rapidly. Canada remains the primary importer of U.S.-produced grapes, but its share of total U.S. exports has decreased from around 80 percent in the 1960s and 1970s to less than 50 percent in 1994. Much of the growth in offshore exports (all export outlets excluding Canada) is the result of newly developed Asian markets, in particular, Singapore and the Philippines in Southeast Asia, as well as Hong Kong and Taiwan. Exports to Japan have been somewhat erratic, with a sharp increase from 1985 to 1986, and a reduction during the first half of the 1990s.

The opening of the Mexican market in October 1993, as a result of the NAFTA

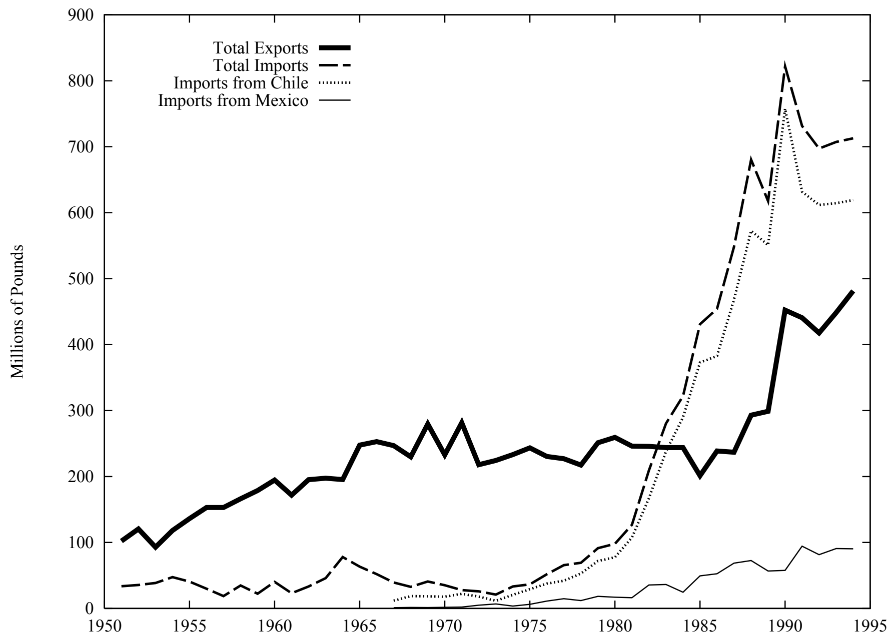

Figure 2.9: Imports and Exports of Table Grapes, 1951–94.

agreement, proved significant. Almost 20 million pounds were shipped to Mexico in 1993, about 3.5 times the volume in 1992; in 1994, exports to Mexico increased substantially again, to more than 2.5 times the 1993 quantity. The recent success in the Mexican market currently places it behind only Canada, Hong Kong, and Taiwan, as the industry's fourth-largest export market.

Other Changes in Markets and Marketing

General changes in technology, institutions, and industry structure in the agricultural marketing system in the United States have had important effects on agricultural product marketing. The main changes in the marketing structure of the table grape industry have followed patterns similar to those observed for many other agricultural products.

The table grape marketing system was once characterized by a large number of independent brokers and handlers dealing with relatively small quantities of output distributed to small, independent retail outlets. Many of the transactions took place through auction sales and wholesale or terminal markets. As the system has evolved, the role of the independent broker has declined. Nowadays, a smaller number of relatively large shippers handle a much greater proportion of total output. Growers may contract with a shipper for several years in advance. Some large growers retain their own sales agents to handle the marketing and sales aspects of their businesses. The marketing and retail system has also been affected by the development of large chain retail outlets and their volume purchasing. Many of these retail chains bypass the established marketing network, opting instead to employ their own in-house buyers who deal directly with growers. One reason why grower cooperatives and other grower organizations have been formed is to countervail the market power of these large buyers.

Post-Harvest Technology and Quality

Many changes in post-harvest handling techniques, transportation, and packaging occurred simultaneously with the changes in industry structure. Technological advances over the past several decades have contributed to both an improved quality of fresh-market grapes and a longer marketing season. Standardization in packaging, with the adoption of uniform lugs, enabled the mechanized handling of pallets, which reduced costs and hastened product movements. Continuing advances in cooling technology have enhanced quality and reduced losses from post-harvest quality deterioration. During the late 1950s and early 1960s, water-ice rail cars, which required frequent stops at ice stations, were replaced with mechanically refrigerated cars. This change reduced the likelihood of quality deterioration during rail transport. The development of thermostatic cooling control made constant-temperature transport possible. Moreover, the increasingly widespread use of trucks in the transportation process has lowered transportation costs, increased flexibility in scheduling, and reduced delivery time. Truck transportation has also enabled wider and faster access to all markets, including those that are smaller and less accessible. Piggyback service—in which refrigerated truck trailers packed at storage facilities or directly on the field are loaded by truck onto flatcars, transported by rail, and then delivered again by truck to the desired destination—has also become an important transportation option.

Increases in the efficiency of shipping technology have helped ensure not only that grapes will arrive at their destination in marketable condition, but also that they will do so at significantly lower costs than before. While quality inspections continue to take place, overall quality improvements have lessened the need for inspections, thereby contributing to transportation-related cost reductions. Absolute improvements in quality, along with reduced variability in the quality of grapes arriving at their destinations, have contributed to increased consumer acceptance and an improved reputation for the industry's product.

Changes in Household Structure

Some important changes in the economic structure of households, and other demographic variables, over the past few decades hold important implications for food demand and marketing. As recently as the 1950s, the predominant type of U.S. household involved two adults and two children, with only the male head of household working away from home. In the 1990s, single-person households are very important, female heads of households are common, and nonworking spouses are now the exception rather than the norm.[1] These factors, combined with rising incomes, changes in available household technology (such as microwaves and home freezers), and changes in available food products (including pre-prepared foods for home serving, and fast-food restaurants), have contributed to major changes in the way people live and, in particular, eat.

Growth in per capita incomes has contributed to an increasing demand not only for food quality but also for services associated with food. The increased labor force participation of women has contributed to an increased demand for convenience (for example, food with low preparation time), since the opportunity cost of a working woman's time is higher. These factors account for much of the major recent change in food purchase patterns: a higher proportion of meals away from home, and a higher proportion of pre-prepared meals at home.

The implications for consumer demand for fresh fruit, fresh grapes in particular, may be mixed. Many fruits require little preparation, are relatively convenient, and fit well into the "snack" category (which has been expanding). However, other

[1] Frazao (1992) describes and analyzes the consumption patterns of female-headed households.

products in the "snack" category may be more convenient, in that they are less perishable, more easily stored, and more easily purchased from non-traditional sources (e.g., in vending machines). Tradeoffs of this type may account for the secular decline in per capita table grape consumption, along with other fresh fruits, during the 1950s and 1960s. More recently, rising consumer health consciousness and broad preference shifts toward fresher, more natural foods may have significantly influenced the potential market for fresh fruit, including fresh grapes.

Changes in General Consumption Patterns

Diets in the United States are slowly shifting to include more foods such as leaner meats and fresh fruits and vegetables, as recommended by public health organizations. However, the progression toward a healthier diet is by no means unidirectional. Although consumption of grains and low-fat items has increased, consumption of cheese and caloric sweeteners has also increased. Per capita consumption of fresh fruit exhibited a steadily declining trend from 1939 through the mid-1960s, when it began to gradually increase. Much of the decline and subsequent turnaround is attributable to the consumption of citrus fruits, particularly oranges, although non-citrus fruits exhibited similar consumption trends.

The overall increase in per capita consumption of fresh fruits and vegetables proceeded slowly during the 1970s and more rapidly during the 1980s. We estimated total per capita consumption of commercially produced fruits and vegetables to have been 678 pounds in 1994 (farm-weight basis), a 20 percent increase from 1970 levels. Per capita consumption of 25 different types of fruit, including both citrus and non-citrus, was 280 pounds. Bananas, apples, and oranges continue to be the most important fresh fruits, in terms of quantities consumed per capita, although the percentage increase in per capita consumption of these fruits has not been as large as it has been for other fruits, such as grapes.

2.2 The Activities of the California Table Grape Commission

The California Table Grape Commission, established in 1968 to engage in promotional activities on behalf of the state's table grape industry, was the first agricultural commission to be organized in the state. Under the California Marketing Act of 1937, this commission's establishment required a two-step process involving special legislation and industry approval through referendum (Lee, Alston, Carman, and Sutton 1996). The legislative component was completed in 1961, with the necessary gubernatorial signature; however, due in large part to disagreements over grading standards, the initial referendum held in 1962 failed. A combination of factors, including UFW-led boycotts and the increasingly negative economic outlook for grape growers, resulted in a revival of the proposal for a Commission, and its subsequent approval in a 1968 referendum (CTGC 1995).

The expansion of the industry's sales volume, at constant or increasing values of production, is one of the Commission's primary objectives. Activities to further this end include developing and expanding both domestic and foreign consumer demand for fresh-market grapes, and overseeing the operations of the necessary distribution channels, particularly during peak periods of supply. Since membership is mandatory, the Commission represents 100 percent of the fresh grape growers in the state.[2] The Commission is funded by grower assessments on each pound of grapes shipped. The assessment rate is determined annually by the Commission's

[2]At the time of the Commission's establishment, Tokay grape growers were already covered under an existing market order and were not included under the Commission's mandate. However, in 1972, Tokay grape grower representatives voted for the inclusion of Tokay grapes in the Commission's promotion programs. The Tokay federal marketing order was terminated in 1995.

board of directors, to meet a budget that is established on the basis of projected crop estimates. The rate is currently $0.006087 per pound, almost 13 cents per 21-pound box.

Promotional Investments

The California Table Grape Commission allocates the majority of its budget to promotion activities. Budget shares for these activities ranged from approximately 80 percent of the Commission's total budget during its first ten to fifteen years of existence to an average of over 90 percent since the 1980s. The average promotion share of 82 percent during the period 1970-1994 ranks the Commission fourth behind walnuts, raisins, and plums in average promotion budget shares for fruit and nut crops (Lee, Alston, Carman, and Sutton 1996). Promotion activities include advertising, merchandising, and public relations for both domestic and foreign markets. Advertising alone accounts for at least 50 percent of the total budget, with at least another 25 percent set aside for merchandising. The balance of the budget is distributed among administration, programs directed at food service, public relations, research, and other special projects.

Domestic and Export Promotional Strategies and Policies

The Commission's promotion strategy focuses on two main components: merchandising and direct consumer advertising. The merchandising component targets retailers in an attempt to increase the visibility and appeal of California table grapes. Specific activities that the Commission has employed include retailer display contests during strategically targeted marketing seasons, the use of mailers to managers of produce merchandising, the use of trade premiums, and the distribution of point-of-purchase display materials. The Commission also employs a team of field representatives responsible for developing linkages with key retailers. Recent efforts have been focused on dispelling a widely held belief that the fresh grape season comes to a close at the end of summer with the final shipments of Thompson Seedless grapes. Using retail-level promotions, the Commission promotes fall varieties such as Emperor, Ribier, Calmeria, Ruby Seedless, and Red Globe, to extend the fresh grape season through Christmas.

Direct consumer advertising has been an important marketing tool for the Commission. Much of the Commission's advertising outlay is used to purchase commercial time on television and radio in targeted markets. In the 1970s, following projected increases in production for future crop years, television advertising was used to familiarize consumers with California grapes and thus expand demand. The Commission specifically identifies and targets key population segments in its advertising program. Target audiences have shifted over time, in accordance with demographic changes in the United States. Recent efforts have focused on both the growing Hispanic population and the aging baby-boomer population.

The Commission has been engaged in export promotion since the late 1970s, with active programs in over twenty countries. In addition to the goal of expanding exports in existing markets, attention is also focused on obtaining export access to countries with prohibitive trade barriers, particularly in Asia and Latin America. Recent efforts to develop an export market in Mexico have been very successful; in the three years since successful negotiations to establish market access for U.S. grapes, Mexico has become one of the industry's largest markets. Potential new markets include Brazil, which increased its imports of U.S. grapes in 1994, as well as Vietnam, South Korea, Cambodia, and Colombia. High-level negotiations for access to the Chinese market have also taken place. Continued expansion of existing strong export markets in Hong Kong and Taiwan is also a priority. Since 1986, the federal government's Market Access Program (MAP) (and its predecessors, the

Targeted Export Assistance Program (TEA) and the Market Promotion Program (MPP)), in addition to the Commission's allocations, has provided the funding for much of the Commission's export promotion activities. Lack of consumer awareness of California grapes has been identified as a recurring problem in many export markets. Promotion activities have consisted largely of direct consumer advertising, to familiarize potential buyers with California grapes and to highlight the grapes' particular characteristics, as well as trade merchandising and incentive programs targeted at wholesalers and retailers.

Figure 2.10 shows the total expenditures on promotion of table grapes and the allocation of those funds by the Commission over the period 1968–1995.

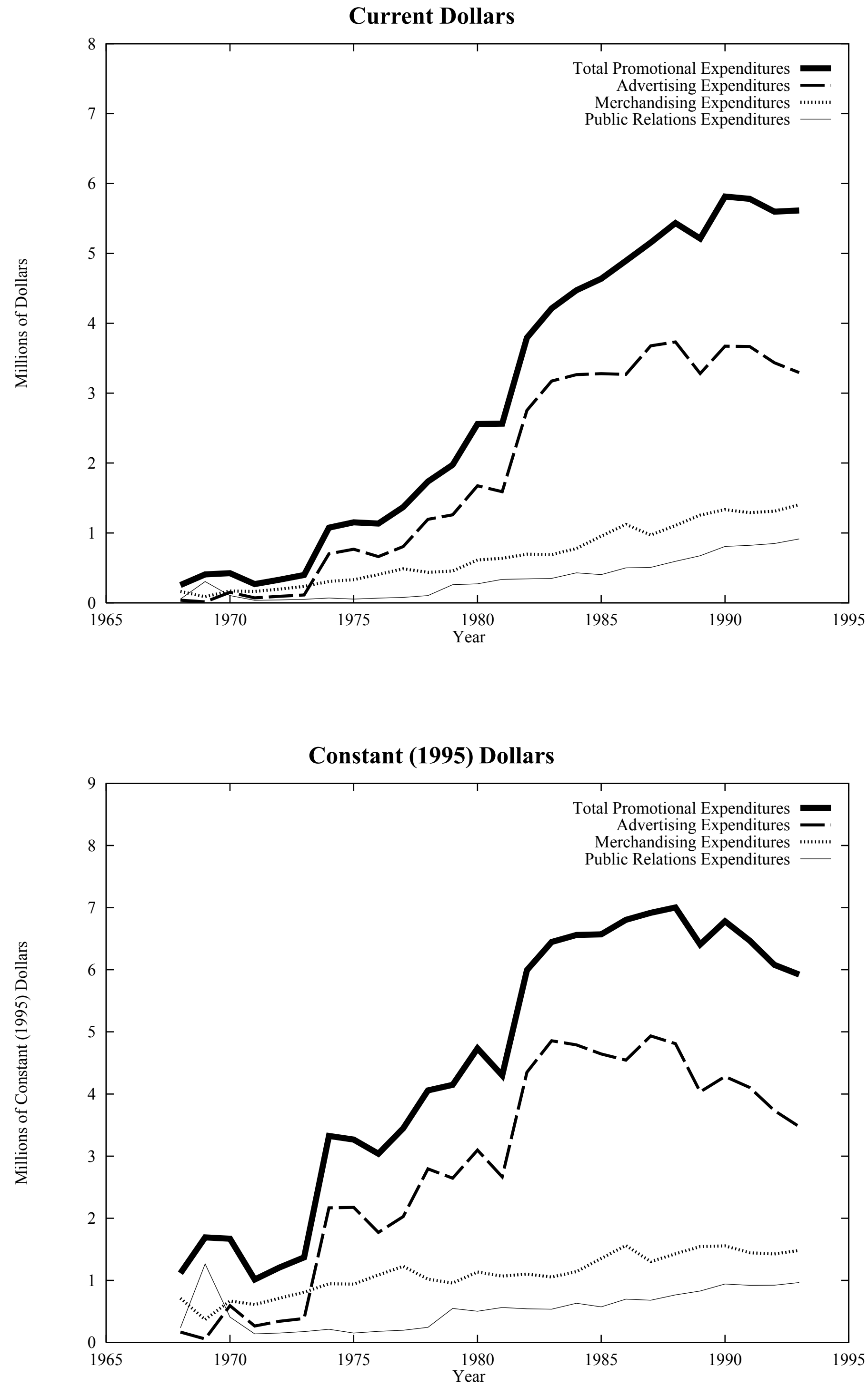

Figure 2.10: Total CTGC Promotion Budget and Allocation, 1968–94

3. ACCOUNTING FOR CHANGES IN AGGREGATE DOMESTIC TABLE GRAPE CONSUMPTION

In this chapter, we report our estimated time-series models of total U.S. and Canadian demand for table grapes. These models include promotion variables in order to obtain direct estimates of the sales response to promotion. Henceforth, "domestic" refers to data for the combined market of the United States and Canada. Not only is it difficult to partition information on either consumption or promotion across these two markets, but there is no particular reason to obtain separate U.S. and Canadian demand estimates for the present study. We use aggregated annual data for the period 1968–1993. We then use the results from our econometric models in simulation models to evaluate the benefits and costs of promotion.

3.1 Data Used in Demand Models

Before presenting our demand models and empirical results, we give an overview of data and data sources, including data used in estimating disaggregated, monthly demand models and export demand models, which are covered in sections 4 and 5, respectively.

Quantities

Data describing the quantities of California table grapes consumed in the domestic market were derived from CTGC tabulations. Three compilations were used: an annual aggregate of table grape consumption for the entire domestic market, a monthly aggregate of domestic table grape shipments, and a month-by-month breakdown of shipments to selected U.S. cities. All three data sets have the same primary source: first packers of table grapes report their fresh shipments to the CTGC which, in turn, uses these reports to calculate the assessment to be paid by each shipper. Over the years, the CTGC has used these records to develop a detailed database on the movements of fresh grapes. This database includes information on the geographic region from which where the grapes originate, their destination, market timing, and variety. In addition to printed sources, the CTGC provided us with archival records from the invoice file, which allowed us to construct a monthly data set, containing shipments by city and variety.

We calculated the annual aggregate quantity by subtracting crop-year exports (excluding Canada) from crop-year shipment totals for the entire California industry. The latter series is now published as `UNLOAD #3` in the annual CTGC shipments report, *The Distribution and Per Capita Consumption of California Table Grapes by Major Varieties in the United States and Canada.* Exports are now published as `UNLOAD #2` in the CTGC tabulations. Both series have been published on an annual basis since the CTGC's establishment in 1968. The CTGC tabulations are on a lug basis; we converted these to pounds, based on an average lug weight of 22 pounds. These data are listed in Appendix B, as table B3.1.

The weekly analysis published since the crop year 1981/82 is also based on data collected from packers by the CTGC. Between 1972 and 1980, the CTGC assembled data from the Transportation Section of the USDA Agricultural Marketing Service's Market News Branch; these data describe weekly arrivals at terminal markets of table grapes (and other commodities). From these data, we computed, and applied to the annual production data described above, a time distribution of arrivals for each year. Weekly shipment data and estimates were then aggregated into monthly estimates.

For the disaggregated city-by-month model, we extracted data from archival storage devices covering the years 1990, 1992, 1993 and 1994. These files contained a record for each shipment reported by packers to the CTGC. From each record, fields identifying the shipping date, number of lugs, lug size, variety, and destination city were read, and data on pounds by city, month, and variety were constructed. The file describing shipments in 1991 was unreadable, so these data are unavailable.

Our statistical analyses have taken into account the possibility that factors other than the CTGC promotion programs may have contributed to growth in demand for table grapes. Two important factors may have been (1) increasing year-round availability of fresh grapes, resulting in particular from the growth of the Chilean table grape industry, and (2) the increasing presence in the market of additional table grape varieties. To measure the first factor, imports of table grapes from Chile were tabulated from *Foreign Agricultural Trade of the United States* (U.S. Department of Commerce). As an indicator of varietal expansion, the share of Thompson Seedless grapes in total shipments of the California industry was calculated, from the `UNLOAD #3` series of the CTGC variety tabulations.

Prices

Three sets of prices were used in our econometric models of grape demand in the United States and Canada. Wholesale price reports from the various terminal markets covered by the Federal-State Market News Service are the primary source of data on fresh grape prices. In our aggregate models, the measure of the price of substitutes for grapes was an average of the Consumer Price Indices for apples, oranges, and bananas, from the Bureau of Labor Statistics. In our disaggregated city-by-month model, the substitute price was calculated from wholesale price reports for Golden and Red Delicious apples.

Since 1992, local reporters to the Federal-State Market News Service have been providing their detailed data to the USDA's Agricultural Marketing Service, which has built a centralized database. This database contains daily prices for a wide range of fruit varieties, package sizes, package types, fruit quality, and fruit appearance. Each record has fields for high and low price, and for the most frequently observed high and low price, on a per-package basis. We converted the most frequently observed high price for each record into a per-pound price, using the record identifier for package size; to develop a monthly price series for each variety, we calculated the average of the per-pound prices observed during the month.

For years prior to 1992, detailed archives were not available. Instead, a one-day-per-week (typically but not always Monday) report is published by each of the local reporting offices of the Federal-State Market News Service. Again, we calculated averages of the "mostly high" prices for each city and month. These data were also computed for 1992, to be used for the cases where more detailed data were not available; reporting to the central AMS database has, at times, been incomplete, particularly in its first year of existence. For the annual aggregate model, we calculated the average of the monthly prices for Thompson Seedless grapes in the Los Angeles wholesale market.

Promotion

We used three sets of data on promotional expenditures. For the aggregate monthly and annual models of domestic table grape consumption, we extracted data on the CTGC's advertising, merchandising, and promotions/communications/public-relations budgets from CTGC financial statements. The sum of the expenditures on the three activities was used in the aggregate annual model. For the aggregate monthly model, the separate effects of the individual components of the CTGC promotional programs were investigated. For the disaggregated city-by-month model, data from advertising-agency billings for spot television and radio were tabulated. For the export models, CTGC data on promotional expenditures by country were used in the annual models, while data on advertising and other promotion were used separately in the monthly models.

Other Variables

The models we estimated pertain to per capita table grape quantities. To calculate these quantities, and to convert other variables to per capita terms, we collected population data for the United States, Canada, and selected foreign countries. For annual data, we used the IMF tabulations in *International Financial Statistics*. For our disaggregated city-by-month data, we used Census Bureau data on the Consolidated Metropolitan Statistical Area (CMSA) population.[1]

For our aggregate domestic models, we derived the income variable from annual data on total private domestic consumption expenditures for the United States and Canada, taken from the IMF tables. To convert to real per capita terms involved several steps. First, aggregate Canadian consumption expenditures were converted to U.S. dollars, using the annual average exchange rate, also from the IMF tabulations. Total U.S. dollar expenditures were then converted to per capita terms by dividing by the domestic population (United States plus Canada). Finally, the resulting per capita series was deflated using the U.S. Consumer Price Index.

For the disaggregated model, data on average per capita personal income for the relevant CMSA or PMSA were extracted from the database maintained by the U.S. Department of Commerce, Bureau of Economic Analysis (BEA). The BEA data, like the Census Bureau population data, are available for a variety of statistical-area designations; the CMSAs, which combine metropolitan areas, such as New York/Northern New Jersey/Long Island, or Oakland/San Francisco/San Jose, are closest in scope to both the media market and to the coverage of the main terminal markets. Where there is no CMSA, such as for the Atlanta area, it is because the Primary MSA is essentially the same as the metropolitan area.

The Consumer Price Index (CPI) is the only price index used as a deflator in this report. CPI data are available on-line from the U.S. Department of Labor, Bureau of Labor Statistics (BLS).[2] For the aggregate models, we used the series for all U.S. Urban Consumers, code `CUUR0000SA0`, including the monthly data and the annual aggregate as appropriate. For the disaggregated model, we used the corresponding city price indices, with codes of the form `CUURAxxxSA0`, where `xxx` is the city code (and the first `A` indicates a large city), where available. In a few cases (Atlanta, Minneapolis, Seattle, and Tampa), monthly CPIs were not available, so we used the national average CPI.

3.2 Aggregate Domestic Demand Models, Annual Data, 1968–1993

For our first analysis, we used aggregate annual data on U.S. and Canadian consumption of California table grapes over the period since the Commission began to operate. These aggregate models provide demand parameters that can be used to estimate gross and net benefits to the industry, estimates that are directly applicable to the entire period during which there has been mandated table grape promotion.

The Demand Model

Suppose we use Q_t to represent the per capita quantity of California table grapes (of uniform quality) demanded by a representative consumer during a particular year, t. The standard theory of consumer demand suggests a model in which the quantity demanded, Q_t, depends on the corresponding price of table grapes, PG_t, the prices of all other goods (such as other fruits, in particular) that are substitutes

[1] In some cases, there is no CMSA, in which case the Primary MSA (PMSA) was used instead. In such cases, the PMSA corresponds to the entire metropolitan area.

[2] The URL is `http://stats.bls.gov`.

or complements for table grapes, PS_t, and total money income or expenditure on all goods, EXP_t. Algebraically, this model can be expressed as:

$$Q_t = f(PG_t, PS_t, EXP_t). \tag{3.1}$$

To make this model operational, one must specify a particular functional form for $f(\cdot)$—for instance, a linear functional form (which we use later). In this model, we expect the own-price effect to be negative (a negative coefficient on PG_t). The cross-price effects (the coefficients on other prices, PS_t) can be either positive or negative, but are expected to be predominantly positive, especially for close substitutes. The income effect (the coefficient on EXP_t) is probably positive and in the range for a normal good, corresponding to an income elasticity of demand for table grapes between 0 and 1. In other words, an increase in the price of grapes will cause a decrease in grape consumption, while an increase in price of a substitute or in total money income will cause an increase in consumption.

The theory of consumer demand also implies that the demand equation should be homogeneous of degree zero in money income and prices—doubling money income and all prices should leave consumption unaffected, since nothing real has changed. This homogeneity condition is commonly imposed by dividing all of the prices and income by a general price index, such as the CPI, thereby expressing all of the monetary variables in the demand equation in *real* terms (denoted RPG_t, RPS_t, and $REXP_t$). The resulting model is:

$$Q_t = f(RPG_t, RPS_t, REXP_t). \tag{3.2}$$

Both of these demand equations (equations (3.1) and (3.2)) implicitly assume constant tastes and preferences for table grapes. In order to accommodate changes in preferences arising from promotion or anything else that may affect demand, such as demographic characteristics of consumers, the model can be augmented with other *demand shift variables*.[3] Clearly, promotion by the Commission is one such variable. To obtain reliable estimates of the influence of the factors that are of most importance for the present study—in particular, the responsiveness of demand to prices and promotion—it is necessary to take into account the influence of other demand shift variables as well. Otherwise, there is a risk that the effects of omitted shifters will be attributed falsely to the variables included in the model.

In a model of consumer demand for California table grapes, appropriate shift variables can be included to represent the effects of such factors as (a) increased consumer health consciousness and a rising consumer interest in natural foods; (b) other demographic changes, such as changes in the age structure of the population, a higher rate of labor-force participation by women, changes in the ethnic composition of the population, and the fact that more meals are eaten away from home; (c) promotion by the California Table Grape Commission and others, and other changes in merchandising expenditures; (d) changes in the varietal mix and general quality of California table grapes; (e) year-round availability arising from the longer season of domestic varieties and increased imports; and (f) the increased availability of imported substitutes.[4]

To deal with all of these types of variables explicitly in an annual model would be impossible, given our limited data set and the difficulty of identifying individual

[3]Blaylock and Smallwood (1986) document some of the general trends in consumer demand for food that may be reflected in shift variables of these types.

[4]During the past thirty years, Chile has become an important producer of table grapes. Shipments to domestic markets during the winter months do not compete directly with grapes grown in California. Instead, it may be that year-round availability of grapes increases the demand for grapes in all seasons, whether because consumers become used to always eating grapes, or because retailers set aside space permanently for grapes, lowering the monthly cost of merchandising, or for other reasons. We do not model the demand for imports specifically, but treat the quantity of imports from Chile as an exogenous demand shifter.

effects when many variables change together smoothly, over time. Instead, we focused on those demand shift variables for which we believed the effects were likely to be important. Thus, we included four demand shift variables: (a) a variable to represent both increasing year-round availability and increased import competition (the per capita quantity of imports of Chilean table grapes), $CHILE\text{-}IMP_t$; (b) a variable to represent the changing varietal mix (the fraction of Thompson Seedless grapes in the total quantity of table grapes), $TS\text{-}SHARE_t$; (c) the quantity of generic promotion (represented by the total—not per capita—promotional expenditures of the Commission, expressed in real terms by dividing by the CPI) $RPROMO_t$; and (d) a linear time trend variable, $YEAR_t$, included to represent the effects of other trends, as described above, that we did not model explicitly.[5]

Incorporating the shift variables leads to an augmented demand model:

$$\begin{aligned} Q_t \qquad & f(RPG_t \;\; RPS_t \;\; REXP_t \;\; RPROMO_t \\ & CHILE\text{-}IMP_t \;\; TS\text{-}SHARE_t \;\; YEAR_t). \end{aligned} \tag{3.3}$$

The effects of demand shift variables are not as easy to predict as those of more conventional variables. Generic promotion by the Commission, $RPROMO_t$, was expected to have an unambiguously positive effect on demand, if the Commission has been successful in increasing demand for table grapes; otherwise, this variable would have no effect on demand. The other variables could have positive or negative effects, depending upon which influences they represent and which of these (positive or negative) influences are most important. For instance, the effect of U.S. imports of Chilean grapes could be negative (reflecting a competitive effect) or positive (representing benefits from year-round availability). The effect of an increase in the Thompson-Seedless share could be negative (if a declining share of Thompson Seedless results from a rising share of preferred varieties) or positive (if Thompson Seedless grapes are preferred or if their share is positively correlated with some other quality factor that is not included in the equation). Such issues can only be resolved empirically. The next section reports empirical work conducted to establish not only the directions, but also the magnitudes of the effects of the different variables in the demand model.

The data for the model in equation (3.3) are included in appendix B, compiled as tables B3.2 and B3.3. The variables and their units are defined in table 3.1. Details on the construction of these variables may be found in appendix B.

Estimation Results and Selection of the Preferred Model

In this section, we present a regression equation representing the demand for table grapes over the period since the establishment of the CTGC in 1968. We document the steps we followed in selecting the preferred model. In subsequent sections, we report the results from a series of diagnostic procedures we used to evaluate whether the regression equation is reliable. As part of the diagnostic exercise, we estimated a number of additional equations, which are also discussed below.

[5]The choice of whether to include promotion in per capita terms or in total should be dictated by whether it is believed that promotion is a type of "public" good—that is, whether it is "nonrival" or "nonexcludable"—rather than a "private" good. When promotion is transmitted in mass media, such as television advertisements, changing the number of consumers does not affect the impact per consumer from a given advertisement (that is, it is a "pure" public good). However, if the cost per advertisement depends on the size of the audience reached, then the quantity of promotion for a given expenditure will decline with the number of consumers being targeted. If the cost of a given advertisement does not increase with the number of consumers, we should not deflate by the number of consumers (the per capita impact does not depend on the population). If the cost increases directly with the number of consumers, we should express it as promotion per capita. Clearly neither approach will be exactly correct: there are some economies of scale, but some costs are likely to rise with the size of the target population. We opted for using total, rather than per capita, promotion because promotion by the CTGC has been more like a public good than a private good from the point of view of consumers.

Table 3.1: Definitions of Variables Used in the Aggregate Annual Demand Model

Variable	Definition	Units	Mean Value	Data Source
Q_t	U.S. and Canadian per capita consumption of California table grapes	Pounds per person per year	3.42	CTGC, *The Distribution and Per Capita Consumption of California Table Grapes by Major Varieties in the United States and Canada*. U.S. and Canadian population from International Monetary Fund *International Financial Statistics*.
RPG_t	Average Los Angeles Real Wholesale Price of Thompson Seedless grapes, deflated using All Goods CPI (1995=1).	Real (1995) dollars per pound	1.02	Federal-State Market News Service, *Los Angeles Fresh Fruit and Vegetable Wholesale Market Prices*, CDFA and USDA, Los Angeles.
RPS_t	Average of the Consumer Price Indices for apples, bananas, and oranges, indexed to one in 1980–82, and deflated using All Goods CPI (1995=1)	1995 dollars per unit	1.58	Bureau of Labor Statistics, online database (`http://www.bls.gov`)
$REXP_t$	Real per capita consumption expenditures on all goods, U.S. and Canada. Canadian consumption converted to dollars using annual average exchange rate.	Thousands of real (1995=1) U.S. dollars per person	14.8	IMF, *International Financial Statistics.*
$RPROMO_t$	CTGC Promotion Expenditures	Millions of real (1995=1) U.S. dollars.	4.47	CTGC financial statements
$CHILE\text{-}IMP_t$	U.S. total per capita imports of Chilean grapes	Pounds per person per year.	0.98	U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agricultural Trade of the United States* [FATUS].
$TS\text{-}SHARE_t$	Fraction of U.S. consumption of California table grapes that is of the Thompson Seedless variety	Fraction between 0 and 1	0.41	CTGC, *The Distribution and Per Capita Consumption of California Table Grapes by Major Varieties in the United States and Canada*.
$YEAR_t$	The number of years A.D.	Years	1980.5	1968–1992

To estimate an econometric demand model, it is necessary to choose a specific functional form for the demand equation. The choice of a functional form for a demand equation can influence the results of the econometric estimation (for example, see Alston and Chalfant 1991). Hence, it is important to examine the sensitivity of the results to this choice, along with other specification choices, such as which demand shifters to include and how to measure them. In what follows, we focus on the results from a demand equation that is linear in all the variables, except that we include the square root of promotion instead of the quantity of promotion; we call this the *square-root* model. We also refer to other models, such as the linear model, and a model that is linear in the natural logarithms of the same variables (a *double-log* model). As we show below, however, the square-root model cannot be rejected, based on the results from any of the other models we estimated. In other words, statistically, the square-root model is at least as good as any other model we tried. And, it is a preferred model from the standpoint of allowing diminishing marginal returns to promotion.[6] In fact, we replicated, for the linear model, all of the procedures described below for the square-root model—including the benefit-cost simulations—since we could not discriminate between these two models statistically, nor on any economic criterion except the diminishing returns feature of the square-root form. Statistical results were essentially identical between these two models.

The equation for the square-root model of demand is

$$\begin{aligned} Q_t \qquad & \beta_0 + \beta_{PG} RPG_t + \beta_{PS} RPS_t + \beta_{EXP} REXP_t + \beta_{PRO}\sqrt{RPROMO_t} \\ & + \beta_{IMP}\, CHILE\text{-}IMP_t + \beta_{TS}\, TS\text{-}SHARE_t + \beta_T\, YEAR_t + e_t . \qquad (3.4) \end{aligned}$$

In this model, the β coefficients are interpreted as partial derivatives. These are multipliers that, holding the other independent variables constant, translate changes in the prices and other right-hand-side variables into changes in quantities consumed. e_t represents residual changes in per capita quantities consumed that are not accounted for by changes in the right-hand-side variables. e_t is sometimes referred to as the "error" term, since it can be thought of as the error in predicting Q_t using only the right-hand-side variables. Under standard assumptions, these errors are normally distributed random variables with an expected value of zero and a constant variance.

Our estimation strategy was first to estimate the model in equation (3.4), and then to examine the estimated coefficients to see whether or not they satisfied our expectations, based on the theory we laid out above. At the same time, we examined the fitted residuals, to see whether their behavior was consistent with conventional econometric assumptions. In addition, we applied diagnostic tests to see whether the validity of the model and its parameters could be rejected by the results from alternative models based on alternative functional forms or different assumptions about whether prices and promotion are statistically exogenous.[7] Only if a model passes all these tests—that is, it is consistent with economic theory and

[6] A consequence of including the square root of promotion, rather than the quantity of promotion, is that this transformation imposes diminishing marginal returns on the demand response for promotion; the linear model is characterized by constant marginal returns. The marginal return to promotion refers to the incremental benefit from increasing promotional effort by a small amount, say one dollar. Diminishing marginal returns means that each incremental dollar brings forth a smaller benefit than the last. It is preferable to have a structure that imposes (or at least permits) diminishing returns.

[7] If either promotion or price is *endogenous*, in the sense that their values are affected by changes in quantities consumed, as well as causing changes in quantity consumed, the econometric model may suffer from *simultaneous-equations bias*. Such bias, if it exists, results from correlation of an explanatory variable with the error term, and may lead to a misstatement of the demand response to changes in price or promotion. The direction of such bias is hard to predict, in the absence of a specific alternative model in which these variables are simultaneously determined.

with our expectations about the signs and magnitudes of the coefficients, has well-behaved residuals, and is not rejected in favor of an alternative specification—can we confidently take the next step and use the estimated model to simulate alternative market scenarios.[8]

Model Selection

Regression results are presented in table 3.2. Column (1) shows the results for the first model, corresponding directly to equation (3.4) above. In this table, the figures in brackets are t-statistics for the coefficients (a value of less than -2.1 or greater than 2.1 indicates that the coefficient is statistically significantly different from zero, using the conventional 95 percent level of significance), and the figures in parentheses are elasticities of demand with respect to the corresponding variables, computed at the means of the sample data. This equation fits the data well, accounting for over 90 percent of the variation in consumption (as indicated by the computed R^2).

Most of our parameter estimates in column (1) have signs consistent with theory. One exception is total expenditure, which has a negative coefficient, but one that is not statistically significantly different from zero. A disappointing aspect of this model is that the coefficients measuring the effects of both grape and competing fruit prices, while of the expected signs and implying plausible magnitudes for elasticities, are not statistically significantly different from zero. Promotion has a positive and statistically significant effect, as do the quantity of Chilean imports and the share of Thompson Seedless. The coefficient on the time trend was not statistically significant (and, in fact, was never significant in any variant of this model we tried).

Column (2) of table 3.2 shows the results from estimating the same model without including the prices of substitutes or the time trend. We chose to drop the prices of substitutes and retain the expenditure variable in the model (even though the latter was slightly less statistically significant and had the "wrong" sign) for three reasons. First, the expenditure variable belongs in the model according to theory; the price of any particular substitute good need not be included. Indeed, it could be argued that, since we have effectively included the price of all other goods by using the CPI as a deflator, we should not include any specific substitutes as well (or if we do, we should modify the CPI, correspondingly, to reflect the separate inclusion of some prices). Second, it was not clear that the particular price of substitutes series we used was an appropriate representation of the price of close substitutes for table grapes. Further, the cross-price elasticity simply may not have been very large, so that, even if we had an unbiased estimate, it would be difficult to distinguish the true effect from zero, given our small sample size and the relatively larger effects of our other variables. In any event, the model in column (2) is only slightly different from the one in column (1), in terms of its overall fit and the values of the coefficients on the included explanatory variables.

An initial round of diagnostic tests indicated some potential problems with the model in column (2), suggesting a structural change in the relationship in 1974 or earlier. To test for structural changes outside the range where a full "Chow" test could be performed (allowing all of the parameters of the model to shift), we estimated equations including a dichotomous "dummy" variable for 1968, $D68_t$ (set equal to one in 1968 and zero otherwise), then dummies for both 1968 and

[8]A linear model of demand cannot be fully consistent with economic theory, since it is not integrable (meaning that the demand relationships it implies could not have been derived from maximization of a well-behaved utility function subject to a budget constraint) except at one point. This is true regardless of choices about how demand shifters, such as promotion, enter the model. But the complete set of theoretical conditions that apply to individual consumers need not apply to per capita demand, anyway. It is reasonable, nevertheless, to require a model to meet the most basic requirement of satisfying homogeneity of degree zero in money income and prices, and to require it to satisfy the law of demand—a negative own-price effect.

Table 3.2: U.S. and Canadian Per-Capita Demand for Table Grapes: Linear Models, with Square Root of Promotion

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPG_t	-0.516	-0.455	-0.801	-0.968	-0.968	-1.281	-0.364
	[-1.31]	[-1.22]	[-2.75]	[-3.37]	[-4.03]	[-5.41]	[-0.25]
	(-0.15)	(-0.14)	(-0.24)	(-0.29)	(-0.29)	(-0.51)	(-0.11)
RPS_t	0.591	-	-	-	-	-	-
	[1.02]	-	-	-	-	-	-
	(0.27)	-	-	-	-	-	-
$REXP_t$	-0.167	-0.188	-0.082	0.014	0.014	0.100	-0.039
	[-1.16]	[-1.63]	[-0.91]	[0.14]	[0.17]	[1.61]	[-0.16]
	(-0.72)	(-0.81)	(-0.36)	(0.06)	(0.06)	(0.51)	(-0.17)
$\sqrt{RPROMO_t}$	0.649	0.564	0.767	0.567	0.567	0.519	0.481
	[2.15]	[2.62]	[4.55]	[2.98]	[4.65]	[5.45]	[1.26]
	(0.20)	(0.18)	(0.24)	(0.18)	(0.18)	(0.16)	(0.15)
$CHILE\text{-}IMP_t$	0.838	0.887	0.587	0.297	0.297	0.040	0.544
	[3.59]	[4.30]	[3.44]	[1.34]	[1.95]	[0.23]	[0.77]
$TS\text{-}SHARE_t$	4.363	4.142	2.955	2.344	2.344	1.541	2.895
	[2.39]	[2.34]	[2.18]	[1.78]	[2.75]	[2.29]	[1.64]
$YEAR_t$	-0.015	-	-	-	-	-	-
	[-0.35]	-	-	-	-	-	-
$D68_t$	-	-	1.117	-	-	-	-
	-	-	[4.10]	-	-	-	-
$D81\text{-}93_t$	-	-	-	0.423	0.423	0.599	0.349
	-	-	-	[1.89]	[2.72]	[3.08]	[0.75]
CONSTANT	31.199	2.939	2.055	1.533	1.533	1.158	1.446
	[0.37]	[1.75]	[1.61]	[1.25]	[1.80]	[1.73]	[0.83]
R^2	0.92	0.92	0.96	0.96	0.96	0.97	0.95
$\overline{R}^2$	0.89	0.90	0.94	0.95	0.95	0.96	0.94
D.W.	1.64	1.66	2.24	2.62	2.62	2.59	2.36
Sample	1968–93	1968–93	1968–93	1969–93	1969–93	1969–93	1969–93

Notes: t statistics in brackets, elasticities (at means) in parentheses. (1) OLS. (2) OLS. (3) OLS. (4) OLS. (5) OLS, with heteroskedasticity-consistent covariance matrix. (6) Weighted OLS, weights calculated as inverses of s^2 from regressions on subsamples (1969–80) and (1981–93), reported in columns (1) and (2) of appendix table A3.2. (7) Instrumental variable estimate, RPG_t and $RPROMO_t$ endogenous.

1969, and so on, until dummies were included for all years 1968 through 1974. A test for a significant coefficient on an individual dummy variable is a test of whether the consumption for that year fits with the general model or represents an outlier. The incremental approach allows a test for whether a structural change in demand took place between 1968 and 1974. In this procedure, the coefficient on $D68_t$ was always statistically significant, until $D72_t$ was also included (that is, when dummies were included for every year from 1968 through 1972), while none of the other dummy variables ever had significant coefficients. The "structural change" appears, therefore, to come after the first year in the estimation period. Consequently, 1968, the first year of operation of the Commission, may be regarded as an outlier, and the model including the dummy variable, $D68_t$, is preferred to one without it.[9] This is essentially the same as dropping the observation for 1968.

These results mean that the model appears stable only from 1969 forward; there was a significant structural change in demand between 1968 and the following years. The regression for 1968–1993, including a dummy for 1968, is reported in column (3) of table 3.2. This equation fits the data very well, accounting for about 94 percent of the variation in per capita consumption. The own-price coefficient is negative, statistically significant, and of plausible magnitude (the own-price elasticity at the mean of the sample was -0.24, indicating that a one percent increase in price would induce a 0.24 percent decrease in consumption), while the estimated coefficient on total expenditure remains negative and statistically insignificant. The coefficient on promotion remains positive and statistically significant, as do those on Chilean imports and the Thompson Seedless share.[10]

An examination of the residuals from the model in column (3) and some further diagnostic testing indicated that heteroskedasticity may have been a problem (that is, the assumption of a constant variance of the residuals may have been inappropriate). However, evidence of heteroskedasticity may reflect some other specification error. For the diagnostic testing, we estimated models excluding the 1968 data; since our tests involved splitting the sample, $D68_t$ could not be included as this variable was always zero in the later subsample. Using the *DIAGNOSTIC* procedure in SHAZAM, the Goldfeldt-Quandt test indicated statistically significant evidence of a change in the error variance.[11] Options to deal with this problem include the application of generalized least squares to correct the estimates from the model, or changes in the specification of the model. We tried both.

Based on the Goldfeldt-Quandt test results, we split the sample and estimated separate sets of parameters, first with data for 1969–1980, and then with data for 1981–1993. The parameter estimates, while different between the earlier and later subsamples, were generally not statistically significantly different between the two periods or between the models for either sub-period and that for the full sample. Subsequent tests led us to allow for a different intercept parameter between the

[9] An analogous test was performed on the last seven observations; none of these dummy variables contributed significantly to the regression. The detailed results for all these dummy variable models are reported in appendix table A3.1.

[10] Using the *DIAGNOSTIC* procedure in SHAZAM, we computed the "Chow" test statistic for a discrete structural change in *all* of the model's parameters at every feasible data point. Since the test requires estimating the model for the samples of data before and after the break point, at least seven observations are needed in each subset of our data set to estimate the parameters that remain after $YEAR_t$ and RPS_t are excluded from the model. The test statistic was not significant for any particular break point; its highest value was at observation seven, which is the earliest point at which it can be used. Alston and Chalfant (1991) showed that this test is biased toward finding structural change when none is present, when a search over break points is conducted, so these results support a view that structural change is not important.

[11] P values for the Goldfeldt-Quandt test statistic were below 0.05 for break points between 1978 and 1982, indicating a statistically significant change in the error variance somewhere within that interval. Again, the caveats concerning the effects of searching for break points apply, as noted above.

two periods.[12] Within the subsamples, the residuals were homoskedastic. These results led us to include a dichotomous intercept dummy variable $D81\text{-}93_t$, equal to 0 before 1981 and 1 from 1981 on, and to re-estimate the model for the entire sample.

Since evidence of heteroskedasticity remained, we obtained generalized least squares estimates, corrected for different error variances for the two periods. Column (4) in table 3.2 reports the model with the intercept dummy added, estimated by ordinary least squares (OLS) without the heteroskedasticity correction. Column (5) in table 3.2 reports the same OLS estimates, but with revised standard errors, computed according to White's (1980) procedure. Allowing for different error variances increased the precision of the estimates (reflected in larger calculated t statistics). Column (6) in table 3.2 contains estimates computed by weighted least squares, allowing for a different error variance after 1980. The weighted least squares parameter estimates were all slightly different from the OLS estimates, but, with two exceptions, there were no important qualitative changes. The exceptions are that the coefficient on Chilean imports, which was positive and statistically significant in the models in columns (1), (2), and (3) of table 3.2, became statistically insignificant, and the coefficient on expenditure changed sign but remained statistically insignificant, once we added $D81\text{-}93_t$.

The model in column (6) serves as the starting point for the simulations and cost-benefit analysis we report later in this section. The demand equation may be written as

$$\begin{aligned} Q_t \quad & 1.158 + 0.599 D81\text{-}93_t - 1.281 RPG_t + 0.100 REXP_t + 0.519\sqrt{RPROMO_t} \\ & +0.040 CHILE\text{-}IMP_t + 1.541\, TS\text{-}SHARE_t + e_t. \end{aligned} \tag{3.5}$$

The price coefficient is negative, statistically significant, and of plausible magnitude, with an elasticity at the mean of -0.51: a one percent increase in price would lead to a 0.51 percent decrease in per capita quantity consumed. The estimated coefficient on total per capita expenditure is positive, but not statistically significant. The corresponding elasticity of demand with respect to income is 0.51, which is plausible, indicating that a one percent increase in income would lead to a 0.51 percent increase in consumption of table grapes.

The coefficient on promotion remains large and statistically significant in the model in column (6) (notably, this effect was relatively insensitive to the various changes in specification described above). The elasticity of demand with respect to promotion ranged from 0.16 to 0.24; in the preferred model, it is 0.16. The estimated effects of Chilean imports and the Thompson Seedless share are positive, but not statistically significant. Overall, this model is plausible and fits the data well. Still, there may be some specification problems, so we now turn to the application of further diagnostic tests.

Diagnostic Tests of the Preferred Model

Diagnostic tests can be used to evaluate the properties of the residuals in an estimated equation. Evidence that the residuals do not satisfy certain theoretical properties may be interpreted as an indication of model misspecification, such as omitting relevant explanatory variables or using the wrong functional form. We used the *DIAGNOSTIC* procedure in SHAZAM to perform a battery of tests for

[12] The regressions for the sub-samples are reported in appendix table A3.2. The tests indicated some structural change, but multicollinearity among the explanatory variables made it difficult to isolate which effect should be included. Slope shifters on several explanatory variables were individually significant, but not when another slope shift was also allowed. An intercept dummy is a natural first choice for representing some unspecified structural change, and when the intercept dummy was included, none of the slope dummies were statistically significant.

heteroskedasticity and omitted variables, and the *RESET* test (Ramsey 1969; Maddala 1992) for misspecification.

Missing Variables. The model already passed the Chow test for structural change.[13] In addition, we tried three variants of Ramsey's specification error test (*RESET*), in which predictions from the model ($\hat{Q}_t$) were used as regressors. Each model was re-estimated with $\hat{Q}_t^2$ added, with both $\hat{Q}_t^2$ and $\hat{Q}_t^3$, and finally, with $\hat{Q}_t^2$, $\hat{Q}_t^3$, and $\hat{Q}_t^4$; in each case, the statistical significance of the added regressors was tested. Passing the *RESET* test corresponds to an insignificant test statistic for all three specification tests, and no evidence of misspecification. Failing the *RESET* test suggests that the model should be rejected, but does not imply a particular alternative. None of these test statistics was statistically significant, confirming the results from the Chow test.

Heteroskedasticity. Several standard tests for heteroskedasticity were performed on the model in column (4) in table 3.2. In all but one of these tests, we strongly rejected the hypothesis that the residuals have a constant variance. Heteroskedasticity is a concern in that coefficient estimates, while still unbiased, have estimated standard errors that are biased. The direction of bias is unknown without more information about the particular form of heteroskedasticity afflicting the equation. A biased standard error means that t ratios are biased (either toward or away from rejecting the hypothesis being tested, depending on the direction of bias), thus invalidating our hypothesis tests.

The most appropriate test for heteroskedasticity depends on the form of the heteroskedasticity that is present, about which one cannot be very confident. Thus, along with attempting a correction for heteroskedasticity using weighted least-squares, we report, in column (5), OLS estimates with an alternative set of standard errors, obtained using White's (1980) heteroskedasticity-consistent covariance matrix. For large enough samples, these estimates allow confidence in our hypothesis tests, as the standard errors of coefficients estimated in this manner provide consistent estimates of the true standard errors, so that, at least asymptotically, tests of hypotheses using the estimates in column (5) are not biased by ignoring heteroskedasticity, as might be the case when using the estimates in column (4). We obtained the estimates in column (6) by assuming a particular form of heteroskedasticity, with different error variances in the first and second halves of the data set, and estimating the parameters using weighted least squares. The different approaches we used to correct for heteroskedasticity did not change our estimates very much, relative to the OLS estimates, nor did our estimates differ much from one approach to another. The model in column (6) is preferred.

Autocorrelation. The Durbin-Watson statistic for the preferred model is 2.59. This value means that we fail to reject the hypothesis of no positive autocorrelation of the residuals, but it falls in the inconclusive region for a test for negatively autocorrelated residuals. To evaluate the latter possibility, we applied the Cochrane-Orcutt procedure to the preferred model. Two points emerge. First, the estimated autoregression parameter is $\hat{\rho}$ -0.41, which is marginally significantly different from zero at the 95 percent confidence level, using the approximate t value that is implied. Second, in any event, estimating the model with an autocorrelation correction did not affect any of the other model parameters appreciably. As a result, we concluded that it was unnecessary to correct for autocorrelation.

[13] While the Chow test may have tended to fail to detect structural change, even when it is present, because it was conducted without correcting for the apparent heteroskedasticity, it must be remembered that the sequential Chow test is highly likely to find evidence of structural change when there is none, if we take the nominal size of the tests literally (Alston and Chalfant 1991).

Functional Form. Another possible source of problems concerns how the individual variables enter the model. To evaluate this aspect of specification, we tried various Box-Cox type transformations of the variables in the model, nesting (as special cases) both the linear model and the double-log model. The Box-Cox transformation of a variable X_t is defined as

$$X_t(\lambda) = \frac{X_t^{\lambda} - 1}{\lambda}$$

where λ is the "Box-Cox" parameter. Ordinarily, estimating a Box-Cox model is a routine procedure. The fact that our model contains a dichotomous variable with values equal to zero at some point(s) makes for a more difficult application of this procedure. Since the Box-Cox transformation involves logarithms, and the logarithm of zero is undefined, one cannot simply fit a Box-Cox model to these data. In response to this problem, the Box-Cox procedure in SHAZAM does not transform those variables with values of zero.

Table 3.3 contains the results of models in which we used different combinations of various transformations of the dependent variable and explanatory variables, using the same set of explanatory variables as in our "preferred" square-root model. Columns (1)–(4) of table 3.3 involve Box-Cox transformations of a linear model. Column (1) refers to OLS estimates of the linear model (that is, including $RPROMO_t$ rather than $\sqrt{RPROMO_t}$), but otherwise corresponding to the square-root model in column (4) of table 3.2. This linear model is our starting point for comparing alternative functional forms.[14] Column (2) of table 3.3 refers to the same model as in column (1) in that table, but the dependent variable, consumption, and all of the right-hand side variables except *D81-93*$_t$ (which includes zero values) were transformed using the Box-Cox transformation. The estimated Box-Cox parameter was 0.73, which was not statistically significantly different from one but was statistically significantly different from zero.[15] Since the double-log model is equivalent to a Box-Cox model with $\lambda = 0$, the double-log model is rejected, while the linear model ($\lambda = 1$) is not rejected. Column (3) reports a Box-Cox model using the same data, but with only the right-hand side variables transformed. The estimated Box-Cox parameter was 1.32, significantly different from 0, but not from 1. Thus, a specification where the right-hand variables were logarithmic but the dependent variable is linear is rejected, while the pure linear model is not rejected. Column (4) reports the same model as in columns (1) and (2), but with only the dependent variable, consumption, transformed. The estimated Box-Cox parameter was 0.16, which was not statistically significantly different from either 0 or 1. Hence, we cannot reject the linear model, but do reject the double-log model.

An alternative functional form choice focuses on the promotional effect. Our preferred model is the square-root model, which imposes diminishing marginal returns to promotion. It must be remembered that the main purpose of this analysis was to measure the average effect, or the marginal effect at a point close to the actual promotion, and not to find an optimum. An alternative model may provide a better approximation, and it may be hazardous to impose a restriction that is inconsistent with what the data alone would imply, just to impose diminishing returns. Hence, we compare two other models to the preferred square-root model (from column (4) of table 3.2, and repeated in column (5) of table 3.3). One is the linear model, represented in column (1) of table 3.3, which imposes constant marginal returns to promotion. The other is a quadratic model, which includes

[14] While this is different from our preferred square-root model in the treatment of the promotion variable, it is more conventional in that all the variables enter in the same manner, and is therefore more useful for an analysis of functional form.

[15] In each of these tests, the likelihood ratio test statistic is distributed as χ^2_1. The critical value at the 5 percent significance level is 3.84.

Table 3.3: Aggregate U.S. and Canadian Per Capita Demand for Table Grapes, Nonlinear Models

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RPG_t	-0.925	-0.691	-0.894	-0.338	-0.968	-0.964	-0.345	-0.268
	[-3.19]	[-3.20]	[-3.33]	[-3.39]	[-3.37]	[-3.08]	[-4.21]	[-3.13]
	(-0.27)	(-0.28)	(-0.27)	(-0.28)	(-0.29)	(-0.29)	(-0.34)	(-0.27)
$REXP_t$	0.021	0.020	0.017	0.009	0.014	0.013	0.359	-0.105
	[0.22]	[0.13]	[0.46]	[0.26]	[0.14]	[0.13]	[0.89]	[-0.26]
	(0.09)	(0.06)	(0.18)	(0.11)	(0.06)	(0.06)	(0.36)	(-0.10)
$RPROMO_t$	0.169	0.168	0.114	0.075	-	0.225	0.146	0.176
	[2.93]	[3.14]	[2.84]	[3.78]	-	[1.46]	[2.71]	[3.92]
	(0.23)	(0.21)	(0.25)	(0.28)	-	(0.30)	(0.15)	(0.18)
$\sqrt{RPROMO_t}$	-	-	-	-	0.567	-	-	-
	-	-	-	-	[2.98]	-	-	-
	-	-	-	-	(0.18)	-	-	-
$RPROMO_t^2$	-	-	-	-	-	-0.008	-	-
	-	-	-	-	-	[-0.39]	-	-
	-	-	-	-	-	(-0.06)	-	-
$CHILE\text{-}IMP_t$	0.258	0.202	0.184	0.062	0.297	0.289	0.017	0.102
	[1.18]	[1.10]	[1.07]	[0.83]	[1.34]	[1.21]	[0.26]	[1.72]
$TS\text{-}SHARE_t$	2.054	1.050	2.834	0.630	2.344	2.225	0.200	0.751
	[1.52]	[1.42]	[1.54]	[1.35]	[1.78]	[1.53]	[1.10]	[1.95]
$D81\text{-}93_t$	0.383	0.268	0.414	0.139	0.423	0.408	0.178	0.122
	[1.64]	[1.49]	[1.89]	[1.72]	[1.89]	[1.64]	[2.21]	[1.95]
CONSTANT	1.956	1.922	3.623	0.796	1.533	1.956	0.118	0.754
	[1.49]	[1.45]	[2.84]	[1.77]	[1.25]	[1.46]	[0.11]	[0.74]
R^2	0.96	0.96	0.96	0.97	0.96	0.96	0.96	0.96
$\overline{R}^2$	0.95	0.95	0.95	0.96	0.95	0.95	0.94	0.95
λ	1.00	0.73	0.16	1.32	1.00	1.00	0.00	0.00
LLF	7.91	8.21	9.54	8.14	8.06	8.02	6.25	8.28
D.W.	2.57	2.60	2.49	2.44	2.62	2.60	2.76	2.71
Sample	1969–93	1969–93	1969–93	1969–93	1969–93	1969–93	1969–93	1969–93

Notes: t statistics in brackets, elasticities (at means) in parentheses. (1) OLS. (2) Box-Cox regression, both sides transformed. (3) Box-Cox regression, only the independent variables transformed. (4) Box-Cox regression, only the dependent variable transformed. (5) OLS. (6) OLS. (7) double-log OLS. (8) double-log OLS, $CHILE\text{-}IMP_t$ and $TS\text{-}SHARE_t$ untransformed. λ is the Box-Cox parameter, with $\lambda = 1$ for the linear equations ((1), (4), and (5), $\lambda = 0$ for the double-log equations ((7) and (8)), and estimated for the flexible forms ((2), (3), and (4)).

$RPROMO_t$ and $RPROMO_t^2$, shown in column (6) of the same table. The quadratic model is consistent with diminishing returns (since the coefficient on the squared promotion variable is negative), but we cannot reject the linear model as a special case (the coefficient on squared promotion is not statistically significantly different from zero).

Finally, in the last two columns of table 3.3, we report estimates from two variants of a double-log model. This model implies diminishing marginal returns if the coefficient on the promotion variable is less than one. The first double-log model, in column (7), has all variables expressed in logarithms; the second, in column (8), leaves the quantity of Chilean imports and the Thompson Seedless share untransformed. Recall that the tests of the Box-Cox parameters led us to reject the double-log model.

Looking across all the models in table 3.3 leads to some general conclusions. First, none of the alternative models is statistically superior to the linear model, according to the formal tests (noting that the R^2 statistics are not comparable across models with different dependent variables). Second, none of the models suggests anything that is different, in any important way, about the economic relationships. Indeed, the results are remarkably similar across the models, especially in relation to the parameters (or effects) of greatest interest: the own-price and promotion effects. In table 3.3, the own-price elasticity at the sample mean ranges from -0.27 to -0.34 (-0.29 in the square-root model). The elasticity of demand with respect to promotion at the mean ranges from 0.15 to 0.30. The signs and magnitudes of the other estimated effects were also generally consistent across the alternative functional forms. More important changes in elasticities resulted from using weighted least squares, rather than OLS, for a given functional form (see columns (5) and (6) of table 3.2).

None of the above tests led to rejection of the linear model. As noted above, however, the square-root model has some desirable features. We conducted two further tests, comparing the linear and square-root functional forms. First, we applied a non-nested test. We used Davidson and McKinnon's J test, as described in Greene (1993, p. 223), and we report the results from estimates obtained using OLS. The test of the null hypothesis that the linear model is correct, against the alternative that the square-root model is correct, yielded a test statistic that was not significantly different from zero (the t statistic was 0.53): we thus failed to reject the linear model. Then the roles of the models were reversed. The test of the null hypothesis that the square-root model is correct, against the alternative of the linear model, also yielded an insignificant test statistic (the t statistic was 0.07): we thus failed to reject the square-root model. In short, we failed to reject the linear model against the alternative of a square-root model, and we also failed to reject the square-root model against a linear alternative. Notice, however, that in both cases the point estimates were much more compatible with the square-root model being correct than with the linear model being correct ($\alpha = 0.89$, where $\alpha = 1$ is the square-root model; $\alpha = 0.11$, where $\alpha = 1$ is the linear model).

One potential problem with the non-nested test is that its power is not known in applications such as ours. Another test for functional form is based on a more general model that nests the linear and square-root models as special cases. In this test, nonlinear regression is used to estimate a model that is linear, except that the promotion variable is raised to the power γ. When $\gamma = 1$, the linear model is correct; when $\gamma = 0.5$, the square-root model is correct. Each of these hypotheses can be tested using routine tests applied to the estimate of γ. Our point estimate was $\gamma = 0.54$, with a standard error of 0.89. Hence, we could not reject the hypothesis that $\gamma = 1$, which implies that the linear model is correct; nor could we reject the hypothesis that $\gamma = 0.5$, which implies that the square-root model is correct. However, once again, the point estimate is much more compatible with the square-root model being correct than with the linear model being correct.

To summarize, we could not reject either the linear or the square-root model, when we tested them against each other in a non-nested test, or against a more general alternative, when using a nested test. However, our point estimates were more consistent with the square-root model being correct than with the linear model being correct. The general implications were very similar; the two models may be regarded as equally good by most criteria. However, the linear model imposes constant returns to scale in promotion, whereas the square-root model imposes diminishing returns and, therefore, we have a slight preference for the square-root model for the benefit-cost evaluation.

Simultaneity and Endogeneity. Another potential specification issue concerns our use of a quantity-dependent model of demand, with price and promotion expenditures treated as exogenous explanatory variables (that is, causing changes in consumption, but not affected by changes in consumption). Later, in our simulation model for calculating the benefits from promotion, we treat prices as responding to quantities (and promotion) as, indeed, they must if promotion is to be profitable for growers.[16] In those simulations, price and quantity of table grapes are treated as jointly endogenous (that is, determined simultaneously). In the econometric model above, however, we treat them differently. Is this inconsistent? The econometric issue is whether prices (and promotion) are *statistically* exogenous to demand; this is a different issue than whether they are *structurally* exogenous.

Prices are statistically exogenous, as we use the term, if we do not appear to bias the estimated coefficients by making the assumption, for estimation, that price is predetermined. In order to evaluate this question, we applied a Hausman test for exogeneity (for example, Greene 1993). Using the results of these tests, we failed to reject the hypothesis that both prices and promotion may be treated as exogenous in our econometric estimation. However, the power of the Hausman test in our application is not known.

Suppose one were to take a conservative view, and prefer the instrumental variable model that treats price, promotion, and consumption, as jointly endogenous. The principal results from estimating this model are listed in column (7) of table 3.2. As it happens, this model yields a substantially lower estimated own-price elasticity of demand (-0.11 vs. -0.29), and slightly lower estimated promotion elasticity (0.15 vs. 0.18), compared with the model in column (5), which reports OLS estimates, and t statistics computed using White's heteroskedasticity-consistent variance-covariance matrix. However, the instrumental-variable estimators have significantly greater variance, as indicated by the lack of significance of all of the parameter estimates. To evaluate whether the instrumental-variable estimators are in fact preferable, one can use a Hausman test. If prices and promotion are in fact statistically endogenous, then the OLS estimates in (5) should be inconsistent, so there should be substantial changes when moving from the OLS to the consistent, instrumental variables estimates of column (7). If, on the other hand, prices and promotion are statistically exogenous, the instrumental-variable estimates in (7) should be unbiased but inefficient, and the variance-covariance matrices of the two estimators could differ substantially. The Hausman statistic evaluates the changes in the regression coefficients, taking into account the changes in the estimated variance-covariance matrices. The Hausman statistic comparing the instrumental-variable estimator in column (7) to the OLS estimator in column (5), which under the null hypothesis of exogenous prices and promotion is distributed as χ^2_6, is calculated as $H = 0.29$, which is not statistically significant.

Lacking evidence of important simultaneity, a preference for the simpler form

[16] As shown by Alston, Carman, and Chalfant (1994), in a competitive industry, promotion must cause price to rise if it is to be profitable for growers.

leads to a preference for the model that treats prices and promotion as exogenous variables.

Within-Sample Goodness of Fit

Our model fits the data generally well, and explains a high proportion (around 97 percent) of the variation in table grape consumption, as indicated by the R^2 value of 0.97. This can be seen in figure 3.1, which shows the actual and fitted values of per capita consumption over time. Figure 3.1 also includes a plot showing the fraction of the fitted value accounted for by all of the variables other than promotion, according to the model. In other words, it compares the fitted values with the same predictions net of the estimated effects of promotion (calculated by subtracting $0.519\sqrt{RPROMO_t}$ from the fitted value in each year).

3.3 Evaluation of the Benefits from Domestic Promotion, 1969–1993

In this section, we use the estimated demand parameters from the previous section in a market-simulation model, in order to estimate both gross and net benefits to the industry from changes in promotion. Measuring these benefits requires (a) a conceptual structural model of the industry market equilibrium, (b) estimates of supply and demand parameters that can be used to parameterize the structural model, (c) estimates of the demand response to promotion expenditures, and (d) information to allow a transformation of the effects of promotion (through retail demand shifts) and assessments or check-offs (through commodity supply shifts) into measures of benefits and costs. Our estimates of benefit-cost ratios are based on the point estimates of parameters, which are best thought of as random variables. Hence, it is appropriate to think of the corresponding estimates of benefit-cost ratios as random variables that can be characterized by probability distributions. As well as computing point estimates of the benefit-cost ratios, we compute the implied distributions. Then, as well as reporting the point estimate of a benefit-cost ratio, we report the corresponding 99 percent confidence interval: a lower bound and an upper bound, between which we expect, with 99 percent confidence, the true benefit-cost ratio would be found.

Conceptual Model of Supply and Demand

The econometric work discussed in the previous section allows us to estimate the increase in the quantities of grapes sold that would result from a given increase in promotional expenditures, holding prices (and other variables) constant. This does not, however, tell us how much sales will actually increase when promotion changes, since prices cannot be assumed to remain constant. Indeed, the increase in prices following a promotion-induced shift in demand is an important source of the benefits realized by growers and packers of table grapes. In order to properly evaluate the industry's demand-shifting activities, therefore, we must account for both demand changes and the response of supply to increased price.

Demand Shifts from Promotion. The diagram in figure 3.2 illustrates the conceptual supply and demand relationships for a typical year t. In the figure, the line labelled S_t represents the supply curve for table grapes. It traces the quantities available to domestic consumers at various prices; at higher prices, more fresh grapes are available domestically, while at lower prices, larger quantities of grapes are diverted to other uses, such as juice, wine, and raisins, or to the export market, or they are left unharvested. The line labelled $D_t(RPROMO_t)$ represents the demand curve. At higher prices, consumers purchase a smaller quantity of grapes than

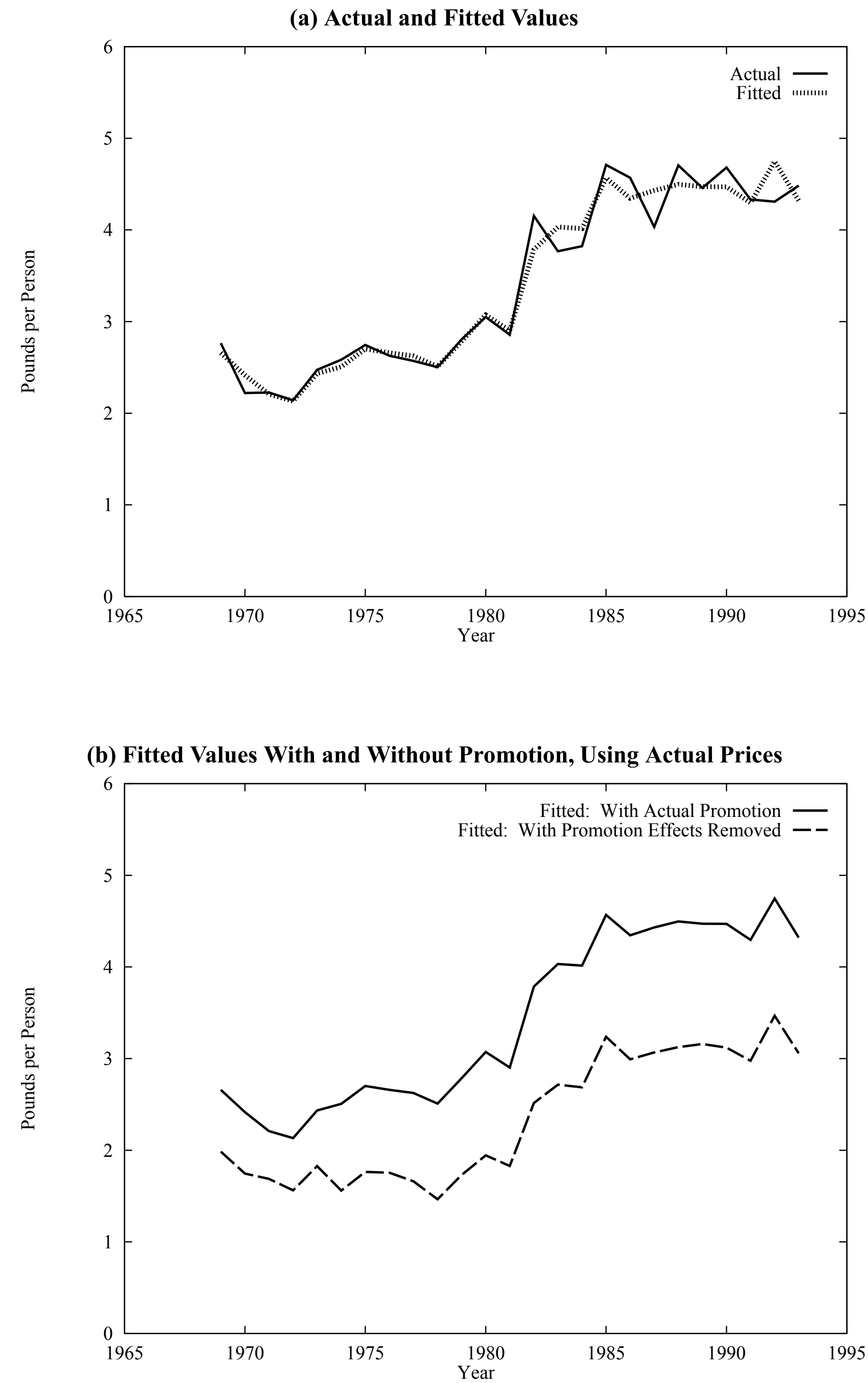

Figure 3.1: Per Capita U.S. and Canadian Consumption of California Table Grapes, 1969–1993

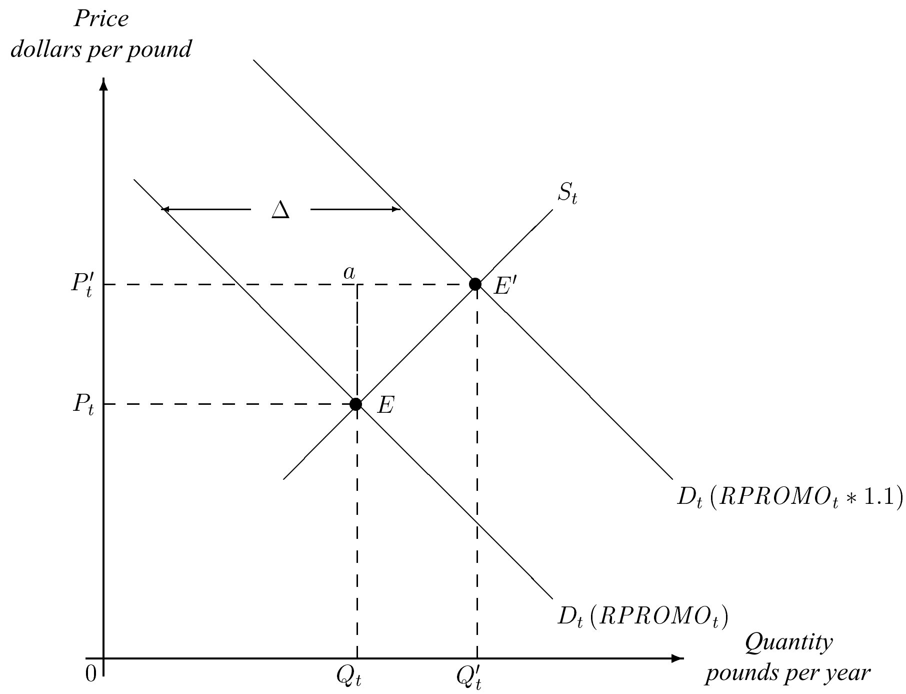

Figure 3.2: Conceptual Supply and Demand Model

at lower prices, holding other factors constant. In particular, the Commission's promotional expenditure is held constant at its actual value, $RPROMO_t$, along this demand curve.[17] The equilibrium price, at which quantities supplied and demanded are the same, is the price observed at point E: price P_t is consistent with the observed quantity Q_t, and the market clears with neither excess supply nor excess demand.

The effects of a 10 percent increase in $RPROMO_t$ are illustrated by the outward shift in the demand curve. The new curve is labelled $D_t(RPROMO_t{*}1.1)$. The econometric model allows us to estimate the horizontal distance of the demand shift, identified by Δ in the diagram. In our preferred model (column 6 of table 3.2), the coefficient on $\sqrt{RPROMO_t}$ is 0.519. Suppose the actual promotion expenditure is \$5 million (in 1995 dollars). This means that a \$0.5 million (that is, ten percent) increase in CTGC promotional expenditures would be expected to lead to an increase in per capita table grape consumption of $0.519(\sqrt{5.5} - \sqrt{5.0}) \quad 0.057$ pounds, if there were no change in price.

Multiplying by the population ($POP_t = 286.5$ million in 1993) yields 16.33 million pounds, the total horizontal demand shift from a 10 percent increase in promotional expenditures, about a 1 percent increase in consumption, at constant prices. However, this is greater than the actual increase in consumption that would result. After the demand shift, there is excess demand for table grapes at the initial market-clearing price, and an increase in price is needed to bring forth the additional quantities to satisfy the increased demand. This is reflected in the fact that the supply curve slopes up. The new equilibrium is given by the point where the new demand curve crosses the supply curve, E'. Price and quantity both increase to the new equilibrium values P_t' and Q_t'.

[17] The econometric work discussed in the previous section provides estimates of the shape and position of this line.

The evaluation of benefits from promotion requires both an estimate of these increments in prices and quantities due to the expenditures, and a measure of the costs of supplying the additional quantities to the market. With an upward-sloping supply curve, increased prices call forth additional supplies; these supplies come at a cost, which, in the case of a perennial crop, may largely be the earnings foregone from other uses of existing production (for example, for wine or juice), rather than new production. The sellers who were already in the market at price P_t profit by the increase in price to P_t'; their gain is given by $(P_t' - P_t)Q_t$, or the area $P_t'aEP_t$ in the diagram. The gains to the sellers of additional supplies are much smaller, as they are reduced by the cost (including revenues from foregone sales in other markets) of the new fresh supplies. The net gain is given by the area of the triangle aEE' in the diagram. The total gain to table grape producers is thus given by the area of the trapezoid $P_t'E'EP_t$; this represents the gain in *producer surplus* resulting from the ten percent increase in promotional expenditures. In such a situation, changes in producer surplus coincide with changes in producers' economic profit from the production of grapes. The only information requirement for this calculation, in addition to the econometrically estimated demand parameters for responses to prices and promotion, is information on the supply response to price (the slope of the supply curve).

A similar exercise may be carried out to evaluate the returns to the entire promotional budget. The position of the demand curve with zero promotion may be calculated—it is shifted to the left by $0.519\sqrt{RPROMO_t)} * POP_t$—and then the zero-promotion prices and quantities can be identified, and the size of the corresponding trapezoid can be calculated.

Costs of Assessments to Finance Promotion. The gain in producer surplus is not adjusted for the cost of the increase in promotional expenditures. To evaluate the profitability of these expenditures, the gain must be set against the cost. We use two measures. One measure compares benefits to producers with the total cost of the program (or of the marginal increase in expenditure). However, when the promotional cost is financed by a per-pound assessment, some of the incidence of the assessment falls on consumers, through the operation of supply and demand. Thus, the total cost may differ from the cost to producers. The second measure (and one that is more relevant to producers) compares the benefits to producers with the producers' share of the cost, recognizing that some of the costs of the assessment are borne by consumers.

Figure 3.3 shows the same initial supply and demand curves as in figure 3.2, labeled $S_t(\tau_t)$ and D_t, where τ_t represents the actual assessment per pound in year t, and the equilibrium is at point E, with price P_t and quantity Q_t. An increase in the assessment per pound is reflected as a shift up of the supply curve to $S_t(\tau_t')$ by the amount of the increase (given by simply adding the additional assessment to the previous price at which producers would be willing to supply any given quantity along the supply curve). This leads to a new equilibrium, at point E', with a higher consumer price, P_t', a smaller net producer price, b, and a smaller quantity produced and consumed, Q_t'.

The extent of the consumer price increase depends on the relative slopes of the supply and demand curves. If supply were fixed and unresponsive to price (so that the supply curve is a vertical line), there would be no increase in the consumer price, and all of the additional assessment would be borne by producers. The more price-responsive (the flatter, more price elastic) is supply, the smaller will be the proportion of the assessment borne by producers. Similar statements apply as the demand curve becomes more or less elastic.

The additional amount of assessment revenue, given by the increase in the assessment, is equal to $\tau_t'Q_t' - \tau_tQ_t$. For small changes in the assessment, this is approxi-

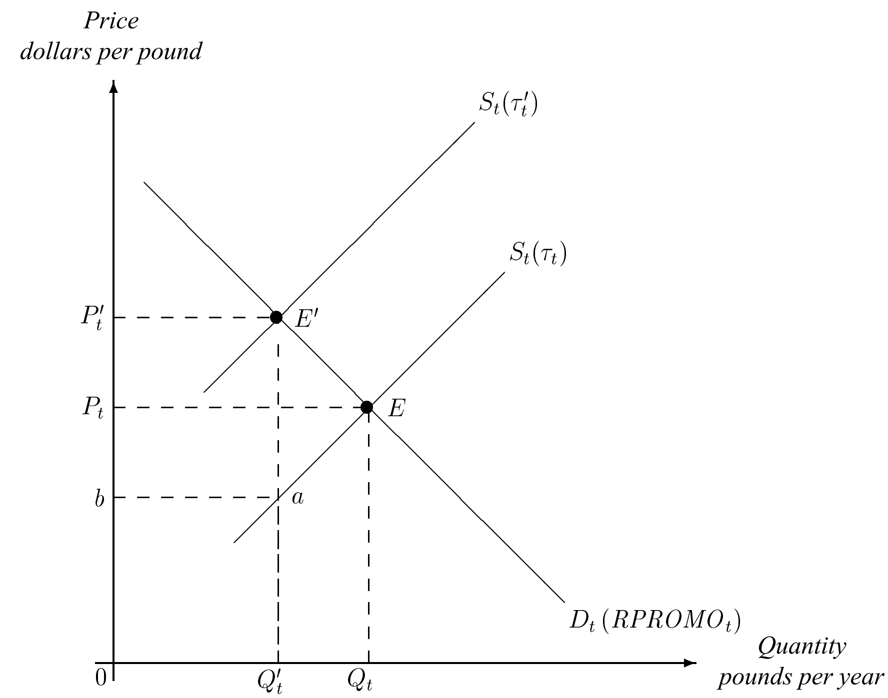

Figure 3.3: Incidence of Assessments

mately equal to the change in the assessment times the final quantity: $(\tau_t' - \tau_t)Q_t'$. In figure 3.3, this is equal to area $P_t'E'ab$. This corresponds closely to the full social cost of the change in assessment needed to finance a change in promotional expenditure of that amount (it leaves out the area of the triangle $E'Ea$, which is negligible for the small changes in assessments to be considered here). The loss of producer surplus (or profit) associated with the same increase in the assessment is equal to area P_tEab, only a fraction of the total amount being spent. In the work below, we compare producer benefits and the two alternative measures of producer costs.

Aggregation over Time

The approach described above compares hypothetical alternative scenarios against the actual historical record. It could be used to evaluate a ten percent increase in promotional expenditure in a particular year, or in every year, a measure of the *marginal* gross or net benefits; or it could be used to evaluate the total investment in promotion by simulating the past under a scenario of no promotion at all (this will measure the *average* gross or net benefits). And, in each case, it is possible to simulate changes in the assessments jointly with the corresponding changes in promotion.

If changes in more than one year are to be simulated, it is necessary to be able to aggregate benefits and costs over time. A natural impulse may be simply to add them up. This is appropriate only if past benefits or costs could not have been invested to earn some interest. If the relevant interest rate is not zero, past benefits and costs should be compounded forward to the present. We compute present values of benefits and costs using two alternative interest (compounding) rates: zero percent (simply adding up over time) and three percent (a reasonable value for the long-term, risk-free, *real* rate of interest).

The Supply Model

In order to conduct the benefit-cost analysis, we combined the preferred demand model with an assumed, hypothetical supply function. First, from the demand side, the *predicted quantities* were calculated by substituting the actual values of each of the explanatory variables into the equation

$$\begin{aligned} \hat{Q}_t \quad & \hat{\beta}_0 + \hat{\beta}_{DUM}\, D81\text{-}93_t + \hat{\beta}_{PG}\, RPG_t + \hat{\beta}_{EXP}\, REXP_t + \hat{\beta}_{PRO}\sqrt{RPROMO_t} \\ & + \hat{\beta}_{IMP}\, CHILE\text{-}IMP_t + \hat{\beta}_{TS}\, TS\text{-}SHARE_t \qquad (3.6) \end{aligned}$$

where the $\hat{\beta}$ coefficients are the estimated values of the parameters from weighted least squares.[18]

Next, the supply function was assumed to be of the constant-elasticity form and to pass through the points defined by the predicted quantities from the demand model. That is, the supply function is of the form

$$Q_t \quad A_t R_t^{\varepsilon}$$

where $A_t \equiv \hat{Q}_t / R_t^{\varepsilon}$. R_t is the producer return per pound in year t, defined as $R_t \quad 1-\tau_t)P_t$ where τ_t is the actual promotional expenditure per pound consumed in year t, expressed as a fraction of the market price in year t (that is, the rate of assessment required to finance the actual promotional expenditure). A_t is a parameter that varies from year to year to ensure that, given the actual values of prices and the other exogenous variables, each year the supply equation passes through the points defined by the predicted quantities from the demand model. This means that we can combine the calibrated supply model and the estimated demand model to simulate the past actual prices and predicted quantities. Supply functions were calibrated using alternative supply elasticities of 0, 0.5, 1.0, 2.0, and 5.0. An elasticity of supply of 0 surely understates the price responsiveness of quantity supplied, even in the short run, since grapes can be diverted from other uses when price rises. The maximum value of 5.0, on the other hand, seems quite large, especially for the short-run, since it implies a 50 percent increase in quantity supplied for a 10 percent increase in price. Especially with a length of run of one year, not long enough for entry into the industry to occur, we can assume with confidence that the range of 0 to 5.0 includes the actual supply elasticity.

Changes in producer surplus were calculated by integrating the supply function over the range of a price change. In practice, this translates to the following formula for the change in producer surplus:

$$\Delta PS_t \quad \frac{R_t' Q_t' - R_t Q_t}{1+\varepsilon}$$

Simulations

Using these definitions of supply and demand equations, we can replicate the past: by equating the equations for supply and demand and solving for the market equilibrium, we obtained values of actual prices and predicted quantities (from the demand

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[18] Since the weighted least squares estimates imply a smaller effect of promotion, choosing to use these estimates may be regarded as a choice to obtain conservatively low estimates of benefit-cost ratios. However, the weighted least squares parameter estimates also had smaller standard errors and imply greater precision in the estimates of benefit-cost ratios as well, a less conservative choice from that perspective. An alternative set of results, using the OLS estimates, is reported in the appendix; these tell essentially the same story as told by the results using the weighted least squares estimates.

model), given the actual values for the exogenous variables. These form our baseline case, to be used in comparison with the simulated outcomes below. We can simulate counterfactual scenarios, by using hypothetical values for the exogenous variables. Here we conduct six types of counterfactual simulations, as follows:

- using hypothetical values for the promotional expenditure in every year (either 1.1 times the actual values or zero promotional expenditure) with actual assessment rates;
- using hypothetical values for the assessment rate in every year (either 1.1 times the actual values or zero assessments) with actual promotion expenditure;
- changing both the promotional expenditures and the assessments (setting both at either 1.1 times the actual values or zero).

For each simulation, we calculate two measures of producer costs of promotion: (a) the cost of the promotional expenditure, or (b) the producer surplus loss associated with an assessment sufficient to generate the same amount of expenditure. Combining these two measures with the six simulations and the two alternative discount rates (zero or three percent) yields a total of 24 benefit-cost comparisons for every value of the supply elasticity. Using five supply elasticity values means we have a total of 120 estimates of benefits, costs, or both.

Benefit-Cost Ratios

The results from the benefit-cost analysis we conducted using the point estimates of the parameters are summarized in table 3.4.[19] The upper half of table 3.4 refers to estimates using zero percent to compound the benefits forward over time; the lower half uses a three percent compounding rate. Since they are smaller, but not much different, for now we will focus on the measures using zero percent (the upper half of table 3.4). Finally, for illustration, we consider the center column, which we derived using a supply elasticity of 1.

The first entry in the center column indicates that, over the 26-year period, the total producer benefits from promotion were $4,322.6 million. The next entry down shows that the total producer incidence of assessments to finance that promotion was $29.4 million over the same period. The next entry down is simply the amount spent on promotion, $115.2 million, also over the same period. The ratio of the total producer benefit to the producer incidence of the assessments is 147.1:1. This benefit-cost ratio indicates that, for every dollar borne by producers in assessments to fund promotion, producers gained 147 dollars in additional profit. This is a very high benefit-cost ratio. It is sufficient, for profitability, to have a benefit-cost ratio greater than 1:1. The fifth and final entry in this set shows that the ratio of the total producer benefit to the total cost of promotion is 37.5:1, still a very high benefit-cost ratio.

The next set of five entries in the center column refers to the same measures of benefits and costs, but considering a marginal increase of 10 percent, rather than looking at total benefits relative to the total promotional expenditure. The first entry in this group indicates that, in total, over the 26-year period, producers would have benefited by $240.2 million if the promotion expenditure had been increased by ten percent over the actual value in each year. The next entry down shows that the total producer incidence of assessments to finance that additional promotion would have been $2.9 million over the same period. The next entry down shows that the cost of spending an additional ten percent on promotion each year would have been

[19] As noted earlier, these computations are based on *estimated* parameters; since estimates are unlikely to be exactly correct, the benefit-cost measures should, in turn, also be thought of as estimates, not exact measurements.

Table 3.4: Benefits and Costs of Table Grape Promotion

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	19,876.5	6,589.8	4,322.6	2,606.5	1,205.8
Present value, Producer cost incidence	115.2	46.1	29.4	17.1	7.6
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	172.5	143.0	147.1	152.1	157.9
Producer Benefits/Total Expenses	172.5	57.2	37.5	22.6	10.5
Marginal benefits, costs:					
Present value, Producer benefits	970.1	380.1	240.2	139.0	61.6
Present value, Producer cost incidence	11.5	4.6	2.9	1.7	0.8
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	84.2	82.2	81.5	80.8	80.3
Producer Benefits/Total Expenses	84.2	33.0	20.8	12.1	5.3
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	25,964.1	8,992.2	5,939.9	3,603.2	1,676.0
Present value, Producer cost incidence	153.3	63.7	41.0	24.1	10.8
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	169.4	141.2	144.9	149.6	155.2
Producer Benefits/Total Expenses	169.4	58.7	38.8	23.5	10.9
Marginal benefits, costs:					
Present value, Producer benefits	1,267.3	516.0	329.5	192.2	85.7
Present value, Producer cost incidence	15.3	6.4	4.1	2.4	1.1
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	82.7	80.8	80.1	79.5	79.0
Producer Benefits/Total Expenses	82.7	33.7	21.5	12.5	5.6

Notes: Computations based on Weighted Least Squares estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

$11.5 million. The ratio of the marginal producer benefit to the producer incidence of the assessments is 81.5:1, a little over half the corresponding average benefit-cost ratio. The fifth and final entry in this set shows the ratio of the marginal producer benefit to the total cost of an additional ten percent expenditure on promotion in every year. The ratio is 20.8; also a little over half the value of its counterpart considering average, rather than marginal, benefits and costs which was 37.5.[20]

What is the effect of different assumed values for the supply elasticity? This can be seen by comparing entries across columns in a given row. As the supply elasticity increases from 0 to 5, the total (average) producer benefit falls from $19,876.5 million to $1,205.8 million. The more elastic is the supply function, the more is the expansion in demand satisfied by an increase in quantity supplied and the less is it satisfied by an increase in price. If supply were perfectly inelastic ($\varepsilon = 0$), there would be no increase in production, and the increase in demand would have to be completely met by an increase in price. The inelastic demand function means that a relatively large price increase is called for to adjust for a given demand shift in the quantity direction, if additional supply is not forthcoming, and this accounts in part for the very large producer benefits when supply is fixed.

For many of the same reasons, a similar pattern can be seen in the producer incidence of assessments to finance the promotion: ranging from $115.2 million when supply is perfectly inelastic to much less than one-tenth of that value, $7.6 million, when the supply elasticity is 5.0. Indeed, for small shifts in supply due to assessments and in demand due to promotion, the patterns of the producer benefits from a demand shift and producer incidence of costs of a tax should match perfectly. Hence the benefit-cost ratio should not be affected much by the supply elasticity, especially for smaller shifts. This can be seen in table 3.4. The estimate of the average benefit-cost ratio varies between 172.5:1 and 143.0:1; for the marginal benefit cost ratio, considering only a 10 percent change in assessments and promotion, the ratio is more nearly constant, ranging from 84.2:1 to 80.3:1.

When the producer benefit, which decreases with increases in the supply elasticity, is divided by the total promotional expenditure, which does not, the ratio declines substantially with increases in the supply elasticity. The benefit-cost ratio (using average benefits) when the supply elasticity is zero is the same as the value for the ratio using the producer incidence of the assessments (since when the supply elasticity is zero, all of the assessments fall on producers). However, it falls from this value of 172.5:1 to 10.5:1 when the supply elasticity is increased to 5. A similar pattern holds for the marginal benefit-cost ratio, which falls from a maximum of 84.2:1 when supply is fixed to a value of 5.3:1 when the supply elasticity is increased to 5.

Monte-Carlo Simulations

An important issue is the degree of confidence that can be placed in any particular values of the benefit-cost measures. How confident can we be that the net benefits are greater than, say, $10 million, given a "best" estimate of, say, $20 million? The precision of our benefit estimate depends on the precision of our estimates of the underlying parameters, but in ways that are not easy to see clearly. The fact that our model fits the data closely, and the fact that the statistical precision of the demand response to promotion is quite good (so that we can be confident that the effect is positive rather than zero) leaves us with some confidence that the promotional program has been effective. But this feeling does not translate directly into a quantitative measure of confidence about the probability distribution of benefits.

[20] The smaller benefit-cost ratios for a *marginal* increase in promotion are to be expected, since our square-root model implies diminishing marginal returns to promotional expenditure. This is also why the cost figures in the second simulation were simply 10 percent of those in the first, while the same proportion did not apply to producer benefits.

In order to evaluate the precision of our benefit and cost measures, we conducted Monte-Carlo simulations. An estimated regression model for a demand equation yields "point estimates" of the demand model's parameters. If we knew these estimated coefficients to be the true values, we would simply calculate producer benefits and other measures directly, and would interpret them as corresponding to the "true" demand curve. In practice, however, we never have such confidence—the many random influences that characterize our sample of data mean that we can only interpret our coefficients as *estimates* of the true values. We are therefore interested not only in the values of these estimates, but in the potential size of estimation error we may make, if we were to use them as the truth.

The result of estimation is not only a point estimate of the true coefficient, but a standard error, which characterizes the underlying probability distribution of estimation errors. A small standard error means that the coefficient is estimated with precision; a large standard error means imprecise estimation. Each coefficient we estimate has associated with it a standard error. Since any summary welfare measure, such as producer benefits from increased promotion, depends on these estimated coefficients, the summary measures also have standard errors. Since these measures are complicated functions of the estimated demand parameters, it is not straightforward to calculate standard errors to assign measures of precision to measures of benefits. Instead, it is convenient to use Monte-Carlo simulations to do so. Using what we know about the joint probability distribution of estimation errors for the estimated demand parameters, we can generate random draws of parameter values. This sampling process mimics the inherent randomness in our estimated coefficients, and can be interpreted as repeating the process of generating our data, with new draws on the error term in the demand equation, and re-estimating the parameters.

While we cannot repeat the "experiment" of drawing data from 1969 to 1993, we can synthesize repetition by generating new parameter values in this way. If we calculate a value for the welfare measure of interest using each new draw from the estimated joint probability distribution of the parameters, we can generate an empirical approximation to the underlying probability distribution for the welfare measure of interest. This empirical version of that distribution can then be used to assign measures of precision to the point estimate of the welfare measure. For instance, we can report standard errors for welfare measures, or convert our measures of precision to confidence intervals, permitting us to make statements such as that a 95 percent confidence interval for the benefit-cost ratio is formed by the interval from a:1 to b:1, where a:1 is a lower confidence limit and b:1 is an upper confidence limit. The width of the confidence interval then provides a measure of confidence about whether the benefit-cost ratio is positive. If our estimate was 10:1 but we were unable to distinguish this from either 20:1 or 0:1, we would not have accomplished as much with our econometric model, in terms of learning about the benefits from promotion, as if we ended up with a confidence interval ranging from 9:1 to 11:1. In summary, while point estimates of welfare consequences from various scenarios for promotion are of interest, they are much more informative when accompanied by measures of precision.

In practice, to do this requires an iterative process. First, as in the simulations reported in Table 3.4, the supply equations were parameterized so that the parameterized supply functions (for various supply elasticities) and the estimated demand function could be solved for the observed prices and the fitted quantities. Next, a particular set of values was drawn at random from the estimated joint distribution of the demand parameters. The resulting drawn demand equation was used with the parameterized supply equations to conduct the counterfactual simulations and to evaluate the 120 scenarios (24 per supply elasticity). One iteration comprises such a set of calculations. We repeated this process 10,000 times (by randomly drawing

10,000 sets of parameter estimates, and then completing the set of calculations for each set of parameter estimates).

The results from our Monte-Carlo study are reported in appendix A.[21] Since our point estimates of benefits are so high, consider the lower 99 percent boundary from the Monte Carlo work. The figures in table A3.5 indicate that, even when taking a very pessimistic view, the benefit-cost ratios are quite respectable. Comparing producer benefits with the producer incidence of the assessments, the estimated average benefit-cost ratio is around 80:1, and the marginal benefit-cost ratio is around 40:1. The estimated average benefit-cost ratio lies between 6.1:1 and 86.9:1, and the marginal benefit-cost ratio lies between 3.0:1 and 42.4:1; the ratio is between 4.5:1 and 62.4:1, depending on the supply elasticity, even when it is assumed that the full cost of the promotion is being born by producers. In the appendix, we also report simulations based on the OLS estimates rather than the weighted least squares estimates reported here (appendix tables A3.6–A3.9). The story is essentially the same, although the benefit-cost ratios tend to be larger (the measured demand response to advertising is greater, but the demand response to price is less, in the OLS estimates).

[21] Table A3.3 reports the means of the results from the Monte-Carlo simulations. Table A3.4 gives the corresponding upper 99 percent confidence limit and table A3.5 gives the corresponding lower 99 percent confidence limits.

4. DISAGGREGATED MODELS OF MONTHLY U.S. DEMAND FOR CALIFORNIA TABLE GRAPES

In this chapter, we report a disaggregated analysis of the U.S. market for fresh grapes, which we performed using monthly data. First, we describe and discuss aggregate monthly per capita demand models for the period 1972–1993. Second, we describe and discuss our monthly per capita demand models for individual U.S. cities, which used data for 1992 and 1993.

4.1 Monthly Models of Aggregate Demand for California Table Grapes, 1972–1993

Monthly data on aggregate U.S. (including Canada) consumption of California table grapes were compiled for the period 1972–1993 from weekly shipment records. We used these data to estimate monthly versions of the models that we developed using annual data (summing the monthly data within each year yields the annual data we used above). These data are listed in Appendix B, as table B4.1. Our strategy in this part was not to emphasize model diagnostics, nor to search for an improved specification but, rather, to take the specification as given and see whether applying essentially the same model to the monthly data would reinforce or weaken the findings from our analysis of the aggregate annual data.

Monthly Aggregate Models

The monthly model was of the same form as the annual model that generated the results in equation 3.5. Thus, in the monthly model, we allowed the promotion variable to be either in square-root form (producing the square-root model that was preferred above) or in levels (the linear model), but we augmented the basic model with monthly intercept dummy variables. These monthly intercept dummies served to capture differences in monthly demand that were not adequately captured by the explanatory variables, including the fact that some months include more days than others do.[1] We selected December as the default month, reflected in the intercept parameter, and included individual 0-1 dummy variables for every other month except for February, March, April, and May—months that were absent from the analysis due to observations of zero shipments, or missing values for prices.

In the annual model, the explanatory variables were all measured as annual values of the variables in question. A symmetric treatment would suggest using monthly values of the explanatory variables in a model with monthly per capita quantities consumed as the dependent variable. Two problems that may arise with this approach are: (a) accurate monthly data may not be available for every variable in the model, and (b) some effects may extend over more than one month. Such concerns are particularly important in relation to the promotion variable. Promotional effort in one month may generate effects that persist into subsequent months, an outcome that may be more pronounced with some types of promotion (say media advertising) than others (say merchandising).[2] Second, and relatedly, promotional expenditure in one month may relate to promotional effort in previous or in subsequent months (for example, up-front costs incurred in the production of materials for distribution over a season; or billing later for promotion that has

[1] One such difference would be seasonal differences in grape quality for a given variety, and month-to-month differences in the varietal mix. Since we are using the Los Angeles price of Thompson Seedless grapes as an index of the price of all table grapes, the effects of seasonal variation in quality and the varietal mix will not be well represented. If we were using an index of the price, constructed using monthly information on the varietal mix, the varietal mix effects might be minimized, but there would still be a requirement to adjust for quality variation.

[2] There is an extensive literature dealing with the persistence effects of advertising and promotion, some of which is concerned specifically with generic commodity advertising and promotion.

already occurred).

It is often difficult to isolate exactly which past or future months would be expected to show changes in consumption, in response to today's promotion expenditures; in other words, it is difficult to partition annual promotional expenditures meaningfully across months, even when they would be expected to relate to only one month or another. In construction of the data for this analysis from the Commission's records, such difficulties were more apparent for some types of promotional expenditures than for others (for instance, it is often possible to obtain information on exactly when media advertising aired). To partition some of the expenditure across months entails the use of some arbitrary rules of thumb, such as either dividing the annual total by the number of relevant months (assuming equal amounts every month) or prorating across months, according to the seasonal pattern of sales.

The available choices were either (a) to include a different measure of monthly promotional expenditure each month, in order to allow the expenditure in any one month to have effects on consumption in that month and in subsequent months, and to measure those dynamic demand responses to promotion using some type of distributed lag model, or (b) to allow consumption in each month to depend on the total annual promotional expenditure for that year (that is, including expenditure in future months, as well as past months, in the same season, and giving all those expenditures equal weights). The latter procedure may seem strange at first blush. However, it is consistent with the view that the Commission allocates its annual budget in a fairly consistent seasonal pattern each year, but that allocation is unobservable, so that the annual expenditure acts as a proxy for the expenditure in any particular month. By the same token, the annual expenditure also acts as a proxy for any previous monthly expenditures, within the same season, that may still affect current consumption. In addition, the resulting model is simple and directly comparable to the annual model, avoiding the inevitable problems that can arise in searching for a suitable distributed lag structure when different lags are relevant for different months in a seasonal demand structure.

Hence, in the monthly model, the explanatory variables include the monthly real price of Thompson Seedless grapes (RPG_t), annual real per capita total consumption expenditure ($REXP_t$), annual per capita imports from Chile ($CHILE\text{-}IMP_t$), the annual Thompson Seedless share ($TS\text{-}SHARE_t$), and annual real promotional expenditure ($RPROMO_t$).[3] The square-root model is given by

$$\begin{aligned} Q_t \quad & \beta_0 + \mu_1 DM_{1,t} + \mu_6 DM_{6,t} + \mu_7 DM_{7,t} + \mu_8 DM_{8,t} \\ & + \mu_9 DM_{9,t} + \mu_{10} DM_{10,t} + \mu_{11} DM_{11,t} + \mu_{81\text{-}93} D81\text{-}93_t \\ & + \beta_{PG} RPG_t + \beta_{EXP} REXP_t + \beta_{IMP} CHILE\text{-}IMP_t + \beta_{TS} TS\text{-}SHARE_t \\ & + \beta_{PROMO} \sqrt{RPROMO_t} + e_t. \end{aligned} \tag{4.1}$$

The linear model is given by replacing $\sqrt{RPROMO_t}$ with $RPROMO_t$. In addition, in the linear model, the annual promotional expenditure was disaggregated into three components, all in real terms: advertising ($RADV_t$), merchandising ($RMERCH_t$), and public relations (RPR_t). Hence,

$$\begin{aligned} Q_t \quad & \beta_0 + \mu_1 DM_{1,t} + \mu_6 DM_{6,t} + \mu_7 DM_{7,t} + \mu_8 DM_{8,t} \\ & + \mu_9 DM_{9,t} + \mu_{10} DM_{10,t} + \mu_{11} DM_{11,t} + \mu_{81\text{-}93} D81\text{-}93_t \\ & + \beta_{PG} RPG_t + \beta_{EXP} REXP_t + \beta_{IMP} CHILE\text{-}IMP_t + \beta_{TS} TS\text{-}SHARE_t \\ & + \beta_{ADV} RADV_t + \beta_{MERCH} RMERCH_t + \beta_{PR} RPR_t + e_t. \end{aligned} \tag{4.2}$$

In this linear model, including just the promotion variable ($RPROMO_t$) is equivalent to including its three components ($RADV_t$, $RMERCH_t$, and RPR_t) and imposing an equality restriction on the three parameters. In other words, the model

[3] We also retained the intercept shift variable, $D81\text{-}93_t$, that we found to be necessary in the annual model.

Table 4.1: Regression Results for the Aggregate Monthly Model of U.S. and Canadian Per Capita Demand for California Table Grapes, 1972–93

Independent Variables	(1)	(2)	(3)	(4)
RPG_t	-0.136	-0.137	-0.140	-0.148
	[-4.85]	[-4.82]	[-5.04]	[-5.46]
	(-0.28)	(-0.28)	(-0.29)	(-0.34)
$REXP_t$	-0.061	-0.204	-0.076	-0.088
	[-0.35]	[-0.99]	[-0.43]	[-0.51]
	(-0.16)	(-0.54)	(-0.20)	(-0.24)
$RPROMO_t$	0.028	-	-	-
	[2.87]	-	-	-
	(0.29)	-	-	-
$\sqrt{RPROMO_t}$	-	-	0.099	0.097
	-	-	[2.97]	[3.45]
	-	-	(0.23)	(0.22)
RAD_t	-	0.025	-	-
	-	[2.49]	-	-
	-	(0.17)	-	-
RPR_t	-	0.025	-	-
	-	[0.33]	-	-
	-	(0.03)	-	-
$RMERCH_t$	-	0.134	-	-
	-	[1.84]	-	-
	-	(0.32)	-	-
R^2	0.90	0.91	0.90	0.90
$\overline{R}^2$	0.89	0.89	0.89	0.89
$D.W.$	1.65	1.68	1.66	1.70
Sample	6/72–10/93			

Independent Variables	(1)	(2)	(3)	(4)
$CHILE\text{-}IMP_t$	0.063	0.062	0.070	0.069
	[1.98]	[1.85]	[2.19]	[2.15]
$TS\text{-}SHARE_t$	0.210	0.169	0.255	0.208
	[0.97]	[0.77]	[1.22]	[1.14]
$D81\text{-}93_t$	0.022	0.030	0.027	0.031
	[0.70]	[0.90]	[0.90]	[1.05]
$DM_{1,t}$	-0.136	-0.134	-0.137	-0.120
	[-2.68]	[-2.63]	[-2.71]	[-2.41]
$DM_{6,t}$	0.156	0.159	0.157	0.168
	[5.41]	[5.49]	[5.44]	[5.78]
$DM_{7,t}$	0.183	0.185	0.183	0.171
	[6.41]	[6.49]	[6.42]	[6.04]
$DM_{8,t}$	0.591	0.594	0.590	0.545
	[19.51]	[19.57]	[19.56]	[18.52]
$DM_{9,t}$	0.363	0.365	0.362	0.350
	[12.19]	[12.26]	[12.21]	[12.05]
$DM_{10,t}$	0.228	0.230	0.228	0.219
	[7.86]	[7.93]	[7.87]	[7.70]
$DM_{11,t}$	0.241	0.243	0.241	0.234
	[8.21]	[8.27]	[8.23]	[8.02]
$CONSTANT$	0.133	0.219	0.053	0.110
	[0.67]	[1.03]	[0.28]	[0.63]

Notes: t statistics in brackets, elasticities (at means) in parentheses. (1) OLS, linear promotion. (2) OLS, disaggregated promotion. (3) OLS, square root of promotion. (4) Weighted Least Squares, square root of promotion.

with $RPROMO_t$ included, instead of its three components, is given by imposing the restriction that β_{ADV} β_{MERCH} β_{PR}. Although we could have included the square roots of the individual elements of promotion, we could not obtain the model with the square root of $RPROMO_t$ as a special case, just by restricting the individual coefficients to be equal, since the square-root transformation is nonlinear.

Estimation Results

Our results from estimating the monthly aggregate demand models are reported in table 4.1. In this table, column (1) refers to the linear model with aggregated promotional expenditures, estimated by OLS. This model fits the data well (R^2 0.90), and all of its coefficients are statistically significant, except for the intercept and those on the real expenditure variable, the Thompson Seedless share, and the intercept dummy for 1981–93. The latter, while statistically insignificant, is of a size that would suggest a shift in demand leading to an increase in annual per capita consumption of about 0.18 pounds (8 times 0.022) after 1980, as compared to the 0.60 pounds per person estimated from the annual model, in equation (3.5). The monthly intercept dummies for January and for June through November all have significant and, except for January, positive coefficients, which indicate greater demand in those months relative to December, other things equal.

The economic effects of interest are consistent with the results from our annual model. We estimated the own-price elasticity of demand for grapes to have been

-0.28, and the elasticity with respect to promotion to have been 0.29 (very similar to their counterparts from the corresponding linear annual model estimated by OLS, -0.27 and 0.23, respectively, shown in column (1) of table 3.3). The effect of Chilean imports was positive and statistically significant, and the effect of increasing the Thompson Seedless share was positive, but not statistically significant.

Applying the same general diagnostic tests that we applied to the aggregate annual model yielded similar results for the monthly model. The errors were serially correlated (the Durbin-Watson statistic was 1.65, and the autocorrelation parameter was estimated as $\hat{\rho} = 0.18$ with a standard error of 0.083, statistically significant) and there appeared to be some heteroskedasticity. Correcting for autocorrelation did not substantially change any of the parameters of interest. We also applied the same weighted least squares approach as for the annual model, allowing for a different error variance after 1980, and the resulting estimates were not appreciably different from the OLS estimates.

We estimated a second OLS regression model, including the three elements of the promotion variable ($RADV_t$ $RMERCH_t$, and RPR_t) instead of $RPROMO_t$. As column (2) of table 4.1 indicates, the coefficients on other variables were largely unaffected by the disaggregation of the promotion variable, and the overall statistical performance of the regression was unaffected. Of the disaggregated elements, only advertising ($RADV_t$) was individually statistically significant, with a coefficient very similar to that on $RPROMO_t$ in column (1). The estimated coefficients on the other two elements were both positive, but not statistically significantly different from zero (and, by the same token, not significantly different from the coefficient on advertising). The point estimate of the coefficient on merchandising ($RMERCH_t$) was somewhat larger than that on advertising, and almost statistically significant, while that on public relations (RPR_t) was almost identical to that on advertising but not at all significant. These results indicated that we could not reject the hypothesis that we can aggregate all three elements into a single promotion variable, as in the annual model and in column (1) of table 4.1.[4]

As with the annual model, the square-root model with diminishing marginal returns was somewhat preferred, in principle, for modeling monthly demand response to promotion. Column (3) of table 4.1 shows the OLS estimates for the square-root model. The results for this model were very similar to those for the linear monthly model in column (1) of table 4.1, as well as the OLS estimates for the square-root model using annual data, given in column (4) of table 3.2 and column (5) of table 3.3.

The square-root model fits the data well ($R^2 = 0.90$), and all of the coefficients were statistically significant except for the intercept and those on the real expenditure variable, the Thompson Seedless share, and the intercept dummy for 1981–93. The point estimate of the intercept dummy suggests an increase in annual per capita consumption of about 0.33 pounds (12 times 0.027) after 1980, again, a little smaller than the effect measured by the corresponding annual model. The coefficients on the monthly intercept dummies for January and for June through November were all statistically significant and, except for January, positive, which indicated greater demand relative to December.

The economic effects of interest were consistent with the results from the annual square-root model estimated by OLS. We estimated the own-price elasticity of demand for grapes to be -0.29, and the elasticity with respect to promotion to be 0.23 (very similar to their counterparts from the corresponding annual model, -0.29

[4]It might be thought that multicollinearity may account for the individual insignificance of elements of promotion. However, when we excluded the advertising variable, merchandising became statistically significant but public relations did not (even when we also excluded merchandising). The t statistic on RPR_t was never greater than 0.13, indicating that the variable contributed nothing to the regression. Another, and perhaps better option, then, may be to drop the RPR_t variable and combine the other two into a single promotion variable.

and 0.18, respectively). The effect of Chilean imports was positive and statistically significant, and the effect of increasing the Thompson Seedless share was positive but statistically insignificant. The square-root model appears to fit the data at least as well as the linear model (if not better) and, as noted above, is preferable since it imposes diminishing returns to promotion.

Applying the same general diagnostic tests we applied to the aggregate annual model yielded similar results for the monthly model. The errors were serially correlated (the Durbin-Watson statistic was 1.66, and the autocorrelation parameter was estimated as $\hat{\rho} = 0.17$ with a standard error of 0.083, statistically significant), and there appeared to be some heteroskedasticity. Correcting for autocorrelation did not substantially change any of the parameters of interest. We also applied the same weighted least squares approach as for the annual model, allowing for a different error variance after 1980. As with the annual model, the weighted least squares estimates of parameters were a little more precise, and the correction shifted the monthly model parameters in the same direction as in the annual model, but not as much. The weighted least squares regression reported in column (4) of table 4.1 indicates a slightly larger price elasticity and a very slightly smaller effect of promotion, compared with the OLS estimates in column (3). None of the differences seem important.

Implications

The results from our aggregate monthly model confirm and reinforce those from the annual model estimated over essentially the same period. In the monthly model, monthly per capita quantities consumed were determined by the real price of grapes and monthly dummy variables, all of which varied monthly within a year, and other variables that were constant across months within a year but varied across years (real per capita income, Chilean imports, the Thompson Seedless share, and, most importantly, real annual expenditure on promotion). Tests indicated that it was sufficient to use aggregate promotion, rather than to disaggregate promotion into its individual elements—advertising, merchandising, and public relations—although a case could be made for dropping the expenditure on public relations from the model and combining advertising and merchandising into a single promotion measure. As with the annual model, it was difficult to distinguish between the linear and square-root models. In both forms, there were mild problems of autocorrelation and heteroskedasticity, but correcting for these problems did not affect our estimates appreciably.

Our main conclusion here is that the monthly results reinforce our confidence in the estimates of price and promotion effects on consumption of table grapes from the annual model. In turn, this bolsters our confidence in the use of the parameters from our annual model in a benefit-cost analysis of the Commission's promotional program, and in the estimates obtained from that benefit-cost analysis.

4.2 Disaggregated City-Month Demand Models

Our second set of monthly models used detailed, city-specific data on prices and quantities of table grapes—quantities were obtained from the Commission's shipment records; prices came from USDA's daily market news reports.

Data for the Econometric Model

Some data on weekly shipments were available for four years: 1990, 1992, 1993, and 1994 (quantity data were unavailable for 1991, owing to the problem alluded to earlier with the computer disk on which the records were stored). These data cover prices and shipments for 28 different individual grape varieties sold at each of a large number of individual cities, although it should be noted that not all price, quantity, variety, and city combinations were available on a consistent basis. Eventually, we were left with a sample of usable data for only two years, 1992 and 1993.[5]

Aggregating across varieties and time is a way of combining information to make a more balanced and consistent data set. In addition, it is a way of reducing dynamic effects and measurement errors that can arise. For instance, grapes sold one day may have been harvested many days previously and may not actually be consumed for a week or more, making it difficult to match the daily price and consumption data with each other and with other variables, such as promotion, in a meaningful way. Aggregating over days reduces the likelihood that price, quantity, and other variables pertain to different periods and do not match one another.

We decided that we should model the demand for table grapes in aggregate.[6] In addition, we aggregated the daily and weekly quantities and prices to create a monthly data set for each of seventeen cities, which in the remainder of this chapter are designated by the subscript j.[7] To aggregate across varieties, we simply summed the quantities (that is, we did not create a quantity index by weighting individual varieties according to their value shares), creating a measure of per capita consumption of all California table grapes, Q_{jt}, for each city j being studied. We regarded this quantity measure as comprehensive and accurate. Monthly data on total shipments to individual cities are listed in table B4.2 in Appendix B; population for these cities is in table B4.6.

We also constructed city-level indexes of the price of grapes. In modeling the monthly and annual aggregate demand for grapes, we used the Thompson Seedless price in Los Angeles as a proxy for an index of the national price for all grapes. This was necessary because detailed prices and quantities for the individual varieties were not available for the complete time series. However, disaggregating by city meant that we had a considerably greater number of monthly observations, even using only data from 1992 and 1993, and we did have a fairly complete set of monthly prices and quantities, by variety, for those years. Thus it was possible to construct a price index.

We constructed a simple price index by weighting the price for each of seven major varieties (for which we had information on both price and quantity) by the share of that variety in the total quantity of those varieties, $\overline{Q}_{jt}$.[8] In other words, including only those of our seven varieties for which we had data on both prices and quantities, the value of the price index is given by the aggregate value divided by the aggregate quantity:

$$P_{jt} \quad \sum_{i=1}^{7} \frac{P_{ijt}Q_{ijt}}{\overline{Q}_{jt}}$$

where

$$\overline{Q}_{jt} \quad \sum_{i=1}^{7} Q_{ijt}.$$

[5] 1994 price data and 1990 quantity data were incomplete. Rather than using techniques for filling in missing data, or combining mismatched data from different years, we used only the data for the two years where they were more complete, 1992 and 1993.

[6] Modeling demands for individual varieties is possible using the data we have compiled, but requires a substantial additional effort that is not justified for the present project. Since the main interest here is in the effects of promotional expenditures that are not allocated to individual varieties, the demand for all grapes seemed to be the appropriate level of analysis.

[7] The seventeen cities for which data were assembled were Atlanta, Boston, Chicago, Dallas, Detroit, Houston, Los Angeles, Miami, Minneapolis, New York City, Philadelphia, Pittsburgh, Sacramento, San Francicso, Seattle, Tampa, and Washington. The five that were not used in the analysis reported in this section were Dallas, Houston, Minneapolis, Sacramento, and Tampa.

[8] The varieties included were Thompson Seedless, Perlette, Superior Seedless, Flame Seedless, Ruby/Red Seedless, Emperor, and Red Globe.

In the work that follows, we use this price index, deflated by the CPI for city j, to form the real price index RPG_{jt}, which was used to model the total quantity consumed of all varieties, including those for which individual prices were not included in the index.[9] For some months, this index was dominated by the Thompson Seedless price, but later in the season, the Thompson Seedless share fell, and other varieties dominated.[10] The nominal price series are listed in table B4.3 in Appendix B, with the city-specific CPIs listed in table B4.5.

The City-Month Model

Our monthly price and quantity data for twelve cities were combined with demand-shift variables that either matched those from the aggregate U.S. models already described, or represented city-level counterparts. We did not have city-level or monthly breakdowns of the quantity of grapes imported from Chile, so only the annual $CHILE\text{-}IMP_t$ variable from chapter 3 was available. Similarly, while we did have city-level measures of personal income, these were annual, not monthly. In any event, monthly variations in income or expenditures, as noted in the previous section, probably have little relevance in explaining month-to-month variations in grape consumption. Annual real per-capita disposable income for the individual cities, $RINC_{jt}$, is listed in table B4.6 in Appendix B. We tried the price of apples as a measure of the price of a substitute, but it was never statistically significant. Finally, we did not have city-by-city breakdowns of total promotion, $RPROMO_t$.

We used one promotion variable that was available on a city-by-city and month-to-month basis, the sum of expenditures on radio and television advertising, divided by the corresponding value of the CPI, to obtain the real expenditure measure, $RADIOTV_{jt}$. Ideally, one would divide by an index of the cost of advertising, but we did not have such an index, so we used the CPI as a proxy. As noted in Chapter 3, it could also be argued that dividing by population is appropriate, to obtain a measure of per capita advertising, especially if the position is taken that the real cost of advertising increases proportionally with the size of the audience (that is, the size of the CMSA). In keeping with our previous models, however, we chose to use the total $RADIOTV_{jt}$ value, rather than including the real expenditure on a per capita basis. Monthly media advertising expenditures for the individual cities is listed in table B4.4 in Appendix B.[11]

We were unable to account specifically for the effects of other promotion or of imports from Chile, since only aggregate annual data were available on these variables. To the extent that Chilean imports have expanded total grape consumption, as suggested by our chapter 3 results, we would bias a demand model estimated over a longer period if we omitted the influences of this variable. If Chilean imports had different effects in different cities, either because the effects of these imports were truly different or because the actual quantities were not uniformly distributed across cities, failing to take that variable into account would result in a misspecified model. Similarly, if the effects of other promotion investments varied between years, or across months or cities, our model would have been incomplete if that effect was not taken into account. A promotional variable $ROTHER_t$ (representing "other"

[9] We constructed an alternative quantity-weighted index using all prices, not just those of the seven more-important varieties, but it was virtually identical to the first index.

[10] Considering only those months when both were available, the Los Angeles price of Thompson Seedless was highly correlated with the city-based price indexes. The correlation coefficient between the real Thompson Seedless price and the real price index was 0.925. This finding lends some support to our use of the Los Angeles Thompson Seedless price as an index of the price of all grapes in our aggregate model, an approximation made necessary because other prices and quantities were not available to permit a better index to be constructed for the longer time period being studied using the aggregate model.

[11] We had no data for the $RADIOTV_{jt}$ variable for Washington for 1992, so this city appears in the model for 1993 only.

promotional expenditure) was available, but only as an annual figure for the entire nation. With only two years of data, changes in both imports from Chile and $ROTHER_t$ were econometrically indistinguishable from changes in the intercept or any other shifts that occurred between the two years, but were common to all cities and months. Without variation across cities in these variables, however, they cannot do anything except serve as proxies for all of these year-to-year differences. A year dummy for 1992 (that is, making 1993 the default year) was included, analogous to the monthly or intercept dummies in previous models, so we did not (in fact could not) include either imports from Chile or $ROTHER_t$.

Since the income variable varied across cities, we could still include it in our demand model, even though it did not vary among months for any given city. To obtain a measure of real income, we divided annual income by the July CPI for each city-year combination. While the CPI is available on a monthly basis, we did not want to divide the annual income variable by a different monthly cost-of-living index for each month, as this would introduce artificial variation in real income, due solely to observing the CPI more frequently than income. In reality, income and the price level both change through the year, so using July's CPI seemed like a good compromise. Finally, this real income variable was divided by the annual population figure for the Consolidated Metropolitan Statistical Area.

As in our other models, to calculate per capita quantities, we divided total monthly shipments by population. We divided our index of grape prices by the city-specific monthly CPI to obtain a real grape price, RPG_{jt}, and included the real price of subsitutes (subsequently dropped), RPS_{jt}, and used the real income and advertising variables described above to obtain the following demand model:

$$Q_{jt} \quad \beta_0 + \beta_{PG} RPG_{jt} + \beta_{RTV} RADIOTV_{jt} + \beta_{INC} RINC_{jt} + \beta_{92} D92_t + e_{jt} \quad (4.3)$$

The variables in this model are defined in table 4.2, which also documents sources for the data we used to construct our data set.

We found it necessary to account for apparent dynamic effects in this model. As noted earlier, with sufficiently disaggregated data, the effect of promotion may extend beyond the period in which expenditures are tracked. For instance, an advertising expenditure in August may lead to increased demand in both August and September. Therefore, we used a variable called MAD_{jt} instead of $RADIOTV_{jt}$, where MAD_{jt} represents a moving average of $RADIOTV_{jt}$ values. We varied the number of months from two (representing persistence of $RADIOTV_{jt}$ for one month beyond the current one) to six (representing a larger persistence of advertising effects), and took the square root of the moving average, called $R\text{-}MAD_{jt}$, analogous to the treatment of promotion in our preferred aggregate model. Thus

$$R\text{-}MAD2_{jt} \qquad \sqrt{\frac{1}{2} RADIOTV_{jt} + \frac{1}{2} RADIOTV_{t-1}}$$

$$R\text{-}MAD3_{jt} \qquad \sqrt{\frac{1}{3} RADIOTV_{jt} + \frac{1}{3} RADIOTV_{t-1} + \frac{1}{3} RADIOTV_{t-2}}$$

and so on, for longer lags. Finally, we selected data from June through December, to focus on those months when $RADIOTV_{jt}$ and shipments of the important varieties are concentrated.

Table 4.3 reports results from OLS estimation of various specifications of this model. We tried up to six lags of $RADIOTV_{jt}$ in constructing the moving average variable. Increasing the lag length generally did not appreciably affect the estimated parameters. The model with the current value plus two lags included, $R\text{-}MAD3_{jt}$, had the largest value for the adjusted R^2 ($\overline{R}^2$), and we chose that as our best fixed-weight specification. Results from that specification are shown as column (1) of table 4.3. The advertising variable, $R\text{-}MAD3_{jt}$, had a positive and

Table 4.2: Data Used in the City-Month Model

Variable	Definition	Units	Data Source
Q_{jt}	Per capita consumption of table grapes, city j, month t	pounds per person per month	CTGC shipment records, tabulated according to month shipped. Population from U.S. Bureau of the Census, *Population Estimates for New England County Metropolitan Areas (NECMAs): July 1, 1990 to July 1, 1995* and *Population Estimates for Metropolitan Areas (MAs) Outside of New England: July 1, 1990 to July 1, 1995* (U.S. Bureau of the Census, Population Division, 1996).
P_{ijt}	Average "mostly–high" wholesale price of fresh grapes, variety i, deflated using CPI.	Real (1993) dollars per pound	Federal-State Market News Service,*Fresh Fruit and Vegetable Wholesale Market Prices*, CDFA and USDA, various cities.
RPS_{jt}	Real average "mostly–high" wholesale price of fresh Red Delicious and Golden Delicious apples.	Real (1993) dollars per pound	Federal-State Market News Service,*Fresh Fruit and Vegetable Wholesale Market Prices*, CDFA and USDA, various cities.
$RINC_{jt}$	Real per capita personal income, by city.	Thousands of real (1993) U.S. dollars per person	Bureau of Economic Analysis, U.S. Department of Commerce, *Regional Economic Information System* (June 1996).
$RADIOTV_{jt}$	CTGC spot radio and television advertising expenditures, by city and month	Millions of real (1993) U.S. dollars.	Billing records of CTGC advertising agencies

statistically significant effect on per capita consumption. Our estimated elasticity of demand with respect to $R\text{-}MAD3_{jt}$ was 0.40, which was larger than the elasticity of demand with respect to promotion we computed from the monthly aggregate model (about 0.22). The income variable had a positive and statistically significant effect on consumption, while the intercept, price, and 1992 dummy coefficients were statistically insignificant. The coefficient on the price of grapes, however, had the expected negative sign, and corresponded to an own-price elasticity of demand of -0.24, comparable to the results from the annual and monthly aggregate models.

In column (2) of table 4.3, we report the results from a model that is identical to the model in column (1), except that we included the moving average of the current and past two months of expenditure on radio and TV advertising, $MAD3_{jt}$, instead of the square root of the same moving average, $R\text{-}MAD3_{jt}$. In other words, the model in column (2) is a linear advertising model corresponding to the square-root advertising model in column (1). Our results were mostly unaffected by this substitution, but both the R^2 and $\overline{R}^2$ were lower than in the square-root model of column (1), suggesting a continued preference for the square-root specification over the linear specification of the advertising response. In the construction of $MAD3_{jt}$, two past months of advertising expenditures have the same weight as the current expenditure. Recognizing that the weights assigned to each component of the moving average could vary over time, we replaced the fixed coefficients in the $MAD3_{jt}$ variables with weights to be estimated:

$$MAD3_{jt} \quad \theta_1 RADIOTV_{jt} + \theta_2 RADIOTV_{t-1} + (1 - \theta_1 - \theta_2) RADIOTV_{t-2}.$$

The results of estimating the model with free-form weights are also reported in table 4.3, in column (3). Our main results were unaffected by relaxing the asumption of fixed weights, although, surprisingly, the lagged value of $RADIOTV_{jt}$ received a larger weight than does the current value. Not too much should be made of this finding, however, since a test would not reject the restriction that the weights were equal. Moreover, the weights on past advertising levels changed and became more compatible with prior expectations when we added other dynamic variables. However, there was evidence of significant autocorrelation, as well as some indications that a more general dynamic process that included lagged dependent variables may be more appropriate. Accordingly, we re-estimated the square-root model in column (3) with three months of $RADIOTV_{jt}$ and free-form weights, $R\text{-}MAD3_{jt}$, augmented with two lagged dependent variables. The augmented model is

$$\begin{aligned} Q_{jt} \quad & \beta_0 + \beta_{PG} RPG_{jt} + \beta_{MAD} R\text{-}MAD3_{jt} + \beta_{INC} RINC_{jt} \\ & + \beta_{92} D92_t + \gamma_1 Q_{j,t-1} + \gamma_2 Q_{j,t-2} + e_{jt} \end{aligned} \tag{4.4}$$

We also allowed for second-order autocorrelation. The results from this specification are reported in column (4) of table 4.3.

The correction for dynamic effects increased the magnitudes of our estimated coefficients on prices, income, and advertising. Complicating this interpretation, however, was the presence of the lagged dependent variables. This being the case, the coefficients measure “impact multipliers” of the effects of the variables on consumption and are no longer equivalent to long-run multipliers. A unit increase in month t in the variable $R\text{-}MAD3_{jt}$ leads to an immediate increase in per capita consumption of 0.086 pounds per person, but then leads to a decrease, next month, of 0.240(0.086) pounds per person, through the effects of the lagged dependent variable. A further decrease follows a month later, 0.321(0.086). Hence, over a three-month period, the total effect on consumption would be an increase of 0.038 pounds per person.

This dynamic effect can be thought of as one way to model the “wearout” effect of advertising, except that the same correction occurs for *any* temporary increase in

Table 4.3: City-Month Models with Different Lag Lengths but Equal Lag Weights

Independent Variables	(1)	(2)	(3)	(4)
RPG_t	-0.472	-0.449	-0.586	-1.306
	[-1.09]	[-0.99]	[-1.33]	[-2.14]
	(-0.24)	(-0.23)	(-0.30)	
$RINC_t$	13.949	11.915	12.074	22.157
	[5.56]	[4.80]	[4.31]	[1.97]
	(0.48)	(0.41)	(0.41)	
$R\text{-}MAD3_t$	0.073	-	0.060	0.086
	[5.31]	-	[3.81]	[2.83]
	(0.40)	-	(0.34)	
$MAD3_t$	-	0.003	-	-
	-	[4.40]	-	-
	-	(0.34)	-	
θ_1	1/3	1/3	0.196	0.401
			[1.91]	[6.96]
θ_2	1/3	1/3	0.439	0.244
			[3.87]	[3.49]
Q_{t-1}	-	-	-	-0.240
	-	-	-	[-1.36]
Q_{t-2}	-	-	-	-0.321
	-	-	-	[-3.33]
$D92_t$	-0.123	-0.099	-0.102	-0.655
	[-1.79]	[-1.42]	[-1.47]	[-1.38]
CONSTANT	0.070	0.555	0.317	1.188
	[0.22]	[1.93]	[0.88]	[1.66]
R^2	0.23	0.19	0.24	0.54
$\overline{R}^2$	0.21	0.16	0.21	0.48

Notes: t statistics in brackets, elasticities (at means) in parentheses. All equations estimated with OLS, for the months June–November, 1992 and 1993. In columns (1) and (2), moving-average weights θ_i are restricted to equal $\frac{1}{3}$. For column (4), autoregressive parameters are $\hat{\rho}_1 = 0.911$ [$t = 4.57$] and $\hat{\rho}_2 = -0.086$ [$t = -0.43$].

consumption. For instance, a decrease in the price, RPG_{jt}, leads to an immediate increase in grape consumption, but this increase will have depressing effects on consumption, for the next two periods, other things held constant. Since we did not conduct a detailed search for the correct dynamic specification, which could involve such things as lagged prices or different effects in different months of the year, the results in model (4) in table 4.3 should be interpreted cautiously.

Our main purpose in estimating the city-month model was to corroborate our more aggregated models, which we have done. The implied elasticities are of magnitudes similar to those from the aggregate models. It would be interesting to obtain city-specific models, in which the dynamic effects and other coefficients might vary across cities, if we were studying the optimal allocation of promotional expenditures across markets. This type of work was beyond the scope of the present study, however, especially as we did not have complete data for other promotion expenditures broken down by city and month.

5. EXPORT DEMAND FOR CALIFORNIA TABLE GRAPES

Exports of fresh table grapes have accounted for between 10 and about 30 percent of California's annual shipments since the early 1950s, reaching 31.4 percent in 1991 and falling slightly to 30.4 percent in 1993. As figure 2.9 illustrates, the trend in the quantity of table grape exports was fairly flat until the late 1980s. Since 1987, exports have grown from between 200 and 250 thousand pounds per year—a range sustained since the 1960s—to over 400,000 pounds per year in the 1990s.

Canada remains the primary non-U.S. market, but was included with the United States in the analysis above, and neither consumption of table grapes in Canada nor CTGC promotional activities in Canada are included in this chapter's analyses. The principal other export destinations for California table grapes have changed over time. In the past, European markets were important destinations for exports, but the more recent emphasis and growth of California's exports has been in Asian markets, and most recently, following the implementation of NAFTA, Mexico. Total quantities exported and the distribution among markets are shown in figure 5.1.

The California Table Grape Commission's export-promotion program has targeted the primary Asian destinations: Hong Kong, Taiwan, Malaysia, and Singapore. Accordingly, the focus of our analysis of export demand and advertising and promotion was on Asian markets. The CTGC export promotion programs have been financed with the assistance of the U.S. government, as described in Chapter 2. Figure 5.2 shows the Commission's total annual promotional expenditure and annual export promotion expenditure. Promotional intensity has been higher in export markets: while consuming around 30.4 percent of total shipments in 1993, export markets attracted around 62 percent of total promotional expenditures. Figure 5.3 shows the allocation of the export-promotion expenditures among individual importing countries.

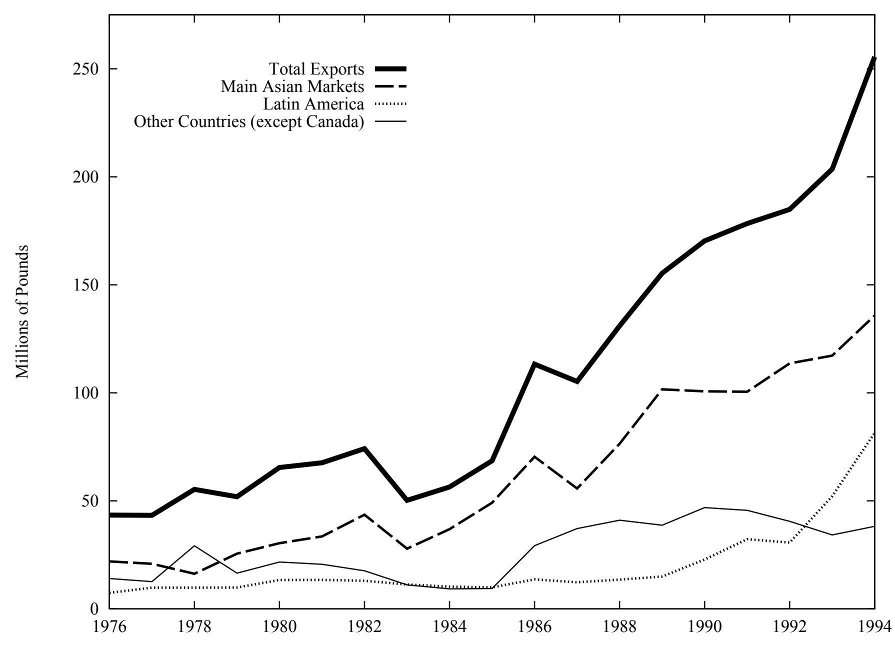

Figure 5.1: California Table Grape Exports, by Market (excluding Canada), 1976–1994

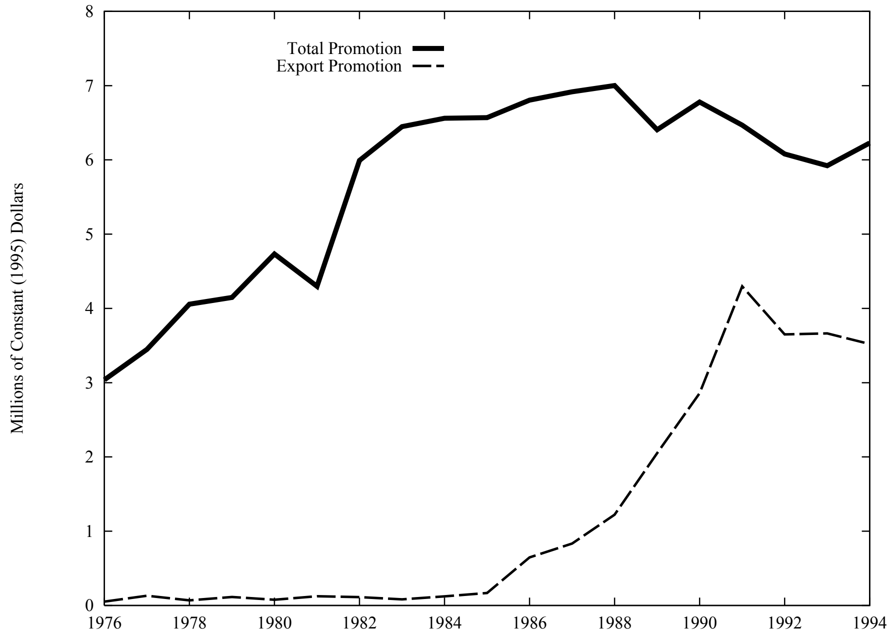

Figure 5.2: Annual CTGC Promotional Expenditure, Total and Export Markets

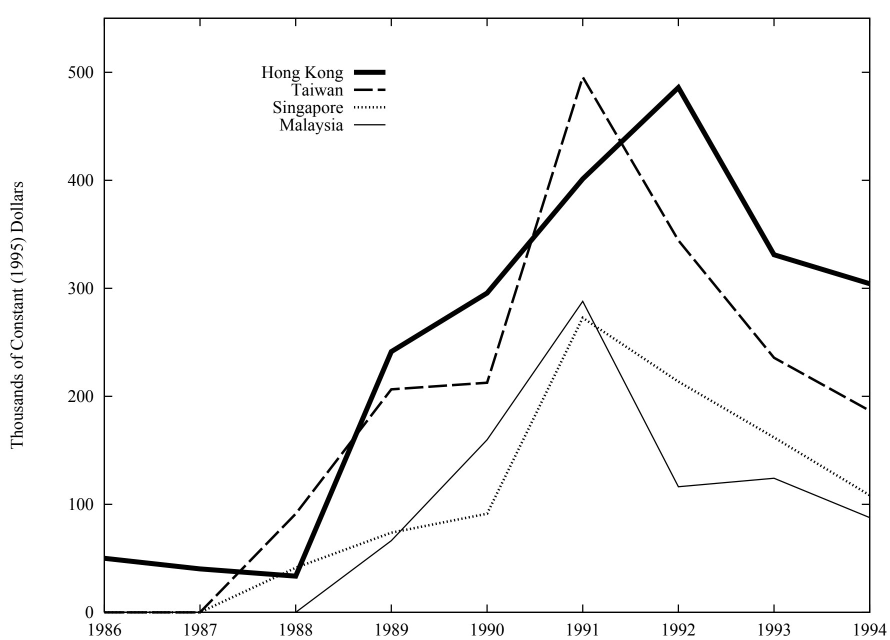

Figure 5.3: Annual CTGC Promotional Expenditure, Principal Export Markets

Below, we report the results of two sets of models. First, we studied the aggregate demand for U.S. grapes in eight primary importing countries (Hong Kong, Taiwan, Malaysia, Singapore, the Philippines, Indonesia, Thailand, and South Korea), using annual data on real per capita consumption, the real price of table grapes, real per capita income, and promotion, for the period 1976 through 1994. We used results from this effort to simulate the effects of changes in the level of promotion and calculate a benefit-cost ratio, with measures of precision, as we did with the aggregate annual U.S. model. In a second set, we used monthly data for the period 1986 through 1994 for four individual countries—Hong Kong, Malaysia, Singapore, and Taiwan. This served primarily as a check on the results from our aggregate annual export-demand model.

5.1 Aggregate Export Demand Models, 1976–1994

Aggregating models of demand across different countries is made difficult by the fact that different countries have different currencies. The use of market exchange rates to convert currencies to comparable units can be justified if per capita income differences are not too great, but this is not a perfect solution (purchasing power parity indexes may be better, but involve their own set of problems). There may be other sources of international differences in demand, too. Often, cultural differences among countries have important implications for demand relationships, and income differences are sometimes very large among countries, making typical consumption patterns different. It is often difficult to develop meaningful measures of the prices of relevant substitutes. Simple aggregation, treating all countries as being alike in terms of their demand response parameters, can be perilous in such circumstances. However, at the same time, there can be gains from aggregation which reduces the role of random variation among individual units of observation.

These types of problems are not different in kind from problems that arise in aggregating across individuals or regions within a country, but they may be more important. The countries included in the analysis we report in this section are relatively similar countries, in terms of per capita incomes and other aspects, and their currencies have been relatively stable in relation to the U.S. dollar. Thus, our aggregation of these countries for the present analysis may be appropriate. The Asian countries included here accounted for around 51.6 percent of U.S. table grape exports in 1994 (excluding Canada).

Demand Model Specification and Estimation

Following the work in Chapter 3, we constructed a relatively simple model, in which per capita consumption of California table grapes in the selected Asian countries in year t, X_t, depended on the real unit value of all California table grape exports (total value of exports to those countries divided by total quantity), $RUPG_t$, real per capita income (total expenditure) in those countries, $REXP_t$, and the real value of CTGC export promotion in those countries, $RPROMO_t$. All of the monetary variables in nominal U.S. dollars were expressed in real 1995 U.S. dollars by dividing by the U.S. CPI. Table 5.1 defines the variables included and the data sources. The data are listed in table B5.2 in Appendix B. We were unable to obtain a meaningful price of an individual alternative commodity to use as a substitute for grapes. The deflation by the CPI was a way of treating all other goods as a general substitute for grapes.

Since only 19 years of data were available, we limited our specification search to considering a linear model and a model that is linear except that we included the square root rather than the level of promotion (the square-root model); we estimated each model with and without a time trend. These alternatives were suggested by our results above using U.S. data. Following preliminary estimation on

Table 5.1: Data Definitions for Models of Aggregate Annual Export Demand for California Table Grapes

Variable	Definition	Units	Mean Value	Data Source
X_t	Per capita exports of table grapes to principal Asian markets in year t. Total exports to Korea, Taiwan, Hong Kong, Thailand, Malaysia, Singapore, Indonesia,a and the Philippines, divided by population in those countries.	Pounds per person per year	0.395	Exports from U.S. Department of Agriculture, Foreign Agricultural Service, *Foreign Agricultural Trade of the United States*. See appendix table B5.2. Population from International Monetary Fund, *International Financial Statistics*, and from national sources. See appendix table B5.3.
$RUPG_t$	Average real value of fresh-grape exports to principal Asian markets, calculated as total value of exports, divided by volume of exports, deflated using U.S. consumer price index.	Constant (1995) dollars per pound	0.752	USDA/AMS, *FATUS*. CPI from Bureau of Labor Statistics, series `CUUR0000SA0`, available at `http://www.bls.gov`.
$REXP_t$	Real per capita personal income, principal Asian markets. Converted from national currency to U.S. dollars using annual average market exchange rates, and deflated using U.S. CPI.	Thousands of real (1995=1) U.S. dollars per person.	0.963	International Monetary Fund, *International Financial Statistics*, and national sources. See appendix table B5.3.
$RPROMO_t$	CTGC promotional expenditures in principal Asian markets.	Millions of real (1995=1) U.S. dollars.	1.253	CTGC tabulations. See appendix table B5.4.

Table 5.2: Models of Aggregate Annual Export Demand for California Table Grapes

Independent Variables	(1)	(2)	(3)	(4)
$RUPG_t$	-0.177	-0.015	-0.124	-0.051
	[-3.72]	[-0.13]	[-2.71]	[-0.49]
	(-1.18)	(-0.10)	(-0.83)	(-0.34)
$REXP_t$	0.068	0.043	0.057	0.044
	[1.54]	[0.96]	[1.74]	[1.20]
	(0.61)	(0.39)	(0.51)	(0.40)
$RPROMO_t$	0.011	0.006	-	-
	[1.71]	[0.82]	-	-
	(0.14)	(0.08)	-	-
$\sqrt{RPROMO_t}$	-	-	0.039	0.031
	-	-	[3.07]	[1.91]
	-	-	(0.21)	(0.17)
$YEAR_t$	-	0.007	-	0.003
	-	[1.54]	-	[0.77]
CONSTANT	0.157	-13.369	0.108	-6.657
	[3.47]	[-1.52]	[2.61]	[-0.76]
R^2	0.92	0.94	0.95	0.95
$\overline{R}^2$	0.91	0.92	0.93	0.93
D.W.	1.76	1.85	1.97	2.07
Sample	1978–94			

Notes: t statistics in brackets, elasticities at means in parentheses. All equations were estimated using OLS.

the full period 1976–1994, we dropped the first two observations; the four alternative models, estimated over 1976–1994, are reported in table 5.2.

As can be seen in table 5.2, including the year as a time-trend variable did not improve the model. The square-root model was generally superior to the linear model statistically, as well as having the advantage of imposing diminishing returns to promotion. The square-root model was, once again, the preferred model. Its R^2 indicated that this simple model—given in column (3) of table 5.2—accounted for a very high proportion of the variation in per capita consumption. The coefficients imply plausible values for elasticities of demand with respect to price (-0.83), income (0.51), and promotion (0.21). Our estimated income coefficient was not statistically significant, however. The Durbin-Watson statistic indicates no problems with autocorrelation of the error terms

Diagnostic tests were applied to the preferred model, using the *DIAGNOSTIC* procedure in SHAZAM. Using these tests, we could reject neither the hypothesis of a constant error variance, nor the hypothesis of a stable model structure across the sample period.[1] Our preferred model for aggregate annual per capita export demand among the selected Asian countries thus is the one in column (3):

$$X_t \quad 0.108 - 0.124\ RUPG_t + 0.0566\ REXP_t + 0.0385\sqrt{RPROMO_t}$$
$$R^2 \quad .95 \quad D.W. \quad .970 \qquad =1 \qquad (5.1)$$

That this model tracks the sample data well can be seen in the plot of fitted values against actual values in figure 5.4. In addition, also in figure 5.4, a plot of fitted values, and fitted values with the promotion variable counterfactually set at zero, shows that a rising and eventually large share of total consumption is attributed by the model to promotion's effect.

Even though the model fits well, we regarded these results as somewhat tenuous. They were obtained from a very simple model, aggregating across a number of different countries, using unit-value data rather than prices, and in which the estimated price response was statistically insignificant. We have not searched for the best specification.

Benefit-Cost Simulation

As for the domestic demand model, we can use the model of export demand to simulate counterfactual scenarios and develop estimates of benefits from export promotion. To do this, we require a model of supply to the export market. In a competitive market, the export supply function can be represented as an excess-supply function, given by the difference between total supply and domestic demand. The elasticity of the excess-supply function is then given by the following formula:

$$\varepsilon_x \quad \frac{Q}{X}\varepsilon + \frac{Q-X}{X}\eta,$$

where Q is total production, X is the quantity exported, ε is the domestic supply elasticity, η is the absolute value of the domestic demand elasticity, and ε_x is the export demand elasticity.[2] Thus, the export supply function becomes more elastic as either total supply or domestic demand becomes more elastic, and as the fraction of production exported increases. Suppose 25 percent of production is exported, and the domestic demand elasticity is -0.5. Then, even if total supply were fixed ($\varepsilon = 0$), the elasticity of supply of exports would be 1.5. Any domestic supply response to price would add to the export supply elasticity.

In the simulations reported below, we used the same model structure as we did for the domestic market analyzed in Chapter 3: the estimated demand model and a constant elasticity (export) supply function. We solved for equilibrium prices and quantities using the 10,000 replications and the actual values of promotion, zero promotion, and a 10 percent increase in promotion.[3] We also simulated the

[1] The Maximum-Chow test indicated a possible structural change at the mid-point of the data, but the test was only nominally significant at the 5 percent significance level, and not at the 1 percent significance level. Since the nominal significance level overstates the true significance level when the test is conducted sequentially, this test probably should be regarded as not rejecting a stable model over the data at the 5 percent significance level (Alston and Chalfant 1991). However, it does mean that, if applied to the midpoint, a conventional Chow test would reject the stability hypothesis.

[2] The supply to the domestic market can be seen as an excess supply, by the same token: the difference between total supply and export demand. Hence, the elasticity of supply to the domestic market is given by the same formula, after replacing the domestic demand elasticity and export quantity with the export demand elasticity and domestic quantity consumed, respectively. With an export demand elasticity of -1, for instance, and a domestic consumption share of 75 percent, when total supply is fixed, the elasticity of supply to the domestic market is 1/3.

[3] In this set of simulations, a small fraction of draws were discarded, since they implied positive values for the demand elasticity. This situation arose because the precision of the estimate of the slope of demand with respect to the price of grapes was low: given a t value of -2.71 with 13 degrees of freedom, about 1 percent of the draws of that parameter would be positive numbers.

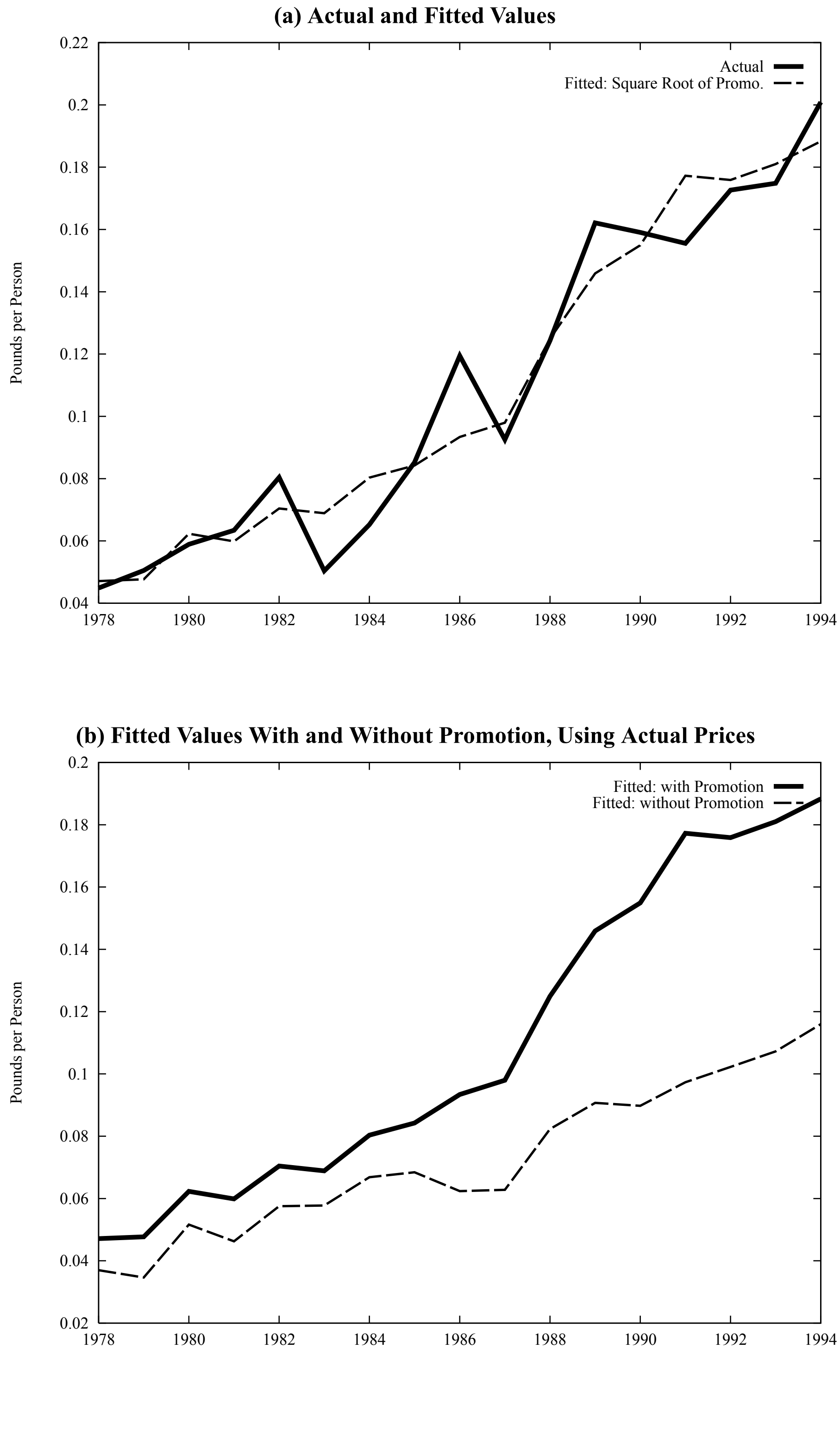

Figure 5.4: Actual and Fitted Values—Export Demand, With and Without Promotion

incidence of the application of a check-off to raise the funds to pay for the changes in promotion being simulated. An important difference in interpretation arises because the consumers, in this case, are not Americans. And, at the same time, the source of the funds may not be table grape consumers and producers, since the funds may be provided from general government revenues, rather than a producer check-off. Since the simulations were conducted using an export-supply function, the corresponding measure of "producer surplus" is, in fact, net domestic surplus, reflecting induced changes in welfare of both producers and domestic consumers when price changes.[4]

Table 5.3 contains the results of our simulations using supply elasticities to the export market of 1, 2, 5, and 10, combined with the point estimates of the parameters of the demand model.[5] The upper half of table 5.3 refers to estimates using zero percent to compound the benefits forward over time; the lower half, a three percent compounding rate. Since they are smaller, but not much different, we will focus on the measures using zero percent (the upper half). Finally, let us look at the third column, derived using a supply elasticity of 5.

The first entry in this column indicates that, over the 17-year period, the total U.S. benefits from export promotion in these Asian markets were $23.8 million. The next entry down shows that the total domestic-market incidence of costs, if an export assessment had been used to finance that promotion, would have been $1.2 million over the same period. The next entry down is simply the amount spent on promotion, $23.8 million, also over the same period. The ratio of the total domestic benefit to the domestic incidence of the export assessments to finance the full amount was 20.6:1. The fifth and final entry in this set shows that the ratio of the total domestic benefit to the total cost of promotion was 1.0:1, indicating that the benefits were sufficient to cover the expenditures on the program. This measures the *social* benefit-cost ratio, in the case where the promotion is fully funded by general government revenues costing one dollar to the United States per dollar spent.

The next set of five entries in the same column refers to the same measures of benefits and costs, but considers a marginal increase of 10 percent, rather than looking at total benefits relative to the total promotional expenditure. The first entry in this group indicates that, in total, over the 17-year period, the United States would have benefited by $1.2 million, if the export promotion expenditure had been increased by ten percent over the actual value in each year. The next entry down shows that the total domestic cost, had export assessments been used to finance that additional promotion, would have been $0.1 million over the same period. The next entry down shows that the cost of spending an additional ten percent on export promotion in every year would have been $2.4 million over the 17-year period. The ratio of the marginal domestic benefit to the domestic incidence of the assessments is 9.7:1, a little under half the corresponding average benefit-cost ratio. The fifth and final entry in this set shows the mean value of the ratio of the marginal domestic benefit to the total cost of an additional ten percent expenditure on export promotion in every year. This ratio was 0.5:1; also about half the value of its counterpart reflecting average rather than marginal benefits and costs.

Increasing the supply elasticity changed the ratio of the domestic benefits to the total expenditure, but did not change the ratio of the domestic benefits to the domestic incidence of an export tax used to finance export promotion. The figures for the 99 percent lower bound (see Appendix table A5.3) indicated that, even if a very pessimistic view were taken, the benefit-cost ratios could be acceptable from

[4]The assessment, in this case, acts similarly to an export tax. The incidence of an export tax is partly on foreign consumers and partly on domestic producers, but domestic consumers benefit.

[5]Appendix table A5.1 shows the mean of the results from the subset of the 10,000 draws that were acceptable (having negative price slopes); table A5.2 presents the corresponding 99 percent upper boundary and table A5.3 presents the corresponding 99 percent lower boundary.

Table 5.3: Benefits and Costs of Export Promotion of California Table Grapes

	Supply Elasticity			
	1.0	**2.0**	**5.0**	**10.0**
0 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	57.8	37.0	18.2	10.0
Present value, Producer cost incidence	7.4	4.4	2.0	1.1
Present value, Total program expenses	23.8	23.8	23.8	23.8
Producer Benefits/Producer Costs	7.8	8.3	8.9	9.2
Producer Benefits/Total Expenses	2.4	1.6	0.8	0.4
Marginal benefits, costs:				
Present value, Producer benefits	3.2	2.0	0.9	0.5
Present value, Producer cost incidence	0.8	0.5	0.2	0.1
Present value, Total program expenses	2.4	2.4	2.4	2.4
Producer Benefits/Producer Costs	4.1	4.1	4.2	4.2
Producer Benefits/Total Expenses	1.4	0.8	0.4	0.2
3 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	71.1	45.9	22.8	12.6
Present value, Producer cost incidence	8.9	5.4	2.5	1.3
Present value, Total program expenses	27.9	27.9	27.9	27.9
Producer Benefits/Producer Costs	8.0	8.5	9.1	9.4
Producer Benefits/Total Expenses	2.5	1.6	0.8	0.4
Marginal benefits, costs:				
Present value, Producer benefits	3.9	2.5	1.2	0.6
Present value, Producer cost incidence	0.9	0.6	0.3	0.1
Present value, Total program expenses	2.8	2.8	2.8	2.8
Producer Benefits/Producer Costs	4.2	4.2	4.3	4.3
Producer Benefits/Total Expenses	1.4	0.9	0.4	0.2

Notes: Computations based on OLS estimates of export demand, using square root of promotional expenditures. Present values are in millions of constant 1995 dollars.

Table 5.4: Variables used in Models of Demand for California Table Grapes for Selected Asian Markets

Variable	Definition	Units	Data Source
X_t	Per capita exports of table grapes to selected Asian markets. Total exports to Hong Kong, Malaysia, Singapore and Taiwan, divided by population in each country.	Pounds per person per month	Exports from CTGC special tabulations. See appendix table A5.4. Annual population from International Monetary Fund, *International Financial Statistics*, and from national sources. See appendix table A5.6.
RPG_t	Average Los Angeles Real Wholesale Price of Thompson Seedless grapes	Real (1995=1) dollars per pound	Federal-State Market News Service,*Los Angeles Fresh Fruit and Vegetable Wholesale Market Prices*, CDFA and USDA, Los Angeles.
$REXP_t$	Real per capita personal income for each country, converted from national currency to U.S. dollars using annual average market exchange rates, and deflated using U.S. CPI.	Thousands of real (1995=1) U.S. dollars per person.	International Monetary Fund, *International Financial Statistics*, and national sources. See appendix table A5.6.
RAD_t	CTGC advertising expenditures in principal Asian markets.	Thousands of real (1995=1) U.S. dollars.	CTGC tabulations. See appendix table A5.5.
$ROTHPROMO_t$	CTGC advertising expenditures in principal Asian markets.	Thousands of real (1995=1) U.S. dollars.	CTGC tabulations. See appendix table A5.5.

the point of view of the grape industry, but might fall below 1.0:1, depending on the supply elasticity and the method of financing the promotion.

5.2 National Import Demand Models for Table Grapes

The remaining element of our analysis of export promotion of table grapes looked at four specific markets, using monthly data for 1986 through 1994. The countries we analyzed were Hong Kong, Malaysia, Singapore, and Taiwan. The model was essentially the same as was used above for the aggregated annual export data. For the individual country studies, however, we included two separate promotion variables for each country j: the real value of advertising expenditure, RAD_{jt}, and the real value of other promotional expenditure, $ROTHPROMO_{jt}$, with both variables included in square-root form. In addition, monthly data on Thompson Seedless prices in the Los Angeles wholesale market were used. Thus, the import demand models for the four countries took the form

$$\begin{aligned} X_{jt} \quad & \beta_0 + \beta_{PG} RPG_{jt} + \beta_{EXP} REXP_{jt} \\ & + \beta_{RAD}\sqrt{RAD_{jt}} + \beta_{ROTH}\sqrt{ROTHPROMO_{jt}} \end{aligned} \tag{5.2}$$

All of the monetary variables were expressed in real U.S. dollars. The variables are defined in table 5.4, with mean values for the variables for each country in table 5.5, and the data listed in tables B5.3–B5.5 in Appendix B.

The models for the four countries were estimated as a system of equations, using

Table 5.5: Means of Variables used in Models of Demand for California Table Grapes for Selected Asian Markets

Variable	Hong Kong	Malaysia	Singapore	Taiwan
	mean values			
X_t	0.847	0.033	0.548	0.182
RPG_t	0.847	0.847	0.847	0.847
$REXP_t$	9.235	1.504	7.081	4.964
RAD_t	34.96	13.59	15.53	27.59
$ROTHPROMO_t$	15.96	10.48	14.59	19.92

seemingly unrelated regressions (SUR) to account for possible contemporaneous correlation of the error terms across the equations for the different countries. We did not impose any equality restrictions on the parameters across the equations, as there seemed to be important differences in the demand relationships. The results of these regressions are summarized in table 5.6.

The results in table 5.6 are reasonably satisfactory overall, but somewhat mixed. The R^2 statistics indicate that the models accounted for between 39 percent and 66 percent of the variation in per capita consumption. The Durbin-Watson statistics indicated that autocorrelation may have been a problem in the models for Hong Kong and Singapore.

The economic implications of the estimated coefficients are plausible, suggesting that the models may be reasonable. In each of the four countries, the own-price elasticity of demand for U.S. grapes was estimated to be negative, and statistically significant. The elasticity at the mean of the sample data ranged from -0.47 in Malaysia to -1.43 in Taiwan, a plausible set of values given the (unknown) potential for substitution of grapes from other countries for U.S. grapes. The coefficient on real income ($REXP_t$) was unexpectedly negative, but statistically insignificant, in three countries. It was positive and significant only in Singapore, implying an income elasticity of demand for U.S. table grapes of 2, perhaps larger than expected, but plausible. In such models, income could well be acting as a proxy for any of a number of trend variables that have been omitted from the model, so it is hard to interpret these coefficients with confidence.

In every country, the coefficients on both advertising variables were positive. In Singapore, however, the coefficient on the square root of real advertising, RAD_t, was not statistically significantly different from zero. The coefficient on the square root of other promotion, $ROTHPROMO_t$, was not statistically significantly different from zero in three of the countries, Malaysia being the exception. Interestingly, however, the point estimates implied a narrow range of elasticities of demand with respect to both of the promotion variables, at the sample means, among the four countries. The elasticity of demand with respect to real advertising, RAD_t, ranged from 0.03 to 0.11; the elasticity of demand with respect to other promotion, $ROTHPROMO_t$, ranged from 0.05 to 0.15.

In short, with the exception of Singapore, the models indicated that promotion, especially advertising, has had a statistically significant, positive effect on demand for California table grapes in each of the countries. Even in Singapore, the results are suggestive of a positive effect. These results reinforce the results above using aggregate annual data for a larger number of Asian countries over a longer time period, although the monthly elasticities of demand response to promotion in the individual countries are somewhat smaller than in the annual aggregate model.

Table 5.6: Monthly Per Capita Demands for U.S. Grapes, Selected Asian Markets, 1986–94

Independent Variables	Hong Kong	Malaysia	Singapore	Taiwan
RPG_t	-0.672	-0.033	-0.311	-0.314
	[-2.57]	[-2.11]	[-2.04]	[-2.97]
	(-0.66)	(-0.81)	(-0.47)	(-1.43)
$REXP_t$	-0.014	0.045	-0.040	-0.019
	[-0.64]	[3.10]	[-1.76]	[-1.31]
	(-0.16)	(2.03)	(-0.51)	(-0.52)
$\sqrt{RAD_t}$	0.089	0.001	0.037	0.011
	[7.11]	[1.30]	[3.83]	[2.49]
	(0.11)	(0.03)	(0.05)	(0.06)
$\sqrt{ROTHPROMO_t}$	0.042	0.003	0.085	0.017
	[1.32]	[0.97]	[2.75]	[1.54]
	(0.05)	(0.08)	(0.15)	(0.09)
CONSTANT	1.010	-0.020	0.686	0.433
	[3.44]	[-0.86]	[4.07]	[3.80]
R^2	0.65	0.42	0.46	0.39
$D.W.$	1.25	1.14	1.71	1.93

Notes: t statistics in brackets, elasticities at means in parentheses. Equations estimated as a set of Seemingly Unrelated Regressions.

6. IMPLICATIONS OF BENEFIT-COST RESULTS

In the previous chapters, we have reported the results of various econometric analyses of the demand for California table grapes, measured the demand response to promotion in domestic and export markets, and used the results to evaluate the benefits and costs of the programs. The purpose of this chapter is to summarize our main findings, integrate them, interpret what they mean, and draw inferences.

6.1 Integrating Results

Our different models, using data for different markets, or using data collected at different frequencies or over different time periods, tell remarkably similar stories about the nature of demand for California table grapes, and the demand response to promotion. In every case, the analyses indicated that a linear model of demand, with the promotion variable entering in square-root form, was preferred. The square-root model allows diminishing marginal returns to promotion, a desirable feature. We performed a wide range of tests against alternative functional forms with the aggregate annual model, in particular.

Price Elasticities

The preferred aggregate annual demand model (table 3.2, column 6) indicates an own-price elasticity of demand for California table grapes of -0.51 at the mean of the sample data. This is a plausible value, entirely in keeping with prior expectations. Most fruits would be expected to face inelastic demands (for example, George and King 1971). In the monthly model of aggregate U.S. and Canadian per capita demand (table 4.1, column 4), the estimated elasticity of demand was slightly smaller, -0.34, but probably not statistically significantly different from the annual model's -0.51. We obtained these estimates using data from 1969 through 1993. In the model based on monthly data from selected U.S. cities, for 1992 and 1993, the corresponding price elasticity was estimated as -0.30 (table 4.3, column 3). It may well be that the true monthly demand elasticities are smaller than annual ones—sluggish adjustment or habit persistence in consumption patterns would imply that shorter-run elasticities are smaller. It is also relevant to note that our OLS estimate of the annual model yielded a price elasticity of -0.29; it was only when we used weighted least squares that the elasticity became as large as -0.51. Although the OLS estimates are not biased, the weighted least squares estimates are preferred on statistical grounds.

The estimated own-price elasticities from our export demand models were consistent with both prior expectations and our domestic demand models. In the preferred aggregate annual export demand model, the own-price elasticity of demand for California table grapes was estimated to be -0.48 (table 5.2, column 3). In the individual monthly demand models for selected countries, the elasticity ranged from -0.47 to -1.43, generally not statistically significantly different from -0.51 (table 5.6).

Income Elasticities

We were somewhat less successful at estimating the elasticity of demand with respect to income (or total expenditure on all goods), which is a common outcome in time-series demand models. Since per capita income tends to follow a smooth trend, it is difficult to accurately measure the demand response to changes in income; cross-sectional data contain more useful variation in income and are probably better for measuring the relevant income effects. In the aggregate annual model, the estimated income elasticity is 0.51, which is plausible, but the parameter is not (quite) statistically significant. In the aggregate monthly model, the coefficient was negative but not statistically significant. In the city-month model, using cross-sectional data, our income elasticity estimate was 0.41, consistent with the annual model, and statistically significant. Finally, in the aggregate export demand model, our income elasticity estimate was 0.85, and statistically significant. A larger income elasticity would be expected to be found in countries having lower per capita incomes, so this is plausible and consistent with our results for the United States.

Demand-Shift Variables

We tried time-trend variables in all of the demand models, but never found them to contribute significantly to the regressions. There was some evidence of discrete structural change in the domestic aggregate models. In our aggregate annual demand model, specific demand shifters included the Thompson Seedless share (a positive and statistically significant effect) and the quantity of imports from Chile (a positive effect, but not statistically significant). A similar story holds for our monthly aggregate demand model. Increases in both Chilean imports and the Thompson Seedless share were found to have positive effects on demand, but, in the monthly model, the effect of Chilean imports was statistically significant, while that of the Thompson Seedless share was not; a reversal compared with the annual model. There is some evidence, then, that both of these variables may have contributed positively to demand.

Promotion Variables

We now turn to the demand shifter of greatest interest for the present study, promotion. As noted above, in every case, we preferred models in which promotion variables entered in square-root form. In the aggregate annual demand model (table 3.2, column (6)), the effect of promotion was positive and statistically significant: the elasticity of demand with respect to promotion at the mean of the sample data is 0.16. In the aggregate monthly model (table 4.1, column (4)), the effect of promotion was also statistically significant, and the corresponding elasticity was 0.22.

The city-level monthly demand model used a moving average of radio and TV advertising expenditures, rather than an aggregate promotion variable. The effect was statistically significant and positive, and the implied elasticity of demand with respect to promotion in the model without the lagged dependent variable (table 4.3, column (3)) was 0.34. This was larger than the estimates using annual data, or monthly data, for total promotion, which is plausible. It may well be, for instance, that demand is more elastic with respect to advertising than other forms of promotion. It may also be that the estimated response was larger because it is easier to identify the timing of advertising, whereas we have to attribute the effects of other promotion over the year as a whole, not knowing the exact pattern of promotion within the year. The absolute magnitudes may be more open to question than the relative magnitudes, however. Finally, the elasticity of aggregate annual export demand with respect to promotion was 0.21 (table 5.2, column (3)), while the elasticities of monthly demand with respect to advertising in individual export markets were much smaller, and less frequently statistically significant.

Our elasticities of demand with respect to promotion were generally consistently high, well beyond the range that would be sufficient to justify the past promotional expenditures (as we will show later, given a price elasticity of -0.5, an expenditure on promotion of 2 percent of the gross value of sales would require an elasticity with respect to promotion of 0.01, much less than 0.16 or 0.30, in order to pay for itself). Consequently, our estimates imply very high benefit-cost ratios, even when we make the most conservative assumptions (that is, combining parameter values in ways that make the benefits relatively low).

Benefit-Cost Analysis

Estimated benefit-cost ratios were very high for both domestic and export promotion, using our point estimates of parameters from the preferred models. This result follows from the (perhaps surprisingly) high measured elasticities of demand response to promotion. Assuming that the parameters were measured precisely, our results indicate that the California table grape program has been very profitable for producers. Alternatively, if we are uncertain about the exact value of the parameters, the results can be taken as indicating that our estimates would have to be wrong by a great margin before we would change our conclusion that the benefits have been greater than the costs. Indeed, even looking at the 99 percent lower bound from our Monte Carlo simulations for domestic promotion, the benefit-cost ratios were substantially greater than one.

The high marginal benefit-cost ratios may be taken as indicating that it would pay to increase both the expenditures on promotion and the assessments used to finance promotion. Comparing the benefit-cost ratio from domestic promotion with the lower ratio from export promotion, it might appear to be profitable for the industry to divert promotional resources from the export market to the domestic market. However, this implication should not be drawn without paying due attention to the fact that only a part of the costs of export promotion are financed by assessments. Taking this into account, the evidence probably does not provide any basis for believing that promotional funds should be reallocated in either direction.

6.2 Alternative Interpretations

Consistently high estimated benefit-cost ratios for public investments in agricultural research across numerous studies have led many to conclude that, in spite of government intervention to correct the underinvestment that would arise from the unfettered workings of the free-market mechanism, too little is still being invested and further (or different) government action is warranted (for example, see Alston and Pardey 1996). In other words, the rationale for collective action is private-sector underinvestment, owing to problems of free-riders and inappropriability of benefits from individual investments in R&D; by the same rationale, the benefit-cost ratios indicate that the action has not eliminated the market failure. Similar conclusions might be drawn from evidence of (remarkably) high benefit-cost ratios for promotion undertaken by a producer group. The reason for taking collective action is because it is believed that the benefits will outweigh the costs. The high benefit-cost ratios could indicate that the collective action has not gone far enough, that the industry should be spending even more on its promotion program, and, given access to the information here, would.

This is not the only interpretation that can be placed on our evidence. Three alternative interpretations of high measured benefit-cost ratios are possible, and they are not entirely mutually exclusive:

- First, the benefit-cost ratio could be wrong. A high benefit-cost ratio might be estimated even though the true benefit-cost ratio would indicate no underinvestment (that is, the true marginal benefit-cost ratio may be 1:1 or even less).

- Second, the benefit-cost ratio could be right but, if those making investment decisions do not believe the underlying estimates of response relationships, and do not believe that the true ratio is greater than 1:1 at the margin, they will not believe they are underinvesting and will continue to underinvest.

- Third, the benefit-cost ratio could be right, those making investment decisions could believe it to be true, and yet they could still continue to underinvest from the point of view of the industry, or society as a whole. This outcome is a type of institutional failure. If the effective objective of the producer group is not simply to maximize benefits to the industry as a whole, but also to pay attention to the distribution of benefits among different subgroups of producers, a persistent underinvestment is likely even when there is no uncertainty about the payoff to the industry as a whole.

In the context of high measured benefit-cost ratios for promotion undertaken by the California Table Grape Commission, all three explanations may have something to contribute. Until now, formal estimates of the benefits and costs of the CTGC's promotion program have not been available. It may well be that, until now, the best estimate of benefits relative to costs would have been a conservative one, indicating no basis for believing there to be a substantial underinvestment in promotion. For some, that view will change as a result of our work.

Nevertheless, it can be expected that our estimates will be viewed with skepticism by some readers. However, even the most skeptical reader would find it difficult to reach any conclusion, based on the data we have analyzed, other than that the benefits have well exceeded the costs. We have provided measures of precision of the benefit-cost ratio. Even our 99 percent lower bound is still an impressive benefit-cost ratio. In addition, the results from our annual model have been corroborated by the results from our monthly models and our disaggregated models of individual cities. The CTGC's export-promotion investments also seem to have been profitable. We cannot, and would not, rule out the possibility that our best point estimates overstate the true average and marginal benefit-cost ratios. However, we subjected the model to a number of tests for misspecification, and tried some alternative models, none of which changed our results much. Hence, we are confident that any reasonable reading of the information we have generated leads to a view that the evidence indicates a high benefit-cost ratio and a persistent underinvestment. Below, we explore ranges of parameters to establish what one would have to believe about the demand response to promotion, the supply elasticity, or both, to believe that the true benefit-cost ratio is 1:1.

We cannot rule out the third possibility: institutional failure. Tensions arise among individuals because they have different economic interests in the timing and form of promotion undertaken. Within any industry group, different producers produce different varieties that reach different markets at different times. Consequently, not all producers benefit equally, or even equiproportionally, from any given promotional program—even if it is strictly generic in nature. It can be expected that, in accommodating such tensions, those making investment decisions will be driven in the direction of devising programs with a more equal distribution of benefits, even though they may forego benefits in total. In addition, since, in large groups, the complete satisfaction of all members that their interests are being maximized is impossible, there will be a tendency to underinvest in total. Only if all producers had identical interests could this be avoided.

6.3 Suspending Disbelief

In this section, we report the results of simulations we conducted to establish the range of combinations of parameter values that would be required to indicate that the true marginal benefit-cost ratio is 1:1, rather than our estimated value. In this way, we hope to establish a measure of confidence that the benefit-cost ratio is indeed greater than 1:1, by seeing how far we have to deviate from our parameter estimates in order to reduce the benefit-cost ratio to 1:1. We conducted simulations based on a hypothetical increase of 10 percent in promotion expenditure in 1993, with producer levies increased by just enough to pay for that increase in promotion.

We considered two parameters in the aggregate domestic demand model to be critical: the own-price elasticity (measured by the slope coefficient β_{RPG}) and the elasticity of demand with respect to promotion (measured by the slope coefficient β_{RPROMO}); we also looked at the supply elasticity, ε. First, we fixed each of these key parameters at its point estimate (with a value of 1.0 assumed for the supply elasticity), and found that a 10 percent increase in promotion expenditures implied a nearly $12 million increase in producer surplus. Then we varied each parameter in turn, holding the others constant, to find the value for the parameter in question that would imply no increase in producer surplus. This is the value that would have to be true for the change in promotion expenditures to represent a breakeven proposition, increasing producer revenues by no more than the increase in cost, equivalent to a marginal benefit-cost ratio of 1:1, comparing the producer benefit to the producer's share of the total cost of the promotion expenditure. These results indicate that, even if the own-price elasticity of demand were to increase in absolute value to over 20.0 (compared with 1993's value of 0.25), or even if the supply elasticity were greater than 10, there would still be a small profit from increased promotion expenditures. These values are quite extreme, supporting our conclusion that increases in promotion expenditures would indeed be profitable using our best point estimates. Alternatively, using the best estimate of the own-price elasticity of demand and an assumed supply elasticity of 1.0, the elasticity of demand with respect to promotion would have to be reduced by a factor of 1/100, to 0.00146, before the 10 percent increase in promotion expenditures would not be profitable.

Finally, we tried alternative (more elastic) values of the demand elasticity and once more solved for the elasticity of demand with respect to promotion that would yield a benefit-cost ratio of 1:1. The relationship between the price elasticity and promotion elasticity that, in combination, would make the benefit-cost ratio 1:1 is approximately linear. What this means is that, if we double the price elasticity, we also double the break-even promotion elasticity, to 2/100 of its original value. If the price elasticity is four times as large as our point estimate in 1993 of -0.25 (that is, around -1), then it still would require reducing the promotion elasticity to 4/100 of its original value, or around 0.0064, before the increased promotion expenditures would be a break-even proposition. In summary, it requires extreme changes in the parameter estimates from our estimated aggregate demand relationship to reverse the conclusion that promotion expenditures are profitable for producers.

6.4 Optimal Advertising Intensities and Checkoffs

Much of the literature on optimal primary product promotion rests on two seminal papers on the economics of advertising: Dorfman and Steiner (1954) and Nerlove and Waugh (1961). According to the Dorfman-Steiner theorem, given fixed output, a monopolist will maximize profits by setting the advertising budget such that the increase in gross revenue resulting from a one dollar increase in advertising expenditure is equal to the ordinary elasticity of demand for the product. That is,

$$\frac{\partial v}{\partial a} \quad \eta,$$

or

$$\frac{a}{v} \quad \frac{\alpha}{\eta}$$

where

$$\alpha \quad \frac{\partial v}{\partial a}\frac{a}{v}.$$

In this equation, a is the advertising expenditure, v is the value of sales (the product of price, p, and the quantity sold, q), α is the elasticity of demand with respect to advertising, and η is the absolute value of the own-price elasticity of demand. The Dorfman-Steiner result may be applicable to a number of primary products where output is fixed (for example, by a quota) and a marketing organization advertises on behalf of producers. However, a different rule is required either (a) when the monopolist can optimize quantity along with advertising, or (b) when the funds for advertising must be raised by a per-unit levy on output so that, unlike the Dorfman-Steiner case, in which advertising is funded in a lump-sum fashion independently from output, the marginal cost of the commodity depends on the rate of advertising.[1]

The more relevant reference for a study of promotion by a producer group without the ability to control output is that by Nerlove and Waugh (1961). Like Dorfman and Steiner (1954), Nerlove and Waugh (1961) modeled a case where advertising is funded in a lump-sum way, unrelated to output, with the implication that all of the advertising cost is borne by producers. That approach has been adopted in many subsequent studies of primary product promotion.

Alston, Carman, and Chalfant (1994) extended the Nerlove-Waugh model to the situation where advertising is funded by a per unit check-off. Their derivations are as follows. The industry demand and supply functions are written as

$$q \qquad D(p,a) = D(p,tq)$$
$$q \qquad S(p-t) = S(p*)$$

where t is the per unit check-off used to fund advertising. The difference here, from the Nerlove-Waugh model, is that, on the supply side, the supply price depends on the check-off (which, for given quantity, is synonomous with advertising expenditure) and, as a result, advertising expenditures a, price p, and quantity q are jointly endogenous given an exogenous check-off t.

When the objective is to maximize producer surplus, intuitively, producers will prefer to increase the check-off and advertising so long as, at the margin, demand shifts up by more than supply, so that equilibrium quantity increases,giving rise to an increase in producer surplus. Hence, the check-off will be optimized when an increase in the check-off yields an additional vertical shift in demand of the same amount per unit so that, at the margin, the combined advertising and check-off will have no net effect on quantity, and

$$\frac{\partial q}{\partial t} \quad . \qquad\qquad 0$$

This condition for optimal advertising, when it is financed by a check-off, was established by Alston, Carman, and Chalfant (1994). Clearly the same rule applies for any other type of demand enhancement funded by a check-off.

Alston, Carman, and Chalfant (1994) solved for the optimal tax, defined by setting $\partial q/\partial t$ $=0$. The condition for optimal advertising that they derived is

$$\frac{a}{v} \quad \frac{t}{p} \quad \frac{\alpha}{\eta}.$$

This is the same as the Dorfman-Steiner condition for optimal advertising by a monopolist with fixed output. It is different from the Nerlove-Waugh condition for optimal advertising financed in a lump-sum fashion (but equivalent if the producers' share of the lump sum is equivalent to their share of a check-off).

[1] Conboy, Goddard, and McCutcheon (1992) contrast the case where advertising is a fixed cost (funded in a lump-sum fashion) and a variable cost (funded by a check-off) and show how the Dorfman-Steiner optimal advertising expenditure rule for a monopolist is affected. They also contrast the Dorfman-Steiner rule with the rule for a monopolist who can optimize quantity as well as price and advertising (for an earlier analysis of this question, see Alston 1980) when advertising is financed by a check-off or as a lump sum. Also, see Goddard, Griffith, and Quilkey (1992), especially pp. 31-40.

The rule for the optimal advertising intensity can be applied to the CTGC's promotional program. At the optimum, the percentage check-off rate (or the advertising intensity) should be equal to the ratio of the elasticity of demand with respect to promotion, to the absolute value of the elasticity of demand with respect to price. From our aggregate demand model, at the mean of the sample data, the elasticity with respect to promotion was 0.16, while the absolute value of the elasticity with respect to price was 0.51. If these same elasticities applied at the optimum point, the ratio 0.31 implies that 31 percent of total gross revenue could be optimally spent on promotion. This is clearly an absurd result. We obviously cannot extrapolate these elasticities so far. The diminishing returns relationship means that the elasticity of demand response to promotion will decline, while the price elasticity is likely to be unaffected, as the promotional expenditure increases. However, the fact that the elasticity ratio for recent expenditure rates has been higher than the promotional intensity indicates that the expenditure has probably been significantly less than optimal.

7. CONCLUSION

In this report, we have measured the effects of promotion activities by the California Table Grape Commission on the demand for table grapes. The purpose of the study was to provide evidence on whether the program could be justified in terms of the benefits relative to the costs. The evidence indicates that the benefits from promotion in both domestic and export markets, in terms of higher net revenues to producers, have been many times greater than the costs of the expenditure on the programs.

The analysis used market-level data for the domestic market, taking the United States and Canada as a whole, and then for selected cities. We first looked at the effects of all promotion activities by the Commission on the total annual demand for all grape varieties.

We estimated an econometric model of domestic demand for table grapes, finding an own-price elasticity of demand of -0.51, an elasticity of demand with respect to income of 0.51, and an elasticity of demand with respect to promotion of 0.16. The model was linear in prices and income; we used the square root of promotional expenditures. The square-root model has attractive theoretical properties, in that it imposes diminishing marginal returns to promotion. It also fits the data better than its linear counterpart. In addition, the model included variables describing imports of grapes from Chile, and the share of Thompson Seedless in fresh grape production, as demand shifters to help account for possible structural change in the industry. The model was estimated using weighted least squares, to account for apparent heteroskedasticity. The model fits the data well, the coefficient estimates have the signs predicted by theory, and are mostly statistically significant. We applied a battery of diagnostic procedures to the econometric model, failing to find significant statistical problems with our final equation.

We used the parameter estimates in a benefit-cost analysis of the CTGC promotion programs, and we found that the increase in net sales revenue to the industry that is attributable to promotion more than offsets the cost of the promotion activities. A Monte-Carlo experiment was used to draw 10,000 sets of parameter values from a distribution consistent with the results of the regression analysis. This set of parameter values was used to construct a distribution of implied benefit-cost measures, which we used to construct a confidence interval for the benefit-cost ratios. Even using the lower 99 percent boundary as a conservative estimate of the returns to CTGC promotion, we found $5 million in benefits to the industry for an additional $1 million of domestic promotion. The mid-range of our estimates suggests that an extra $1 million would generate benefits of over $20 million.

Independent estimates of the demand relationship were developed using different data sets. We estimated a monthly version of the aggregate demand model, using month-by-month shipments to the United States and Canada, using monthly price data and annual expenditure, promotion, and demand-shift data. The results of the monthly estimates were consistent with the annual model. We also studied the effects of expenditures on radio and television promotion in selected markets, controlling for other factors that affect the demand for table grapes. This city-level demand analysis, using detailed monthly data, reinforced our confidence in the estimates of demand response to changes in price and promotion. The measured effects of radio and television advertising of table grapes were statistically and economically significant.

The study also looked at promotion's effects on demand in selected Asian export markets, and the results were comparable to those for the domestic market, although not quite as strong. We estimated per capita import demand for California table grapes in eight large Asian countries, using a specification very similar to that used for demand in the United States and Canada. We estimated an own-price elasticity of demand of -0.48, a demand elasticity with respect to income of 0.51, and an elasticity with respect to promotion of 0.21, again using a model that was linear in grape prices and quantities and income, and using the square root of promotional expenditures. We then used these parameter estimates, and information on their joint probability distributions, to conduct a stochastic benefit-cost analysis. Using our most conservative estimates, the benefit-cost analysis indicates that every $1 spent on export promotion has generated net benefits to the United States worth $1.80. If less conservative assumptions were used, the benefits may be over $11 per $1 spent. In the mid-range of our estimates, an extra $1 million of export promotion may generate benefits of $2 million.

In both the domestic and export market analyses, the range of estimates of benefits relative to costs does not derive from uncertainty about whether promotion has shifted demand, nor about how how much it has shifted demand. Rather, it results from our uncertainty about parameters that translate a given shift in demand into changes in price and quantity. A shift in demand may be thought of as either an increase in consumers' willingness to pay for a given quantity of grapes, reflected in a higher price per unit for a given quantity of grapes, or as an increase in the quantity of grapes demanded at a given price. How this translates to changes in price received and quantity sold depends on supply conditions. If the supply of grapes is fixed, an increase in demand translates entirely into an increase in price. To the extent that an increase in price brings forth more grapes on the fresh market, however, the increase in price is smaller and part of the increase in demand shows up through a larger quantity of grapes sold on the fresh market. Typically, there will be some of both effects following successful promotion—an increased price and an increased quantity sold.

Much of the variation in our estimates derives from varying the assumed supply response to price, which determines exactly how the effects of promotion are divided between increased returns per unit and increased quantities sold. If supply is very unresponsive to price, the main effect of promotion is reflected as increased returns per unit, with relatively little change in the quantity sold. This leads to relatively large estimates of benefits for a given demand shift. If supply is very unresponsive to price, the main effect of promotion is reflected as increased quantity sold, with relatively little change in the returns per unit. This leads to relatively small estimates of benefits for a given demand shift.

We did not attempt to predict exactly how much of the impact of promotion would be in price and how much would be in shipments—this was not the objective of the study. To do so would require far more information about the supply of grapes to the fresh market than we have at present. Instead, we simulated the effects of promotion on price and quantity for a range of supply response scenarios, varying from a case where all of the impact was felt on price to one where nearly all was felt on quantity.

In every case, the increase in industry revenues (price times quantity after the promotion minus price times quantity before the promotion) exceeded the cost of promotion by enough that we could be very confident that the promotion pays. This is true both when the costs of promotion are assumed simply to be the expenditures on promotion, and when the producer assessment that pays for the promotion is also modeled.

The measures of benefits and costs refer to the industry in aggregate. It is appropriate to think of these measures as corresponding to profit to producers in the industry. However, since we have not analyzed data related to individual producers, we cannot say what the benefits would be to any particular individual. Since the benefits derive primarily from increased market prices for grapes in aggregate, it is reasonable to conclude that every grower benefits. Also, we have not obtained detailed information on the relative effectiveness of different elements of domestic promotion, so we cannot say whether any one element has been more or less effective than any other.

The results suggest that the effects of promotion are felt within the year in which it occurs, but that the effects do not persist. To continue to increase demand relative to the case of no promotion requires continued, annual promotion. This means that a decrease in promotion next year would, according to our results, translate into an immediate decrease in sales. The amount by which sales would decrease would depend on the reduction in promotion, but the industry would lose more than it would save in the form of reduced promotion expenditure.

The econometric results provide strong evidence supporting the view that promotion by the California Table Grape Commission has significantly expanded the demand for California table grapes both domestically and in international markets. Using our results in a market simulation model, along with a range of assumed values for the elasticity of supply, we were able to compute estimates of benefits from promotion and compare them to promotion costs. Our estimated benefits were many times greater than either the total costs or the producer incidence of costs of a check-off, even when we used very large assumed values for supply elasticities, which resulted in smaller estimates of producer benefits.

The measured demand response to promotion is large, perhaps larger than expected. We used various procedures in an attempt to put measures of precision and confidence on our point estimates. Even our 99 percent lower bound values imply a healthy benefit-cost ratio. In order to obtain a benefit-cost ratio of 1:1, just sufficient for the program to have broken even, we would have to believe that the true measure of demand response to promotion was 1/100th of our best estimate. Statistically, our estimates indicate that such a value is highly improbable.

Our ability to evaluate and test our results further was hampered by the nature of the available data. It would be desirable in the future to manage the promotional program so as to generate more useful data. If the extent of the promotional program can be varied across markets and over time in a managed fashion, it is possible to generate data that increase the power of statistical procedures to isolate the effects of different types of promotional programs. This information may be useful in program design and evaluation, as well as for ex-post evaluations of the sort described here.

A. SUPPLEMENTARY REGRESSION AND SIMULATION RESULTS

Table A3.1: U.S. and Canadian Per-Capita Demand for U.S. Table Grapes: Linear Models with Alternative Time Dummies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPG_t	-0.598	-0.731	-0.791	-0.801	-0.780	-0.716	-0.698
	[-1.40]	[-2.42]	[-2.60]	[-2.60]	[-2.48]	[-2.12]	[-1.97]
$REXP_t$	-0.095	-0.052	-0.104	-0.142	-0.172	-0.155	-0.141
	[-0.54]	[-0.57]	[-1.02]	[-1.26]	[-1.41]	[-1.21]	[-1.01]
$RPROMO_t$	0.213	0.230	0.228	0.204	0.170	0.207	0.204
	[1.98]	[4.61]	[4.61]	[3.50]	[2.27]	[2.10]	[1.99]
$CHILE\text{-}IMP_t$	0.629	0.479	0.546	0.637	0.730	0.672	0.669
	[2.02]	[2.69]	[2.92]	[2.90]	[2.84]	[2.40]	[2.31]
$TS\text{-}SHARE_t$	3.531	2.337	2.009	2.368	2.791	2.507	2.863
	[1.31]	[1.63]	[1.38]	[1.54]	[1.68]	[1.42]	[1.31]
$D68_t$	1.040	1.137	1.045	0.902	0.739	0.893	0.911
	[1.73]	[4.05]	[3.60]	[2.64]	[1.79]	[1.81]	[1.77]
$D69_t$	0.121	0.130	0.021	-0.100	-0.225	-0.074	-0.044
	[0.20]	[0.49]	[0.07]	[-0.31]	[-0.61]	[-0.16]	[-0.09]
$D70_t$	-0.159	-	-0.311	-0.412	-0.517	-0.388	-0.344
	[-0.26]	-	[-1.12]	[-1.34]	[-1.51]	[-0.94]	[-0.76]
$D71_t$	-0.095	-	-	-0.253	-0.397	-0.242	-0.225
	[-0.17]	-	-	[-0.81]	[-1.07]	[-0.53]	[-0.47]
$D72_t$	0.005	-	-	-	-0.228	-0.108	-0.093
	[0.01]	-	-	-	[-0.73]	[-0.29]	[-0.24]
$D73_t$	0.346	-	-	-	-	0.203	0.228
	[0.76]	-	-	-	-	[0.60]	[0.63]
$D74_t$	0.226	-	-	-	-	-	0.098
	[0.51]	-	-	-	-	-	[0.30]
$D75_t$	0.182	-	-	-	-	-	-
	[0.45]	-	-	-	-	-	-
$CONSTANT$	2.351	2.429	3.356	3.828	4.163	3.812	3.457
	[0.69]	[1.76]	[2.10]	[2.23]	[2.31]	[1.97]	[1.49]
R^2	0.97	0.96	0.96	0.96	0.96	0.97	0.97
$\overline{R}^2$	0.93	0.94	0.94	0.94	0.94	0.94	0.93
$D.W.$	2.42	2.24	2.37	2.45	2.41	2.42	2.43

Notes: t statistics in brackets. All equations estimated using OLS.

Table A3.2: U.S. and Canadian Per-Capita Demand for U.S. Table Grapes: Subsample Models

Independent Variables	(1)	(2)	(3)	(4)
RPG_t	-1.443	-0.664	-1.124	-1.281
	[-6.33]	[-1.43]	[-4.04]	[-5.41]
$REXP_t$	0.143	-0.003	0.028	0.100
	[2.63]	[-0.02]	[0.40]	[1.61]
$\sqrt{RPROMO_t}$	0.560	0.565	0.590	0.519
	[4.47]	[0.81]	[5.31]	[5.45]
$CHILE\text{-}IMP_t$	-0.428	0.516	0.442	0.040
	[-0.69]	[1.40]	[3.10]	[0.23]
$TS\text{-}SHARE_t$	1.874	5.375	1.633	1.541
	[2.21]	[1.88]	[2.02]	[2.29]
$D81\text{-}93_t$	-	-	-	0.599
	-	-	-	[3.08]
$CONSTANT$	0.638	0.301	1.761	1.158
	[0.95]	[0.08]	[2.28]	[1.73]
R^2	0.93	0.82	0.95	0.97
$\overline{R}^2$	0.87	0.69	0.94	0.96
$D.W.$	2.55	2.65	1.90	2.59
Sample	1969–80	1981–93	1969–93	1969–93

Notes: t statistics in brackets. (1) OLS. (2) OLS. (3) and (4) Weighted OLS, weights calculated as inverses of estimated variances from the subsample equations in columns (1) and (2).

Table A3.3: Benefits and Costs of Table Grape Promotion: Means from Simulations

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	20,725.2	6,574.2	4,309.9	2,598.0	1,202.1
Present value, Producer cost incidence	114.9	45.7	29.2	17.0	7.6
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	181.1	147.2	152.3	158.0	164.3
Producer Benefits/Total Expenses	179.9	57.1	37.4	22.6	10.4
Marginal benefits, costs:					
Present value, Producer benefits	1,011.6	382.8	240.9	139.1	61.5
Present value, Producer cost incidence	11.5	4.6	2.9	1.7	0.8
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	88.4	85.7	84.9	84.2	83.7
Producer Benefits/Total Expenses	87.8	33.2	20.9	12.1	5.3
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	27,072.8	8,976.3	5,924.4	3,591.9	1,670.9
Present value, Producer cost incidence	152.9	63.1	40.7	23.9	10.8
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	177.6	145.4	149.9	155.4	161.6
Producer Benefits/Total Expenses	176.6	58.6	38.7	23.4	10.9
Marginal benefits, costs:					
Present value, Producer benefits	1,321.4	520.0	330.5	192.3	85.6
Present value, Producer cost incidence	15.3	6.3	4.1	2.4	1.1
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	86.7	84.2	83.5	82.9	82.4
Producer Benefits/Total Expenses	86.2	33.9	21.6	12.5	5.6

Notes: 10,000 replications. Computations based on Weighted Least Squares estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.4: Benefits and Costs of Table Grape Promotion: Upper 99 Percent Boundary

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	40,241.8	9,187.1	5,991.2	3,628.2	1,689.4
Present value, Producer cost incidence	125.5	56.0	37.5	22.8	10.6
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	356.2	263.8	284.2	302.0	318.2
Producer Benefits/Total Expenses	349.3	79.7	52.0	31.5	14.7
Marginal benefits, costs:					
Present value, Producer benefits	1,964.2	589.0	356.3	201.8	88.3
Present value, Producer cost incidence	12.6	5.6	3.8	2.3	1.1
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	173.8	166.5	164.4	163.9	163.7
Producer Benefits/Total Expenses	170.5	51.1	30.9	17.5	7.7
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	52,566.6	12,641.9	8,259.5	5,018.2	2,349.0
Present value, Producer cost incidence	165.3	76.9	52.2	32.0	15.0
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	349.6	260.7	279.7	296.6	312.9
Producer Benefits/Total Expenses	343.0	82.5	53.9	32.7	15.3
Marginal benefits, costs:					
Present value, Producer benefits	2,565.7	804.5	490.4	279.4	122.8
Present value, Producer cost incidence	16.5	7.7	5.2	3.2	1.5
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	170.6	163.6	161.8	161.4	161.2
Producer Benefits/Total Expenses	167.4	52.5	32.0	18.2	8.0

Notes: 10,000 replications. Computations based on Weighted Least Squares estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.5: Benefits and Costs of Table Grape Promotion: Lower 99 Percent Boundary

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	10,007.5	3,899.3	2,578.6	1,534.8	700.6
Present value, Producer cost incidence	101.6	32.3	19.0	10.5	4.5
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	86.2	77.4	77.7	78.8	80.2
Producer Benefits/Total Expenses	86.9	33.8	22.4	13.3	6.1
Marginal benefits, costs:					
Present value, Producer benefits	488.5	207.6	135.2	78.6	35.1
Present value, Producer cost incidence	10.2	3.2	1.9	1.1	0.4
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	42.1	41.4	40.9	40.5	40.2
Producer Benefits/Total Expenses	42.4	18.0	11.7	6.8	3.0
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	13,072.5	5,285.0	3,522.1	2,124.2	972.8
Present value, Producer cost incidence	137.3	45.0	26.7	14.8	6.3
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	84.8	76.3	76.4	77.4	78.7
Producer Benefits/Total Expenses	85.3	34.5	23.0	13.9	6.3
Marginal benefits, costs:					
Present value, Producer benefits	638.1	280.6	184.4	108.9	48.7
Present value, Producer cost incidence	13.7	4.5	2.7	1.5	0.6
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	41.4	40.7	40.2	39.8	39.5
Producer Benefits/Total Expenses	41.6	18.3	12.0	7.1	3.2

Notes: 10,000 replications. Computations based on Weighted Least Squares estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.6: Benefits and Costs of Table Grape Promotion, using OLS: Estimates from Regressions

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	28,790.1	7,698.4	4,957.1	2,941.1	1,339.9
Present value, Producer cost incidence	115.2	38.9	23.8	13.5	5.9
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	249.9	198.1	208.1	218.1	228.2
Producer Benefits/Total Expenses	249.9	66.8	43.0	25.5	11.6
Marginal benefits, costs:					
Present value, Producer benefits	1,405.2	464.1	282.1	158.6	68.7
Present value, Producer cost incidence	11.5	3.9	2.4	1.4	0.6
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	122.0	119.1	117.9	117.0	116.3
Producer Benefits/Total Expenses	122.0	40.3	24.5	13.8	6.0
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	37,610.6	10,554.5	6,834.2	4,074.3	1,864.5
Present value, Producer cost incidence	153.3	53.9	33.4	19.0	8.3
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	245.4	195.7	204.9	214.5	224.4
Producer Benefits/Total Expenses	245.4	68.9	44.6	26.6	12.2
Marginal benefits, costs:					
Present value, Producer benefits	1,835.7	632.8	388.3	219.8	95.6
Present value, Producer cost incidence	15.3	5.4	3.3	1.9	0.8
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	119.8	117.0	116.0	115.2	114.5
Producer Benefits/Total Expenses	119.8	41.3	25.3	14.3	6.2

Notes: Computations based on point estimates of demand parameters, from OLS regressions, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.7: Benefits and Costs of Table Grape Promotion, using OLS: Means from Simulations

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	33,152.9	7,550.7	4,880.3	2,903.1	1,327.9
Present value, Producer cost incidence	114.5	38.0	23.4	13.3	5.8
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	292.1	217.1	233.1	248.8	261.2
Producer Benefits/Total Expenses	287.8	65.5	42.4	25.2	11.5
Marginal benefits, costs:					
Present value, Producer benefits	1,618.2	471.4	283.6	158.6	68.5
Present value, Producer cost incidence	11.4	3.8	2.4	1.3	0.6
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	142.6	136.8	135.7	135.5	134.0
Producer Benefits/Total Expenses	140.5	40.9	24.6	13.8	5.9
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	43,310.0	10,364.0	6,732.1	4,022.4	1,847.7
Present value, Producer cost incidence	152.3	52.8	32.8	18.8	8.3
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	283.9	214.5	229.5	244.6	256.8
Producer Benefits/Total Expenses	282.6	67.6	43.9	26.2	12.1
Marginal benefits, costs:					
Present value, Producer benefits	2,113.9	643.5	390.6	219.8	95.4
Present value, Producer cost incidence	15.2	5.3	3.3	1.9	0.8
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	138.6	134.5	133.5	133.3	131.9
Producer Benefits/Total Expenses	137.9	42.0	25.5	14.3	6.2

Notes: 10,000 replications. Computations based on OLS estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.8: Benefits and Costs of Table Grape Promotion, using OLS: Upper 99 Percent Boundary

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	107,734.8	11,979.8	7,978.1	4,858.1	2,268.5
Present value, Producer cost incidence	128.9	52.7	34.8	20.9	9.6
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	1,026.6	611.7	711.8	789.3	844.2
Producer Benefits/Total Expenses	935.1	104.0	69.2	42.2	19.7
Marginal benefits, costs:					
Present value, Producer benefits	5,258.4	921.4	526.6	286.1	121.6
Present value, Producer cost incidence	12.9	5.3	3.5	2.1	1.0
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	501.1	443.5	440.9	439.0	437.8
Producer Benefits/Total Expenses	456.4	80.0	45.7	24.8	10.6
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	140,741.5	16,597.9	11,041.4	6,743.5	3,157.7
Present value, Producer cost incidence	169.6	72.5	48.4	29.3	13.5
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	998.1	603.3	700.5	774.3	830.5
Producer Benefits/Total Expenses	918.3	108.3	72.0	44.0	20.6
Marginal benefits, costs:					
Present value, Producer benefits	6,869.4	1,263.9	728.8	397.3	169.4
Present value, Producer cost incidence	17.0	7.3	4.9	2.9	1.4
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	487.2	436.4	433.6	431.7	430.6
Producer Benefits/Total Expenses	448.2	82.5	47.6	25.9	11.1

Notes: 10,000 replications. Computations based on OLS estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A3.9: Benefits and Costs of Table Grape Promotion, using OLS: Lower 99 Percent Boundary

	Supply Elasticity				
Series	**0**	**0.5**	**1.0**	**2.0**	**5.0**
0 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	5,719.9	1,967.2	1,207.4	679.7	302.9
Present value, Producer cost incidence	93.8	16.3	8.8	4.6	1.9
Present value, Total program expenses	115.2	115.2	115.2	115.2	115.2
Producer Benefits/Producer Costs	49.1	46.5	46.5	46.8	47.1
Producer Benefits/Total Expenses	49.6	17.1	10.5	5.9	2.6
Marginal benefits, costs:					
Present value, Producer benefits	279.2	100.3	60.9	33.9	14.9
Present value, Producer cost incidence	9.4	1.6	0.9	0.5	0.2
Present value, Total program expenses	11.5	11.5	11.5	11.5	11.5
Producer Benefits/Producer Costs	24.0	23.6	23.4	23.3	23.1
Producer Benefits/Total Expenses	24.2	8.7	5.3	2.9	1.3
3 percent compounding					
Average benefits, costs:					
Present value, Producer benefits	7,472.3	2,683.6	1,665.0	939.9	421.5
Present value, Producer cost incidence	127.3	22.9	12.5	6.5	2.7
Present value, Total program expenses	153.3	153.3	153.3	153.3	153.3
Producer Benefits/Producer Costs	48.6	45.7	45.7	46.1	46.3
Producer Benefits/Total Expenses	48.8	17.5	10.9	6.1	2.8
Marginal benefits, costs:					
Present value, Producer benefits	364.7	136.6	83.9	46.8	20.8
Present value, Producer cost incidence	12.7	2.3	1.3	0.7	0.3
Present value, Total program expenses	15.3	15.3	15.3	15.3	15.3
Producer Benefits/Producer Costs	23.7	23.2	23.0	22.9	22.7
Producer Benefits/Total Expenses	23.8	8.9	5.5	3.1	1.4

Notes: 10,000 replications. Computations based on OLS estimates of demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A5.1: Benefits and Costs of Grape Export Promotion, using OLS: Means from Simulations

	Supply Elasticity			
	1.0	**2.0**	**5.0**	**10.0**
0 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	57.7	36.4	17.6	9.6
Present value, Producer cost incidence	7.1	4.3	2.0	1.0
Present value, Total program expenses	23.6	23.6	23.6	23.6
Producer Benefits/Producer Costs	13.8	15.5	17.0	17.7
Producer Benefits/Total Expenses	2.4	1.5	0.7	0.4
Marginal benefits, costs:				
Present value, Producer benefits	3.3	2.0	0.9	0.5
Present value, Producer cost incidence	0.8	0.5	0.2	0.1
Present value, Total program expenses	2.4	2.4	2.4	2.4
Producer Benefits/Producer Costs	8.0	8.1	8.1	8.1
Producer Benefits/Total Expenses	1.4	0.8	0.4	0.2
3 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	66.4	42.1	20.5	11.2
Present value, Producer cost incidence	8.0	4.8	2.2	1.2
Present value, Total program expenses	26.0	26.0	26.0	26.0
Producer Benefits/Producer Costs	14.2	15.8	17.4	18.0
Producer Benefits/Total Expenses	2.6	1.6	0.8	0.4
Marginal benefits, costs:				
Present value, Producer benefits	3.8	2.3	1.1	0.6
Present value, Producer cost incidence	0.8	0.5	0.2	0.1
Present value, Total program expenses	2.6	2.6	2.6	2.6
Producer Benefits/Producer Costs	8.2	8.2	8.3	8.3
Producer Benefits/Total Expenses	1.5	0.9	0.4	0.2

Notes: 10,000 replications. Computations based on OLS estimates of export demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A5.2: Benefits and Costs of Grape Export Promotion, using OLS: Upper 99 Percent Boundary

	Supply Elasticity			
	1.0	**2.0**	**5.0**	**10.0**
0 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	115.2	69.7	32.3	17.3
Present value, Producer cost incidence	10.7	7.0	3.5	1.9
Present value, Total program expenses	23.6	23.6	23.6	23.6
Producer Benefits/Producer Costs	65.1	75.1	84.0	87.5
Producer Benefits/Total Expenses	4.9	3.0	1.4	0.7
Marginal benefits, costs:				
Present value, Producer benefits	7.8	4.1	1.7	0.9
Present value, Producer cost incidence	1.1	0.7	0.4	0.2
Present value, Total program expenses	2.4	2.4	2.4	2.4
Producer Benefits/Producer Costs	40.0	40.4	40.5	40.5
Producer Benefits/Total Expenses	3.3	1.7	0.7	0.4
3 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	134.6	81.9	38.0	20.2
Present value, Producer cost incidence	12.0	7.9	3.9	2.2
Present value, Total program expenses	26.0	26.0	26.0	26.0
Producer Benefits/Producer Costs	67.1	77.1	86.0	89.5
Producer Benefits/Total Expenses	5.2	3.1	1.5	0.8
Marginal benefits, costs:				
Present value, Producer benefits	9.1	4.8	2.0	1.0
Present value, Producer cost incidence	1.2	0.8	0.4	0.2
Present value, Total program expenses	2.6	2.6	2.6	2.6
Producer Benefits/Producer Costs	40.8	41.2	41.6	41.4
Producer Benefits/Total Expenses	3.5	1.9	0.8	0.4

Notes: 10,000 replications. Computations based on OLS estimates of export demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

Table A5.3: Benefits and Costs of Grape Export Promotion, using OLS: Lower 99 Percent Boundary

	Supply Elasticity			
	1.0	**2.0**	**5.0**	**10.0**
0 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	11.5	7.7	4.0	2.2
Present value, Producer cost incidence	1.7	0.9	0.4	0.2
Present value, Total program expenses	23.6	23.6	23.6	23.6
Producer Benefits/Producer Costs	1.1	1.1	1.2	1.2
Producer Benefits/Total Expenses	0.5	0.3	0.2	0.1
Marginal benefits, costs:				
Present value, Producer benefits	0.6	0.4	0.2	0.1
Present value, Producer cost incidence	0.2	0.1	0.0	0.0
Present value, Total program expenses	2.4	2.4	2.4	2.4
Producer Benefits/Producer Costs	0.5	0.5	0.5	0.5
Producer Benefits/Total Expenses	0.2	0.2	0.1	0.0
3 percent compounding				
Average benefits, costs:				
Present value, Producer benefits	13.1	8.8	4.6	2.6
Present value, Producer cost incidence	1.9	1.0	0.4	0.2
Present value, Total program expenses	26.0	26.0	26.0	26.0
Producer Benefits/Producer Costs	1.1	1.1	1.2	1.2
Producer Benefits/Total Expenses	0.5	0.3	0.2	0.1
Marginal benefits, costs:				
Present value, Producer benefits	0.7	0.4	0.2	0.1
Present value, Producer cost incidence	0.2	0.1	0.0	0.0
Present value, Total program expenses	2.6	2.6	2.6	2.6
Producer Benefits/Producer Costs	0.5	0.5	0.5	0.5
Producer Benefits/Total Expenses	0.3	0.2	0.1	0.0

Notes: 10,000 replications. Computations based on OLS estimates of export demand, using square root of promotional expenditures. Present values are in millions of constant (1995) dollars.

B. DATA APPENDIX

Table B2.1: Disposition of Fresh Grape Production, Volume, 1950–93

Year	Total Fresh Shipments[1]	Domestic Shipments[2]	Fresh Imports	Fresh Exports
	Thousands of Pounds			
1950	825,600	*n.a.*	*n.a.*	*n.a.*
1951	980,000	877,769	33,680	102,231
1952	995,000	874,438	35,640	120,562
1953	833,000	740,083	38,520	92,917
1954	872,600	754,460	47,480	118,140
1955	985,200	848,956	40,760	136,244
1956	871,400	718,429	29,920	152,971
1957	843,800	690,766	18,760	153,034
1958	852,200	685,991	34,840	166,209
1959	922,200	743,390	22,360	178,810
1960	906,200	711,556	40,240	194,644
1961	821,800	650,114	23,080	171,686
1962	1,001,200	806,011	33,200	195,189
1963	901,600	704,151	45,880	197,449
1964	924,800	729,431	78,000	195,369
1965	1,026,800	779,261	63,280	247,539
1966	1,033,000	780,050	52,040	252,950
1967	760,800	513,923	39,320	246,877
1968	943,800	713,922	32,656	229,878
1969	941,000	661,436	40,808	279,564
1970	647,000	414,237	35,125	232,763
1971	633,400	351,987	27,855	281,413
1972	594,200	376,346	25,912	217,854
1973	681,400	457,084	20,969	224,316
1974	709,400	476,134	33,356	233,266
1975	793,800	550,275	36,542	243,525
1976	723,000	492,591	51,790	230,409
1977	720,000	492,923	65,701	227,077
1978	694,000	477,153	69,137	216,847
1979	824,000	572,806	91,353	251,194
1980	926,000	666,660	97,900	259,340
1981	868,000	621,963	126,722	246,037
1982	1,228,400	982,700	209,279	245,700
1983	1,105,000	861,203	280,599	243,797
1984	1,150,000	906,108	321,968	243,892
1985	1,362,000	1,160,819	430,839	201,181
1986	1,393,000	1,154,309	454,080	238,691
1987	1,260,000	1,023,108	548,148	236,892
1988	1,492,000	1,198,907	680,372	293,093
1989	1,430,000	1,131,209	617,582	298,791
1990	1,542,000	1,089,761	821,810	452,239
1991	1,404,000	963,303	731,447	440,697
1992	1,400,000	982,367	697,224	417,633
1993	1,476,000	1,027,603	707,230	448,397

Notes: [1] Fresh shipments of table- and raisin-type varieties. Wine varieties are excluded.
[2] Total fresh shipments, less exports.

Sources: Federal-State Market News Service, *Marketing California Grapes, Raisins, and Wine,* 1953 Season and 1968 Season. Federal-State Market News Service, *Marketing California Grapes for Fresh Use,* 1992 and 1993 Seasons. Sacramento: California Department of Food and Agriculture and USDA.

Table B2.2: Disposition of Fresh Grape Production, Value, 1950–93

Year	Total Fresh Shipments[1]	Domestic Shipments[2]	Fresh Imports	Fresh Exports
	Thousands of Dollars			
1950	102,860	*n.a.*	*n.a.*	*n.a.*
1951	106,775	95,637	939	8,997
1952	108,908	95,712	1,235	10,238
1953	105,210	93,474	1,765	9,479
1954	121,269	104,851	1,950	11,033
1955	122,112	105,225	1,572	11,738
1956	116,140	95,752	1,180	13,714
1957	109,242	89,430	831	14,602
1958	125,577	101,085	1,489	15,435
1959	132,837	107,081	1,050	16,359
1960	146,697	115,188	1,643	16,971
1961	111,248	88,007	1,435	16,584
1962	250,084	201,329	2,142	17,575
1963	146,480	114,401	3,168	18,265
1964	144,702	114,133	4,754	19,166
1965	142,758	108,342	3,454	22,712
1966	163,144	123,195	3,166	25,252
1967	223,408	150,913	3,450	25,666
1968	264,559	200,121	3,653	23,881
1969	187,589	131,858	4,484	28,283
1970	157,514	100,847	3,891	28,235
1971	183,305	101,864	3,644	35,061
1972	197,542	125,117	3,887	41,588
1973	198,486	133,145	3,467	47,443
1974	261,238	175,337	5,437	46,582
1975	288,141	199,744	10,076	49,205
1976	319,220	217,490	11,644	56,546
1977	345,739	236,698	15,423	59,524
1978	422,877	290,745	20,680	64,724
1979	471,146	327,518	26,906	75,349
1980	538,202	387,470	39,385	83,348
1981	812,245	582,012	53,023	93,998
1982	838,517	670,799	84,570	95,169
1983	687,923	536,145	104,202	86,401
1984	822,857	648,346	111,834	88,571
1985	668,170	569,474	169,330	76,444
1986	898,420	744,475	162,741	102,445
1987	772,435	627,210	211,173	108,008
1988	965,340	775,706	254,385	129,457
1989	1,002,332	792,900	220,326	132,114
1990	1,181,140	834,734	280,663	215,929
1991	1,163,217	798,099	253,906	217,850
1992	742,609	521,082	261,570	207,148
1993	1,202,277	837,035	258,747	237,182

Notes: [1] Total fresh shipments, times average Los Angeles wholesale price of Seedless and Thompson Seedless grapes.
[2] Total domestic shipments, times average Los Angeles wholesale price of Seedless and Thompson Seedless grapes.

Sources: Federal-State Market News Service, *Marketing California Grapes, Raisins, and Wine,* 1953 Season and 1968 Season. Federal-State Market News Service, *Marketing California Grapes for Fresh Use,* 1992 and 1993 Seasons. Sacramento: California Department of Food and Agriculture and USDA.

Table B2.3: California Table Grape Commission Promotional Expenditures, in Current Dollars, 1968–93

Year	Total Promotional Expenditures	Advertising Expenditures	Merchandising Expenditures	Public Relations Expenditures
	Dollars			
1968	254,569	38,337	162,314	53,918
1969	407,258	13,812	88,891	304,555
1970	425,139	150,731	170,419	103,989
1971	269,205	70,186	162,117	36,902
1972	330,898	93,656	195,678	41,564
1973	399,079	112,391	235,759	50,929
1974	1,075,431	701,026	305,765	68,640
1975	1,152,769	767,686	331,685	53,398
1976	1,134,212	661,693	405,773	66,746
1977	1,371,058	805,677	487,442	77,939
1978	1,736,091	1,195,610	436,199	104,282
1979	1,975,691	1,259,428	455,789	260,474
1980	2,559,164	1,674,390	613,267	271,507
1981	2,563,789	1,590,052	637,226	336,511
1982	3,794,527	2,754,326	697,217	342,984
1983	4,213,558	3,174,418	688,654	350,486
1984	4,472,817	3,265,957	777,011	429,849
1985	4,638,228	3,279,189	955,057	403,982
1986	4,893,083	3,268,631	1,123,150	501,302
1987	5,155,551	3,677,893	970,398	507,260
1988	5,434,861	3,733,126	1,107,028	594,707
1989	5,212,027	3,281,856	1,255,467	674,704
1990	5,814,425	3,672,869	1,333,852	807,704
1991	5,780,045	3,667,294	1,290,146	822,605
1992	5,596,881	3,435,713	1,312,029	849,139
1993	5,615,096	3,295,282	1,405,184	914,630

Source: California Table Grape Commission annual budgets.

Table B2.4: California Table Grape Commission Promotional Expenditures, in Constant Dollars, 1968–93

Year	Total Promotional Expenditures	Advertising Expenditures	Merchandising Expenditures	Public Relations Expenditures
	Constant(1995) Dollars			
1968	1,057,047	159,187	673,976	223,884
1969	1,603,509	54,382	349,993	1,199,133
1970	1,583,314	561,356	634,679	387,279
1971	960,497	250,417	578,417	131,663
1972	1,143,894	323,763	676,447	143,684
1973	1,298,804	365,777	767,279	165,749
1974	3,152,125	2,054,731	896,208	201,186
1975	3,096,192	2,061,908	890,864	143,420
1976	2,880,380	1,680,398	1,030,478	169,504
1977	3,269,272	1,921,128	1,162,300	185,845
1978	3,847,625	2,649,780	966,729	231,116
1979	3,932,333	2,506,713	907,183	518,437
1980	4,487,854	2,936,279	1,075,450	476,126
1981	4,075,550	2,527,640	1,012,972	534,938
1982	5,681,960	4,124,353	1,044,019	513,587
1983	6,113,043	4,605,456	999,101	508,486
1984	6,220,617	4,542,163	1,080,636	597,817
1985	6,228,847	4,403,744	1,282,581	542,522
1986	6,451,191	4,309,463	1,480,795	660,932
1987	6,557,897	4,678,306	1,234,353	645,238
1988	6,638,524	4,559,905	1,352,202	726,417
1989	6,073,693	3,824,421	1,463,024	786,248
1990	6,428,343	4,060,670	1,474,687	892,985
1991	6,132,280	3,890,778	1,368,767	872,734
1992	5,764,428	3,538,564	1,351,306	874,559
1993	5,615,096	3,295,282	1,405,184	914,630

Source: California Table Grape Commission annual budgets.

Table B3.1: Shipments, Exports, and Consumption of U.S. Fresh Table Grapes, 1963–93

	CTGC Reports			USDA Reports		
	(1)	(2)	(3)	(4)	(5)	(6)
Year	Shipments	Exports	Domestic Consumption	Shipments	Exports	Domestic Consumption
	Thousands of Pounds					
1963				901,600	30,617	870,983
1964				924,800	32,252	892,548
1965				1,026,800	41,204	985,596
1966				1,033,000	57,987	975,013
1967				760,800	36,290	724,510
1968	758,320	12,424	745,896	943,800	32,115	911,685
1969	625,284	10,591	614,693	941,000	40,415	900,585
1970	506,710	6,271	500,439	647,000	34,340	612,660
1971	511,580	3,060	508,520	633,400	25,222	608,178
1972	507,067	12,397	494,670	594,200	32,312	561,888
1973	601,213	23,772	577,441	681,400	43,697	637,703
1974	635,424	26,361	609,063	709,400	41,679	667,721
1975	689,653	35,800	653,852	793,800	51,672	742,128
1976	654,428	22,369	632,059	723,000	43,414	679,586
1977	650,089	25,283	624,807	720,000	43,268	676,732
1978	652,022	37,584	614,437	694,000	55,312	638,688
1979	736,797	40,403	696,394	824,000	51,911	772,089
1980	817,280	51,113	766,166	926,000	65,424	860,576
1981	775,297	50,390	724,907	868,000	67,606	800,394
1982	1,126,236	61,687	1,064,549	1,228,400	74,169	1,154,231
1983	1,017,121	42,457	974,664	1,105,000	50,244	1,054,756
1984	1,048,206	50,509	997,697	1,150,000	56,421	1,093,579
1985	1,304,779	65,692	1,239,087	1,362,000	68,526	1,293,474
1986	1,297,784	84,645	1,213,139	1,393,000	113,265	1,279,735
1987	1,171,631	91,069	1,080,562	1,260,000	105,230	1,154,770
1988	1,384,573	112,363	1,272,210	1,492,000	130,946	1,361,054
1989	1,332,831	115,212	1,217,619	1,430,000	155,346	1,274,654
1990	1,431,322	139,432	1,291,891	1,542,000	170,355	1,371,645
1991	1,354,410	145,138	1,209,272	1,404,000	178,385	1,225,615
1992	1,377,110	159,995	1,217,116	1,400,000	184,870	1,215,130
1993	1,469,433	184,843	1,284,590	1,476,000	203,579	1,272,421

Notes: (1) Fresh shipments reported to California Table Grape Commission.
(2) Exports, except to Canada, reported to California Table Grape Commission.
(3) CTGC shipments less exports.
(4) Fresh shipments of table- and raisin-type varieties, reported by USDA. Wine varieties are excluded.
(5) Exports of fresh grapes, except to Canada, reported by USDA.
(6) USDA shipments less exports.

Sources: (1)–(2): CTGC unload reports. (4): Federal-State Market News Service, *Marketing California Grapes, Raisins, and Wine,* 1953 Season and 1968 Season. Federal-State Market News Service, *Marketing California Grapes for Fresh Use,* 1992 and 1993 Seasons. Sacramento: California Department of Food and Agriculture and USDA. (5): USDA, Foreign Agricultural Service, *Foreign Agricultural Trade of the United States.*

Table B3.2: Table Grape Data Used in Annual Aggregate Model of Table Grape Demand, 1968–93

$YEAR_t$	Q_t	RPG_t	RPS_t	$RPROMO_t$	$CHILE\text{-}IMP_t$	$TS\text{-}SHARE_t$
1968	3.388	1.228	1.639	1.115	0.094	0.446
1969	2.764	0.828	1.502	1.691	0.092	0.432
1970	2.221	0.956	1.397	1.670	0.087	0.382
1971	2.226	1.089	1.380	1.013	0.107	0.433
1972	2.140	1.212	1.396	1.206	0.086	0.411
1973	2.474	1.000	1.474	1.370	0.055	0.380
1974	2.584	1.138	1.463	3.324	0.096	0.336
1975	2.745	1.028	1.465	3.265	0.135	0.374
1976	2.627	1.183	1.370	3.038	0.173	0.451
1977	2.571	1.208	1.461	3.448	0.191	0.387
1978	2.502	1.424	1.674	4.058	0.238	0.416
1979	2.805	1.200	1.645	4.147	0.321	0.411
1980	3.050	1.075	1.579	4.733	0.342	0.480
1981	2.856	1.569	1.471	4.298	0.469	0.433
1982	4.154	1.078	1.576	5.993	0.723	0.468
1983	3.768	0.953	1.447	6.447	1.020	0.436
1984	3.823	1.050	1.549	6.561	1.231	0.461
1985	4.710	0.695	1.571	6.569	1.570	0.479
1986	4.570	0.897	1.595	6.804	1.597	0.446
1987	4.033	0.822	1.659	6.916	1.937	0.395
1988	4.705	0.834	1.709	7.001	2.347	0.392
1989	4.459	0.861	1.716	6.406	2.237	0.420
1990	4.681	0.893	1.735	6.780	3.045	0.383
1991	4.332	0.927	2.116	6.468	2.511	0.365
1992	4.309	0.576	1.794	6.080	2.404	0.382
1993	4.483	0.859	1.739	5.922	2.388	0.347

Note: See table 3.1 in text for sources and definitions.

Table B3.3: Macroeconomic Data Used in Annual Aggregate Model of Table Grape Demand, 1968–93

		United States			Canada		
Year	*REXP*	*C*	*POP*	*CPI*	*C*	*POP*	*X-RATE*
1968	11.965	559.8	199,399	0.228	44.84	20,730	1.077
1969	12.141	604.7	201,385	0.241	49.09	21,030	1.077
1970	12.164	648.1	203,984	0.255	51.85	21,320	1.044
1971	12.491	702.5	206,827	0.266	56.27	21,590	1.010
1972	13.162	770.7	209,284	0.274	63.02	21,830	0.990
1973	13.582	851.6	211,357	0.291	72.07	22,070	1.000
1974	13.340	931.2	213,342	0.323	84.23	22,400	0.978
1975	13.381	1,029.0	215,465	0.353	97.53	22,730	1.017
1976	14.048	1,148.8	217,563	0.373	111.50	23,030	0.986
1977	14.417	1,277.1	219,760	0.398	123.56	23,280	1.063
1978	14.746	1,428.8	222,095	0.428	137.43	23,490	1.141
1979	14.581	1,593.5	224,567	0.476	153.39	23,700	1.171
1980	14.048	1,760.4	227,225	0.541	172.42	23,960	1.169
1981	13.905	1,941.3	229,466	0.596	196.19	24,340	1.199
1982	13.849	2,076.8	231,664	0.633	210.51	24,630	1.234
1983	14.617	2,283.4	233,792	0.654	231.45	24,890	1.232
1984	15.101	2,492.3	235,825	0.682	251.65	25,130	1.295
1985	15.644	2,704.8	237,924	0.706	274.50	25,160	1.365
1986	16.272	2,892.7	240,133	0.719	297.48	25,350	1.389
1987	16.715	3,094.5	242,289	0.745	322.77	25,620	1.326
1988	17.313	3,349.7	244,499	0.776	349.94	25,910	1.231
1989	17.621	3,594.8	246,819	0.814	378.94	26,240	1.184
1990	17.877	3,893.3	249,402	0.858	394.32	26,580	1.167
1991	17.375	3,975.1	252,131	0.894	412.25	27,030	1.146
1992	17.573	4,219.8	255,028	0.921	423.06	27,440	1.209
1993	17.642	4,454.1	257,783	0.948	437.29	28,750	1.290

Note: See table 3.1 in text for sources and definitions.

Table B4.1: Data Used in Monthly Models of U.S. and Canadian Demand

Mo./Yr.	*QTGC*	*X*	*qf*	*P*	Mo./Yr.	*QTGC*	*X*	*qf*	*P*
1/72	*n.a.*	*n.a.*	*n.a.*	*n.a.*	1/78	25.549	0.994	0.100	*n.a.*
6/72	46.686	1.141	0.197	0.403	6/78	81.609	4.704	0.313	0.625
7/72	71.002	1.736	0.300	0.321	7/78	72.855	4.200	0.280	0.572
8/72	109.584	2.679	0.463	0.263	8/78	166.323	9.587	0.638	0.478
9/72	80.404	1.966	0.339	0.295	9/78	98.834	5.697	0.379	0.560
10/72	49.604	1.213	0.209	0.418	10/78	70.878	4.086	0.272	0.634
11/72	57.710	1.411	0.244	0.295	11/78	83.868	4.834	0.322	0.787
12/72	34.042	0.832	0.144	*n.a.*	12/78	49.699	2.865	0.191	*n.a.*
1/73	14.914	0.365	0.062	*n.a.*	1/79	20.896	1.205	0.079	*n.a.*
6/73	36.487	1.443	0.150	*n.a.*	6/79	89.826	4.926	0.342	0.773
7/73	67.715	2.677	0.279	0.279	7/79	64.477	3.536	0.245	0.586
8/73	131.484	5.199	0.541	0.234	8/79	192.328	10.547	0.732	0.413
9/73	121.623	4.809	0.500	0.234	9/79	122.891	6.739	0.468	0.522
10/73	78.891	3.119	0.325	0.326	10/79	81.009	4.442	0.308	0.565
11/73	68.043	2.690	0.280	0.384	11/79	102.777	5.636	0.391	*n.a.*
12/73	49.635	1.963	0.204	*n.a.*	12/79	56.761	3.113	0.216	*n.a.*
1/74	23.010	0.910	0.094	*n.a.*	1/80	22.594	1.239	0.085	*n.a.*
6/74	55.509	2.303	0.226	0.477	6/80	87.163	5.451	0.325	0.826
7/74	46.862	1.944	0.191	0.433	7/80	63.321	3.960	0.236	0.739
8/74	133.333	5.531	0.542	0.304	8/80	187.656	11.736	0.700	0.587
9/74	126.081	5.231	0.513	0.313	9/80	159.969	10.005	0.597	0.487
10/74	100.976	4.189	0.411	0.337	10/80	116.132	7.263	0.433	0.478
11/74	86.471	3.587	0.352	0.401	11/80	108.697	6.798	0.406	0.473
12/74	46.304	1.921	0.188	0.347	12/80	49.990	3.126	0.187	0.478
1/75	21.757	0.903	0.088	0.333	1/81	28.712	1.796	0.106	*n.a.*
6/75	45.564	2.365	0.181	0.591	6/81	47.620	3.095	0.175	0.826
7/75	57.032	2.961	0.227	0.460	7/81	75.089	4.880	0.277	0.728
8/75	137.311	7.128	0.547	0.332	8/81	234.408	15.235	0.864	0.548
9/75	139.480	7.241	0.555	0.291	9/81	127.029	8.256	0.468	0.859
10/75	97.016	5.036	0.386	0.266	10/81	88.693	5.765	0.327	0.982
11/75	109.105	5.664	0.434	0.315	11/81	91.503	5.947	0.337	1.217
12/75	49.903	2.590	0.199	0.286	12/81	64.619	4.200	0.238	*n.a.*
1/76	22.627	1.175	0.089	*n.a.*	1/82	30.745	1.998	0.112	*n.a.*
6/76	80.322	2.746	0.322	0.500	6/82	70.624	3.868	0.260	0.739
7/76	61.558	2.104	0.247	0.565	7/82	85.515	4.684	0.315	0.696
8/76	186.321	6.369	0.748	0.300	8/82	273.045	14.955	1.007	0.513
9/76	131.346	4.490	0.527	0.321	9/82	219.921	12.046	0.811	0.500
10/76	72.422	2.475	0.291	0.522	10/82	144.308	7.904	0.532	0.565
11/76	64.192	2.194	0.258	*n.a.*	11/82	146.882	8.045	0.542	0.809
12/76	34.236	1.170	0.137	*n.a.*	12/82	89.555	4.905	0.330	0.957
1/77	13.497	0.461	0.054	*n.a.*	1/83	61.864	3.388	0.226	*n.a.*
6/77	64.583	2.512	0.255	0.638	6/83	79.755	3.329	0.295	0.848
7/77	54.647	2.125	0.216	0.668	7/83	101.932	4.255	0.378	0.674
8/77	144.780	5.631	0.573	0.426	8/83	269.034	11.230	0.997	0.461
9/77	106.456	4.140	0.421	0.462	9/83	179.289	7.484	0.664	0.565
10/77	80.197	3.119	0.317	0.426	10/83	114.618	4.784	0.425	0.487
11/77	92.262	3.588	0.365	0.261	11/83	124.901	5.214	0.463	0.467
12/77	56.422	2.194	0.223	*n.a.*	12/83	85.714	3.578	0.318	0.696

(Continued)

Table B4.1 (Continued)

Mo./Yr.	$QTGC$	X	qf	P	Mo./Yr.	$QTGC$	X	qf	P
1/84	37.359	1.559	0.137	0.783	1/89	38.328	3.110	0.129	0.652
6/84	101.103	4.872	0.369	0.924	6/89	139.144	12.028	0.466	0.853
7/84	103.804	5.002	0.379	0.665	7/89	205.267	17.744	0.687	0.630
8/84	296.528	14.288	1.082	0.435	8/89	311.312	26.910	1.042	0.582
9/84	164.644	7.934	0.601	0.663	9/89	232.666	20.112	0.778	0.565
10/84	125.083	6.027	0.456	0.670	10/89	193.099	16.692	0.646	0.657
11/84	121.265	5.843	0.442	0.783	11/89	168.162	14.536	0.563	0.793
12/84	75.794	3.652	0.276	0.870	12/89	37.655	3.255	0.126	0.826
1/85	33.497	1.614	0.121	*n.a.*	1/90	0.916	0.079	0.003	*n.a.*
6/85	117.735	5.928	0.425	0.717	6/90	148.643	14.480	0.486	0.884
7/85	166.011	8.358	0.599	0.591	7/90	182.054	17.735	0.595	0.774
8/85	319.125	16.067	1.152	0.435	8/90	320.277	31.200	1.047	0.620
9/85	224.856	11.321	0.812	0.417	9/90	239.185	23.300	0.782	0.663
10/85	167.445	8.430	0.604	0.391	10/90	196.300	19.122	0.642	0.749
11/85	154.548	7.781	0.558	0.391	11/90	216.166	21.058	0.707	0.815
12/85	77.104	3.882	0.278	*n.a.*	12/90	82.968	8.082	0.271	0.857
1/86	36.517	1.839	0.131	*n.a.*	1/91	21.532	2.098	0.070	*n.a.*
6/86	136.007	8.871	0.479	0.723	6/91	133.489	14.305	0.427	*n.a.*
7/86	182.274	11.888	0.642	0.639	7/91	140.356	15.040	0.449	0.853
8/86	294.676	19.220	1.038	0.527	8/91	296.607	31.784	0.949	0.674
9/86	187.597	12.236	0.661	0.626	9/91	225.595	24.175	0.722	0.609
10/86	156.250	10.191	0.550	0.663	10/91	203.218	21.777	0.650	0.630
11/86	168.815	11.011	0.594	0.598	11/91	218.715	23.437	0.700	1.038
12/86	93.234	6.081	0.328	0.739	12/91	94.800	10.159	0.303	1.167
1/87	28.078	1.831	0.098	*n.a.*	1/92	28.949	3.102	0.092	*n.a.*
6/87	130.304	10.128	0.449	0.630	6/92	187.555	21.790	0.587	0.630
7/87	172.777	13.430	0.595	0.522	7/92	218.769	25.417	0.685	0.543
8/87	299.888	23.310	1.032	0.557	8/92	313.481	36.421	0.981	0.530
9/87	189.320	14.716	0.652	0.652	9/92	227.675	26.452	0.712	0.565
10/87	157.751	12.262	0.543	0.587	10/92	188.924	21.949	0.591	0.565
11/87	148.902	11.574	0.513	0.730	11/92	172.020	19.985	0.538	0.348
12/87	55.348	4.302	0.191	*n.a.*	12/92	54.248	6.303	0.170	*n.a.*
1/88	10.625	0.826	0.036	*n.a.*	1/93	4.597	0.534	0.014	*n.a.*
6/88	136.519	11.079	0.464	1.022	6/93	165.214	20.783	0.504	0.856
7/88	150.736	12.233	0.512	0.924	7/93	176.049	22.146	0.537	0.793
8/88	302.285	24.532	1.027	0.635	8/93	312.663	39.331	0.954	0.674
9/88	210.596	17.091	0.716	0.435	9/93	245.701	30.907	0.750	0.685
10/88	180.469	14.646	0.613	0.509	10/93	212.617	26.746	0.649	0.879
11/88	197.290	16.011	0.670	0.500	11/93	233.375	29.357	0.712	*n.a.*
12/88	113.911	9.244	0.387	0.500	12/93	86.196	10.843	0.263	*n.a.*

Notes: $QTGC$ is total fresh shipments of California table grapes, in millions of pounds. X is fresh exports (except to Canada), in millions of pounds. qf is U.S. and Canada per-capita consumption, in pounds. P is average nominal wholesale price of Thompson Seedless grapes, at the Los Angeles terminal market.

Table B4.2: Shipments of Fresh Grapes to Selected Cities, by Month, 1992, 1993

Mo./Yr.	*ATL*	*BOS*	*CHI*	*DET*	*LAX*	*MIA*
	Thousands of Pounds					
5/92	268.76	854.69	1,148.06	359.40	1,977.10	333.36
6/92	1,533.38	2,532.37	4,979.96	1,630.40	10,025.40	2,579.12
7/92	3,495.81	9,411.32	9,373.24	5,844.98	15,828.27	4,847.26
8/92	3,757.50	8,097.22	11,544.96	5,471.45	17,415.17	4,913.67
9/92	1,978.28	3,073.13	4,752.95	3,058.16	16,678.73	5,076.74
10/92	3,539.22	5,222.31	5,774.12	3,052.45	20,769.99	7,186.36
11/92	3,677.45	5,522.61	3,468.19	4,911.70	14,435.28	7,278.20
12/92	590.93	1,910.01	1,037.45	1,989.90	6,178.87	3,608.12
5/93	431.27	1,312.55	1,807.60	374.62	3,145.42	646.65
6/93	1,742.29	4,430.53	4,666.18	2,005.65	10,324.78	3,004.75
7/93	2,372.24	7,537.47	7,527.40	3,837.07	14,884.17	3,266.58
8/93	3,376.64	8,501.97	9,374.69	3,997.09	20,127.82	5,653.23
9/93	2,228.22	4,455.42	7,405.13	4,219.69	21,836.03	4,877.00
10/93	2,654.54	4,448.05	7,451.09	3,822.49	16,149.36	6,199.59
11/93	2,147.21	3,511.44	4,959.11	2,661.32	12,176.51	7,556.76
12/93	826.24	1,650.74	2,096.36	1,309.96	9,238.76	3,479.19

Mo./Yr.	*NYC*	*PHI*	*PTT*	*SFO*	*SEA*	*WDC*
	Thousands of Pounds					
5/92	1,786.68	463.86	208.40	602.02	737.92	*n.a.*
6/92	6,859.04	2,367.98	1,420.59	3,976.97	1,945.68	*n.a.*
7/92	21,892.95	8,333.74	2,979.63	5,461.86	3,259.67	*n.a.*
8/92	22,431.99	8,111.36	3,943.93	6,449.74	4,635.51	*n.a.*
9/92	13,643.44	5,214.48	1,859.04	5,543.62	2,822.36	*n.a.*
10/92	17,086.60	5,775.88	2,146.86	5,613.08	1,354.25	*n.a.*
11/92	17,186.72	4,745.90	1,670.59	5,317.42	1,994.56	*n.a.*
12/92	6,179.03	3,375.81	964.13	2,695.67	661.38	*n.a.*
5/93	4,016.01	793.07	533.98	992.22	1,545.01	3,204.17
6/93	10,429.51	3,672.21	1,632.23	3,514.59	3,471.50	2,545.82
7/93	13,732.45	6,804.69	2,283.29	5,546.29	5,169.38	4,317.09
8/93	16,754.35	7,055.48	2,804.49	5,783.45	4,917.55	4,901.77
9/93	19,133.42	5,939.56	2,830.57	6,531.14	4,364.72	6,031.62
10/93	15,999.74	6,306.63	2,629.91	7,269.78	3,098.87	4,310.86
11/93	13,179.36	5,347.15	2,680.91	6,890.64	2,449.11	3,486.01
12/93	10,009.60	3,142.41	1,985.42	2,325.12	1,845.51	1,608.22

Notes: Metropolitan areas are abbreviated as follows: Atlanta (*ATL*), Boston (*BOS*), Chicago (*CHI*), Detroit (*DET*), Los Angeles (*LAX*), Miami (*MIA*), New York City (*NYC*), Philadelphia (*PHI*), Pittsburgh (*PTT*), San Francisco (*SFO*), Seattle (*SEA*), and Washington, D.C. (*WDC*).

Source: CTGC Special Tabulations.

Table B4.3: Index of Fresh Grapes Prices in Selected Cities, by Month, 1992, 1993

Mo./Yr.	*ATL*	*BOS*	*CHI*	*DET*	*LAX*	*MIA*
	Dollars per Pound					
5/92	1.27	1.63	1.49	*n.a.*	1.48	*n.a.*
6/92	0.62	0.77	0.66	0.65	0.61	0.62
7/92	0.55	0.71	0.61	0.62	0.53	0.62
8/92	0.54	0.71	0.64	0.62	0.56	0.64
9/92	0.57	0.79	0.67	0.60	0.59	0.67
10/92	0.67	0.79	0.74	0.69	0.57	0.64
11/92	0.81	0.81	0.96	0.90	0.39	0.63
12/92	0.85	0.74	1.16	0.93	0.81	0.74
5/93	0.90	1.15	1.11	0.97	0.88	1.35
6/93	0.74	0.84	0.83	0.78	0.77	0.85
7/93	0.81	0.95	0.92	0.80	0.75	0.93
8/93	0.67	*n.a.*	0.84	0.73	0.70	0.79
9/93	0.67	0.84	0.86	0.71	0.68	0.76
10/93	0.69	0.93	0.83	0.77	0.73	0.77
11/93	0.87	0.97	*n.a.*	0.93	0.59	0.74
12/93	0.82	0.82	*n.a.*	0.98	0.80	0.70

Mo./Yr.	*NYC*	*PHI*	*PTT*	*SFO*	*SEA*	*WDC*
	Dollars per Pound					
5/92	1.77	2.09	*n.a.*	1.22	*n.a.*	*n.a.*
6/92	0.56	0.60	0.66	0.63	0.61	*n.a.*
7/92	0.63	0.60	0.56	0.55	0.57	*n.a.*
8/92	0.55	0.55	0.53	0.60	0.57	*n.a.*
9/92	0.63	0.63	0.56	0.60	0.62	*n.a.*
10/92	0.84	0.75	0.54	0.70	0.69	*n.a.*
11/92	0.85	0.91	0.61	0.85	0.87	*n.a.*
12/92	0.99	1.08	0.66	1.15	0.95	*n.a.*
5/93	1.08	1.00	1.16	0.96	1.06	1.11
6/93	0.80	0.82	0.78	0.77	0.83	0.77
7/93	0.73	0.81	0.78	0.80	0.87	0.79
8/93	0.72	0.76	0.69	0.73	0.74	0.66
9/93	0.68	0.74	0.65	0.76	0.63	0.64
10/93	*n.a.*	0.72	0.69	0.85	0.67	0.67
11/93	*n.a.*	1.00	0.77	0.87	0.83	0.77
12/93	*n.a.*	0.95	0.71	0.92	0.95	0.70

Source: Authors' computations, using CTGC tabulations and Federal-State Market News Service terminal-market prices.

Table B4.4: CTGC Media Advertising in Selected Cities, by Month, 1992, 1993

Mo./Yr.	*ATL*	*BOS*	*CHI*	*DET*	*LAX*	*MIA*
	Thousands of Dollars					
5/92	0.00	0.00	0.00	0.00	0.00	0.00
6/92	12.30	16.82	18.28	13.97	46.63	16.20
7/92	13.85	18.80	21.63	14.63	46.84	17.81
8/92	18.20	27.79	37.47	22.13	71.89	26.32
9/92	11.70	16.82	19.46	13.97	23.82	15.45
10/92	12.90	16.93	20.31	13.97	45.82	16.95
11/92	12.30	16.82	19.57	13.97	45.82	15.90
12/92	0.00	0.00	0.00	0.00	0.00	0.00
5/93	0.00	0.00	0.00	0.00	0.00	0.00
6/93	11.79	28.86	38.25	17.79	55.44	23.90
7/93	12.65	17.98	20.56	11.69	57.50	12.92
8/93	0.00	0.00	0.00	0.00	0.00	0.00
9/93	9.00	16.82	22.66	11.63	39.13	17.41
10/93	13.80	14.91	23.14	9.49	31.82	11.42
11/93	0.00	0.00	6.42	0.00	0.00	0.00
12/93	10.00	13.68	15.19	9.37	33.88	8.74

Mo./Yr.	*NYC*	*PHI*	*PTT*	*SFO*	*SEA*	*WDC*
	Thousands of Dollars					
5/92	0.00	0.00	0.00	0.00	0.00	0.00
6/92	39.31	16.32	7.39	20.04	11.87	*n.a.*
7/92	43.68	17.47	8.38	33.75	13.09	*n.a.*
8/92	62.14	22.03	11.82	46.83	18.91	*n.a.*
9/92	39.59	13.78	7.39	18.87	11.87	*n.a.*
10/92	39.78	13.63	7.39	21.23	3.58	*n.a.*
11/92	39.55	13.47	7.26	28.95	11.87	*n.a.*
12/92	0.00	0.00	0.00	0.00	0.00	0.00
5/93	0.00	0.00	0.00	0.00	0.00	0.00
6/93	62.61	33.28	11.53	43.55	16.85	27.41
7/93	34.52	14.89	6.90	23.58	9.47	17.65
8/93	0.00	0.00	0.00	0.00	0.00	0.00
9/93	40.19	19.36	7.37	26.35	11.95	17.18
10/93	26.09	12.44	5.56	1.52	9.17	13.50
11/93	0.00	0.00	0.00	0.00	0.00	0.00
12/93	33.69	11.19	5.44	18.00	11.33	12.80

Source: CTGC special tabulations.

Table B4.5: Consumer Price Indices for Selected Cities, by Month, 1992, 1993

Mo./Yr.	*ATL*	*BOS*	*CHI*	*DET*	*LAX*	*MIA*
			Index (1982-83=100)			
5/92	139.70	147.50	140.50	135.40	146.00	133.70
6/92	140.20	148.20	141.20	135.50	146.20	133.75
7/92	140.50	148.90	141.40	135.65	146.70	133.80
8/92	140.90	149.15	141.90	135.80	146.90	134.20
9/92	141.30	149.40	142.70	136.65	147.40	134.60
10/92	141.80	149.90	142.10	137.50	148.40	135.25
11/92	142.00	150.40	142.40	137.30	148.20	135.90
12/92	141.90	151.15	142.90	137.10	148.20	136.85
5/93	144.20	151.90	145.70	138.90	150.10	139.00
6/93	144.40	152.20	145.60	139.10	149.70	139.00
7/93	144.40	152.50	145.50	139.50	149.80	139.00
8/93	144.80	152.25	146.10	139.90	149.90	139.10
9/93	145.10	152.00	146.70	140.90	150.20	139.20
10/93	145.70	153.25	147.20	141.90	150.90	139.50
11/93	145.80	154.50	146.40	141.05	151.60	139.80
12/93	145.80	154.05	146.10	140.20	151.90	140.40

Mo./Yr.	*NYC*	*PHI*	*PTT*	*SFO*	*SEA*	*WDC*
			Index (1982-83=100)			
5/92	148.90	145.70	135.15	141.90	139.70	*n.a.*
6/92	149.50	147.50	135.20	141.90	140.20	*n.a.*
7/92	149.90	147.30	136.05	142.20	140.50	*n.a.*
8/92	150.80	148.00	136.90	142.70	140.90	*n.a.*
9/92	151.40	148.10	137.30	143.70	141.30	*n.a.*
10/92	152.10	148.00	137.70	144.30	141.80	*n.a.*
11/92	152.20	147.50	137.50	144.20	142.00	*n.a.*
12/92	151.90	147.50	137.30	144.30	141.90	*n.a.*
5/93	153.80	149.40	139.55	146.90	144.20	149.20
6/93	154.20	150.50	139.50	146.10	144.40	149.20
7/93	154.30	150.70	139.95	146.10	144.40	149.20
8/93	155.30	150.60	140.40	146.20	144.80	149.45
9/93	155.30	151.10	140.50	146.50	145.10	149.70
10/93	155.50	152.20	140.60	147.00	145.70	150.30
11/93	155.40	152.10	140.85	147.20	145.80	150.90
12/93	155.60	151.30	141.10	147.00	145.80	150.90

Source: Bureau of Labor Statistics.

Table B4.6: Per-Capita Disposable Income and Population for Selected Cities, 1992, 1993

Cities	Personal Income 1992	Personal Income 1993	Population 1992	Population 1993
	Thousands of Dollars		*Thousands*	
Atlanta	21.83	22.71	3,134.92	3,228.74
Boston	24.02	24.86	5,673.58	5,699.22
Chicago	23.38	24.22	8,399.90	8,467.34
Detroit	21.62	22.59	5,235.70	5,246.05
Los Angeles	21.32	21.32	15,067.29	15,212.08
Miami	19.19	21.10	3,316.49	3,351.35
New York City	27.32	28.11	17,931.44	18,019.83
Philadelphia	23.33	24.11	5,926.09	5,940.99
Pittsburgh	21.07	21.78	2,405.10	2,407.06
San Francisco	26.70	27.39	6,410.92	6,470.00
Seattle	23.50	23.95	3,132.15	3,183.82
Washington, D.C.	*n.a.*	25.96	*n.a.*	6,978.40

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, and U.S. Department of Commerce, Bureau of the Census.

Table B5.1: U.S. Exports of Fresh Grapes, by Destination, 1976–94

Year	Total[1]	Mexico	Latin America	Western Europe	Japan	Southeast Asia[2]	Other Asia[3]	Other
	Thousands of Pounds							
1976	43,414	1,123	6,281	5,217	3,486	8,238	13,729	5,340
1977	43,268	564	9,245	8,322	1,965	6,651	14,237	2,284
1978	55,312	903	8,935	12,983	5,934	2,623	13,642	10,292
1979	51,911	1,100	8,765	5,056	3,784	8,657	16,867	7,682
1980	65,424	1,089	12,272	8,329	2,981	11,090	19,287	10,375
1981	67,606	3,696	9,737	4,701	2,497	12,135	21,397	13,442
1982	74,169	1,555	11,422	3,256	3,711	14,029	29,550	10,644
1983	50,244	1,975	9,283	1,639	3,586	9,951	17,930	5,881
1984	56,421	2,394	7,880	2,209	4,305	10,931	25,955	2,748
1985	68,526	1,164	8,771	2,831	4,090	11,911	37,231	2,528
1986	113,265	2,466	11,154	13,319	10,604	11,306	59,079	5,337
1987	105,230	2,288	10,045	18,284	10,932	10,580	45,129	7,973
1988	130,946	2,928	10,606	17,684	12,786	15,941	60,445	10,556
1989	155,346	3,414	11,579	20,401	11,136	25,890	75,735	7,192
1990	170,355	4,941	17,862	29,944	9,618	23,520	77,156	7,313
1991	178,385	8,386	23,870	29,597	9,808	33,152	67,379	6,193
1992	184,870	5,636	25,071	24,671	7,471	37,301	76,353	8,367
1993	203,579	19,802	32,338	16,903	7,612	48,673	68,570	9,682
1994	255,517	53,636	27,874	14,353	11,363	55,475	80,315	12,500

Notes: [1]Except Canada.
[2]Thailand, Malaysia, Singapore, the Philippines and Indonesia.
[3]South Korea, Hong Kong and Taiwan.

Source: USDA, Foreign Agricultural Service, *Foreign Agricultural Trade of the United States*.

Table B5.2: Data for Model of Exports to Principal Countries

Year	*POP*	*EXP*	*Q*	*V*	*P*	*PROMO*
1976	214.13	61.93	21.97	7.25	0.33	19.4
1977	219.21	73.60	20.89	7.94	0.38	52.2
1978	224.32	86.57	10.07	4.23	0.42	29.6
1979	229.58	94.46	11.60	5.45	0.47	54.7
1980	234.33	121.48	13.81	6.63	0.48	41.5
1981	240.41	137.38	15.24	8.38	0.55	74.7
1982	246.40	148.11	19.81	10.50	0.53	71.0
1983	251.43	142.41	12.67	6.59	0.52	54.4
1984	256.96	149.55	16.77	8.22	0.49	83.5
1985	262.09	152.27	22.34	10.95	0.49	118.7
1986	267.86	154.05	31.99	16.96	0.53	465.6
1987	273.63	160.81	25.32	13.67	0.54	621.4
1988	279.25	198.27	34.72	16.67	0.48	949.4
1989	284.94	229.17	46.19	22.17	0.48	1,668.9
1990	287.72	257.91	45.76	24.25	0.53	2,451.1
1991	293.78	290.27	45.70	24.22	0.53	3,840.7
1992	299.23	335.48	51.66	28.41	0.55	3,360.0
1993	304.81	365.86	53.29	29.31	0.55	3,473.4
1994	307.25	416.09	61.72	34.56	0.56	3,423.4

Notes: Data are for Hong Kong, Malaysia, Singapore, Indonesia, Thailand, Taiwan, and South Korea. *POP* is total population, in millions. *EXP* is total personal income, in millions of dollars. Q is total exports to the seven countries, in millions of pounds. V is the total value of these exports, in millions of dollars. P is the average price of exports, V/Q. *PROMO* is CTGC promotion expenditures in the seven counties, in thousands of dollars. See table 5.1 in text for details on sources.

Table B5.3: U.S. Exports of Fresh Grapes, Selected Asian Countries, by Month, 1986–95

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	Thousands of Pounds			
5/86	66.1	2.2	90.4	0.0
6/86	196.2	97.0	787.0	0.0
7/86	2,096.6	463.0	1,040.6	0.0
8/86	4,290.2	443.1	831.1	917.1
9/86	3,560.4	427.7	1,457.2	3,137.1
10/86	5,630.5	729.7	1,821.0	6,402.2
11/86	4,874.4	218.3	1,150.8	9,607.6
12/86	833.3	183.0	773.8	5,136.7
6/87	601.9	24.3	374.8	0.0
7/87	1,466.1	588.6	1,234.6	1,175.1
8/87	2,987.2	469.6	1,459.4	4,400.4
9/87	6,834.3	390.2	1,261.0	10,855.5
10/87	2,828.5	908.3	2,017.2	4,909.6
11/87	3,560.4	185.2	892.9	826.7
12/87	1,256.6	169.8	315.3	599.7
5/88	0.0	0.0	86.0	149.9
6/88	288.8	0.0	524.7	0.0
7/88	1,437.4	284.4	1,655.7	33.1
8/88	4,887.6	211.6	970.0	271.2
9/88	7,228.9	308.6	1,349.2	7,226.7
10/88	7,566.2	679.0	2,859.4	8,985.9
11/88	7,220.1	388.0	1,263.2	7,420.7
12/88	4,975.8	86.0	716.5	1,893.8
5/89	0.0	0.0	99.2	52.9
6/89	1,410.9	92.6	1,331.6	4.4
7/89	3,562.6	286.6	1,406.5	61.7
8/89	7,394.2	392.4	2,817.5	4,629.7
9/89	8,024.7	366.0	1,519.0	7,246.5
10/89	9,903.1	511.5	2,358.9	9,900.9
11/89	7,246.5	593.0	1,655.7	2,667.6
12/89	3,701.5	0.0	130.1	1,494.7
1/90	0.0	0.0	0.0	28.7
5/90	2,744.7	0.0	22.0	125.7
6/90	7,636.7	50.7	1,036.2	0.0
7/90	10,901.7	231.5	963.4	661.4
8/90	12,165.0	789.2	3,022.5	4,828.1
9/90	6,973.1	548.9	2,206.8	15,859.9
10/90	3,840.4	771.6	2,204.6	4,830.3
11/90	2,696.2	720.9	2,292.8	4,605.4
12/90	0.0	359.3	652.6	1,499.1

(Continued)

Table B5.3 (Continued)

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	Thousands of Pounds			
1/91	0.0	0.0	295.4	0.0
6/91	399.0	123.5	813.5	79.4
7/91	1,609.4	246.9	1,225.8	370.4
8/91	9,049.9	1,093.5	2,980.6	2,072.3
9/91	8,428.2	908.3	2,563.9	4,237.2
10/91	11,329.4	1,069.2	2,810.9	9,753.2
11/91	6,845.3	853.2	2,592.6	3,287.1
12/91	5,011.1	407.9	961.2	2,217.8
1/92	1,095.7	174.2	227.1	401.2
5/92	0.0	0.0	39.7	0.0
6/92	2,418.4	260.1	1,298.5	52.9
7/92	3,617.7	491.6	2,211.2	3,181.2
8/92	9,938.3	1,128.8	2,228.9	3,355.4
9/92	11,056.1	1,069.2	2,555.1	9,920.7
10/92	7,070.2	1,347.0	2,006.2	14,138.1
11/92	5,119.1	903.9	1,265.4	648.2
12/92	3,031.3	524.7	485.0	1,362.4
1/93	586.4	178.6	116.8	288.8
5/93	134.5	0.0	202.8	22.0
6/93	679.0	227.1	855.4	24.3
7/93	1,668.9	469.6	2,109.8	174.2
8/93	9,545.9	1,261.0	2,945.3	5,341.7
9/93	12,017.3	1,902.6	3,291.5	12,464.8
10/93	8,694.9	1,673.3	2,151.7	4,312.2
11/93	5,207.3	1,926.8	1,741.6	3,463.4
12/93	1,739.4	1,188.3	1,212.5	2,347.9
1/94	37.5	112.4	317.5	1,106.7
5/94	46.3	0.0	167.5	33.1
6/94	542.3	231.5	903.9	4.4
7/94	1,653.5	657.0	1,598.3	460.8
8/94	9,724.5	1,532.2	2,264.1	9,570.2
9/94	16,512.5	1,496.9	3,150.4	8,097.5
10/94	10,114.7	2,863.8	3,183.4	9,455.5
11/94	5,747.4	1,918.0	1,285.3	2,350.1
12/94	2,101.0	471.8	235.9	2,094.4
1/95	114.6	196.2	6.6	183.0
5/95	33.1	0.0	88.2	26.5
6/95	822.3	562.2	1,153.0	657.0
7/95	848.8	727.5	1,241.2	418.9
8/95	7,709.5	1,510.2	1,871.7	3,392.9
9/95	19,096.2	1,849.7	1,847.5	8,736.8
10/95	12,727.2	2,826.3	2,874.8	7,793.3
11/95	14,402.7	3,240.8	2,277.4	4,404.8
12/95	6,157.4	3,291.5	1,413.1	2,347.9

Source: CTGC, Special Tabulations.

Table B5.4: CTGC Advertising in Selected Asian Countries, by Month, 1986–95

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	U.S. Dollars			
8/86	10,286	0	0	0
9/86	10,286	0	0	0
10/86	10,286	0	0	0
11/86	5,143	0	0	0
7/87	6,000	0	0	0
8/87	6,000	0	0	0
9/87	6,000	0	0	0
10/87	6,000	0	0	0
11/87	6,000	0	0	0
7/88	0	0	8,000	0
8/88	13,000	0	8,000	0
9/88	13,000	0	8,000	35,400
10/88	0	0	8,000	0
11/88	0	0	0	17,700
12/88	0	0	0	17,700
7/89	0	18,000	20,000	0
8/89	49,100	18,000	20,000	0
9/89	49,100	0	0	48,000
10/89	49,100	18,000	20,000	48,000
11/89	49,100	0	0	36,000
12/89	0	0	0	36,000
5/90	9,134	0	0	0
6/90	36,634	0	0	0
7/90	94,134	23,467	21,578	0
8/90	79,134	43,134	21,578	0
9/90	25,334	43,134	21,578	75,000
10/90	9,134	23,467	13,564	67,346
11/90	0	3,800	0	40,000

(Continued)

Table B5.4 (Continued)

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	U.S. Dollars			
7/91	21,888	0	0	7,275
8/91	90,214	74,124	713,675	0
9/91	66,250	70,672	691,567	130,490
10/91	72,339	52,540	49,428	130,701
11/91	105,496	60,013	53,788	104,182
12/91	2,410	0	0	70,258
7/92	1,325	0	0	0
8/92	134,519	59,775	58,640	15,040
9/92	118,247	364,476	49,859	156,118
10/92	148,623	4,762	49,859	19,991
11/92	39,883	6,081	38,318	68,529
12/92	4,718	0	0	57,341
6/93	0	0	35,864	0
7/93	0	23,693	22,383	0
8/93	100,554	26,268	22,599	17,768
9/93	89,343	30,918	29,123	93,939
10/93	99,729	29,377	28,302	53,702
11/93	24,261	7,089	15,296	58,018
12/93	0	380	0	0
8/94	221	0	0	0
9/94	92,030	61,356	633,661	87,226
10/94	119,487	19,489	23,791	80,733
11/94	47,003	4,500	18,301	13,568
12/94	37,156	0	0	0
8/95	38,545	30,667	23,897	0
9/95	80,241	22,482	42,724	125,700
10/95	114,016	61,980	49,241	89,928
11/95	58,452	0	0	0

Source: CTGC, Special Tabulations.

Table B5.5: CTGC Promotion, except Advertising, in Selected Asian Countries, by Month, 1986–95

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	U.S. Dollars			
6/86	0	1,485	2,641	0
7/86	1,214	1,485	2,641	429
8/86	1,214	1,485	2,641	1,429
9/86	1,214	1,485	2,641	4,629
10/86	1,214	1,485	2,641	4,629
11/86	1,214	1,485	2,641	4,629
12/86	1,214	1,485	2,641	4,629
1/87	0	0	0	3,629
5/87	975	520	859	867
6/87	4,904	2,663	3,715	867
7/87	4,904	2,663	4,315	867
8/87	4,904	2,663	4,315	3,867
9/87	4,904	2,663	4,315	12,847
10/87	4,904	2,663	4,315	12,847
11/87	4,904	2,663	4,315	12,847
12/87	4,904	2,663	3,715	12,847
1/88	0	0	0	9,847
5/88	2,000	1,349	1,349	0
6/88	6,875	4,920	4,920	5,000
7/88	9,189	4,920	4,920	5,930
8/88	9,189	4,920	4,920	5,930
9/88	9,189	4,920	4,920	13,230
10/88	9,189	4,920	4,920	13,230
11/88	9,189	4,920	4,920	7,500
12/88	9,189	4,920	4,920	7,500
1/89	9,189	0	0	5,000
5/89	1,063	1,563	1,563	0
6/89	7,992	5,758	7,365	11,985
7/89	12,392	10,958	13,865	11,985
8/89	12,392	5,958	8,865	11,985
9/89	12,392	5,958	8,865	11,985
10/89	12,392	5,958	8,865	11,985
11/89	12,392	5,958	8,865	11,985
12/89	12,392	5,958	8,865	11,985
1/90	0	0	0	11,985
5/90	11,576	0	8,625	0
6/90	13,376	9,714	24,339	0
7/90	11,376	14,714	14,339	12,733
8/90	13,376	9,714	14,339	29,133
9/90	11,376	9,714	14,339	26,883
10/90	11,376	9,714	14,339	26,883
11/90	0	9,714	14,339	26,883
12/90	0	9,714	14,339	26,883

(Continued)

Table B5.5 (Continued)

Mo./Yr.	Hong Kong	Malaysia	Singapore	Taiwan
	U.S. Dollars			
6/91	0	0	19,361	0
7/91	20,057	23,941	27,439	12,608
8/91	25,159	19,283	19,361	34,409
9/91	20,057	19,283	19,361	30,688
10/91	20,057	19,283	19,361	30,688
11/91	20,057	19,283	19,361	24,442
12/91	20,057	16,881	19,361	13,685
1/92	20,057	7,203	19,361	13,685
6/92	0	9,000	17,875	0
7/92	41,450	9,000	17,875	30,511
8/92	43,059	21,884	34,722	31,285
9/92	38,487	11,500	21,275	49,815
10/92	38,487	11,500	21,275	49,815
11/92	38,487	11,500	21,275	43,363
12/92	11,139	9,000	21,275	12,840
1/93	11,139	0	17,875	12,840
6/93	0	11,077	16,283	0
7/93	19,132	24,747	29,746	47,690
8/93	32,619	13,577	20,283	55,675
9/93	28,269	13,577	20,283	38,275
10/93	28,269	13,577	20,283	38,275
11/93	28,269	13,577	20,283	29,029
12/93	16,073	11,077	16,283	11,971
1/94	16,073	0	5,854	11,971
6/94	0	12,821	17,745	0
7/94	22,536	15,821	21,960	31,976
8/94	24,902	15,821	21,960	38,016
9/94	22,536	15,821	21,960	26,916
10/94	22,536	15,821	21,960	26,916
11/94	22,536	15,821	21,960	14,376
12/94	22,536	12,821	17,745	14,376
1/95	16,184	0	8,661	14,376
6/95	2,786	24,539	30,082	3,077
7/95	15,431	18,881	21,838	25,504
8/95	18,043	23,881	21,838	25,504
9/95	15,431	18,881	21,838	28,759
10/95	15,431	18,881	21,838	25,504
11/95	15,431	18,881	21,838	18,848
12/95	15,431	18,881	15,095	18,848

Source: CTGC, Special Tabulations.

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