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United States
Department
of Agriculture

Economic
Research
Report
Number 2

April 2005



Electronic Report from the Economic Research Service

www.ers.usda.gov

Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry

Roberta Cook and Linda Calvin

Abstract

The rapid growth of the North American greenhouse tomato industry has changed the longstanding dynamics of the fresh tomato industry. During the 1990s, Canada emerged as the largest North American producer of greenhouse tomatoes, a prominence it never attained in the fresh field tomato industry. The United States and Mexico have also become important greenhouse tomato producers, consistent with their long dominance in North American fresh field tomato production. Greenhouse tomatoes have changed the look of U.S. retail tomato sales, where they now account for 37 percent of the quantity sold of fresh tomatoes. While the primary U.S. fresh field tomato product, the mature green tomato, long dominated retail sales, its share has decreased significantly due to the growth of greenhouse tomatoes. The U.S. mature green tomato industry is now more dependent on the continuing growth of the foodservice market, which generally prefers its product.

Keywords: Greenhouse tomatoes, field tomatoes, mature green tomatoes, United States, Canada, Mexico, market integration, product differentiation, seasonality in production.

Acknowledgments

The authors wish to thank the many growers, marketers, and fresh tomato industry representatives in the United States, Canada, and Mexico who generously contributed their time and expertise in helping us better our understanding of the greenhouse tomato industry and its impact on the field tomato industry. In addition, we turned to a small group of people repeat-

edly for insight into the industry, and we would like to acknowledge their willingness to help us in this endeavor. In alphabetical order they are: Ed Beckman, California Tomato Commission; Reggie Brown, Florida Tomato Commission; Mike DeGiglio, Village Farms; Jay Colasanti, Red Zoo; Fried De Schouwer, formerly of Eurofresh; Murray Driediger, British Columbia Vegetable Marketing Commission; Denton Hoffman, formerly of the Ontario Greenhouse Vegetable Growers; Carolyn Hughes, California Tomato Commission; Merle Jensen, Professor Emeritus, University of Arizona; Tom Papadopoulos, The Greenhouse and Processing Crops Research Centre, Agriculture and Agri-Food Canada; Mario Robles, Confederación de Asociaciones Agrícolas del Estado de Sinaloa (CAADES); and Mario Steta, Asociación Mexicana de Productores de Hortalizas en Invernaderos (AMPHI). Thanks are also due to our reviewers: John Brooker, University of Tennessee; Kyle Cunningham, USDA, Foreign Agriculture Service; Terry Long, USDA, Agricultural Marketing Service; Gary Lucier, USDA, Economic Research Service; and Gary Thompson, University of Arizona. We also recognize our colleagues at USDA, Agricultural Marketing Service for their help with data—Barbara Maxwell, Art Munchow, and Fred Teensma. Finally, we appreciate the editorial assistance of John Weber and the design and layout skills of Wynnice Pointer-Napper, both of ERS’s Information Services Division.

Cover Photo: Eurofresh.

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Summary

The North American greenhouse tomato industry has grown rapidly since the early 1990s and now plays a major role in the fresh tomato industry. However, relatively little is known about this new industry, in part because of the lack of reliable production, trade, and price data. Both analysts and industry members will benefit from a more comprehensive understanding of the rising greenhouse industry and its effect on the entire fresh field tomato sector.

What Is the Issue?

Greenhouse tomato growers in the United States, Canada, and Mexico are investing in capital-intensive production facilities without a strong base of industry information. Some field tomato growers are feeling the effects of increased competition but have little information to assess the likely effect on their industry. The issues are basic. What is the structure of the greenhouse tomato industry? What are the strengths and weaknesses of the various parts of the industry? What is the current level of greenhouse tomato production and how has it grown? What is the role of trade? How have prices changed with the rapid growth of the industry? What impact has the greenhouse tomato industry had on the fresh field tomato industry?

What Did the Study Find?

Total North American greenhouse tomato production for 2003 is estimated at 528,078 metric tons, from negligible amounts in the early 1990s. Canada is the largest producer with an estimated 42 percent of production, followed by the United States with 30 percent, and Mexico with 28 percent. Among the three countries, Canada was the industry's pioneer and is a market force during its March to December season. The strengths of its industry are high yields and consistent product quality. Canada's volume of summer tomatoes is so great that it is hard for growers in the United States and Mexico to compete profitably in that season. The main weakness of the Canadian greenhouse industry is that it does not produce tomatoes in the winter.

In the United States, the large greenhouse operations are located in the Southwest and West, where climate conditions enable them to produce tomatoes profitably in the winter, when prices are higher. The strengths of the U.S. industry are high yields, product consistency, and year-round supply. The U.S. industry is vulnerable to increasing competition from Mexico during the winter months, which could erode profits that carry it through the summer when prices are lower. To meet domestic demand, the United States imports over half of its supply of greenhouse tomatoes from Canada and Mexico.

Mexico is the latest entrant to the North American greenhouse tomato industry, but it already has more greenhouse tomato area than either the United States or Canada. However, average yields in Mexico are comparatively low. Mexican growers are using a wide range of technologies, not just high technology greenhouses with hydroponics. Mexico's main strength is climate conditions enabling winter production and the potential to be a year-round supplier. Mexico's industry is challenged by the high cost of capital,

high heating costs, inexperienced management, lack of infrastructure and dedicated input suppliers, and inconsistent product quality.

Between the early 1990s and 2003, North American greenhouse tomato area is estimated to have grown by almost 600 percent to 1,726 hectares. Production has also grown; from 1998 to 2003, North American greenhouse production grew 103 percent. Growth continues but is stabilizing in Canada and the United States, while continuing strong in Mexico. In 2003, in the United States and Mexico, the greenhouse shares of total fresh tomato production were 9 and 8 percent, respectively, but are likely higher now. In Canada, greenhouse tomatoes now completely dominate fresh tomato production, with an 89-percent share.

As the North American greenhouse tomato industry has expanded from market niche to mainstream status, tomato prices have declined. There have been two periods of very low prices. In summer 1999, beefsteak tomato prices fell to a new low, causing financial problems for a number of greenhouse growers. In 2000, the industry began to produce tomatoes-on-the-vine (TOV), which have been popular with consumers. The shift to TOVs took the downward price pressure off beefsteak tomatoes. TOVs have enjoyed a substantial premium over beefsteaks, but as more and more growers turned to TOVs, prices also began to decline, with a particularly rapid drop in summer 2004.

U.S. fresh tomato consumption is split about evenly between the retail and foodservice markets. Greenhouse tomatoes have made major inroads in U.S. retail channels, but they have not had much success in food service. An estimated 37 percent of fresh tomatoes sold in U.S. retail channels are greenhouse tomatoes. The retail quantity sold of all types of field tomatoes—round (mature green and vine ripe), roma, cherry and grape—increased until 2001, but has declined slightly since then. Mature green tomatoes, the backbone of the U.S. field tomato industry, have been impacted the most by greenhouse gains. The mature green tomato share of the retail quantity of fresh tomatoes sold plummeted from 1998 to 2003. However, higher retail shares for other types of field tomatoes have limited the erosion in the overall retail market share for field tomatoes. The growing foodservice market, where mature green tomatoes are preferred, has helped cushion mature green tomato growers from increased competition from greenhouse tomatoes.

How Was the Study Conducted?

Since public data on the greenhouse tomato industry are scarce, this analysis rests primarily on extensive interviews with greenhouse and field tomato growers, marketers, and industry representatives in the United States, Canada, and Mexico. While there are still important data gaps, this study provides the first estimates of production and trade. As the industry grows and government statistics catch up, there will be a firmer basis for analysis.

Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry

Roberta Cook and Linda Calvin¹

Introduction

As recently as the early 1990s, greenhouse tomatoes were a specialty product, and most came from the Netherlands. By the late 1990s, greenhouse tomatoes were being allotted sizable shelf-space in most U.S. and Canadian grocery stores. Now, the United States, Canada, and Mexico all produce greenhouse tomatoes, and suppliers outside North America play a diminished role. The rapid growth of the North American greenhouse tomato industry has caused greenhouse tomatoes to become more integrated into the fresh tomato industry, rather than operate as a separate niche. Now the greenhouse industry is large enough to impact industry dynamics for all fresh tomato growers. This report documents the emergence of the North American greenhouse tomato industry and assesses its impact on the fresh tomato sector as a whole.

The report begins with an overview of the North American fresh tomato industry, putting the emerging North American greenhouse tomato industry in context within an industry still dominated by field tomatoes. While the North American Free Trade Agreement (NAFTA) has contributed to greater integration in the fresh tomato industry, there are important regional differences which merit a country-by-country approach. We start with a discussion of the greenhouse tomato industries in Canada and Mexico, noting each country's fresh tomato trade profile. The structure of the entire fresh tomato industry is considered for Mexico, since unlike in the United States and Canada, many greenhouse growers also produce field tomatoes. The United States is discussed last because imports from Canada and Mexico have such an important impact on the U.S. greenhouse tomato industry. In addition to describing the evolution of the U.S. greenhouse tomato industry, this section consolidates all of the information on trade flows touched on elsewhere to estimate total U.S. greenhouse tomato supply, from domestic production and imports. This lays the groundwork for the next section analyzing the U.S. greenhouse tomato market, highlighting price trends in the principal consumer market in North America. Following is an analysis of the impact of greenhouse tomatoes on the fresh field tomato industry in the United States.

Because of the rapid increase in production, the North American greenhouse tomato industry has faced conflict, most notably two antidumping cases between the United States and Canada. A section on conflicts and efforts to cooperate highlights the stresses of an emerging industry. The report concludes with the outlook facing the greenhouse and fresh field tomato industries.

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Canada is the only country in North America with annual government statistics on greenhouse tomato area and production. Estimates of U.S. and Mexican area and production are based on interviews with growers, marketers, and leaders of industry organizations. While subject to error, they provide an important first step in understanding the industry. Limited price reporting also challenges analysis. There are no free-on-board (FOB) shipping-point prices for greenhouse tomatoes grown in the United States.² Daily prices by type of greenhouse tomato are available on imports from Mexico, but only those entering through Nogales, Arizona, and not for the whole year. Trade statistics from the U.S. Department of Commerce (DOC) provide monthly unit-value border prices for imports on all imported greenhouse tomatoes, by country of origin, but no information on price by type or size of greenhouse tomato. The findings of this report reflect the use of all available public information, supplemented by extensive primary data collection from industry sources.

Overview of the North American Greenhouse Tomato Industry

This overview discusses three factors that are critical to understanding the greenhouse tomato industry. It also provides a broad picture of the industry and perspective for the following individual country analyses. The first important factor is seasonality, which explains why there is a North American greenhouse tomato industry, not just three separate industries, and the role of trade. The structure of the North American fresh field tomato industry is also a function of seasonality, and the two fresh tomato industries are developing along similar lines. The second broad theme that will reappear throughout this study is product differentiation. Greenhouse tomatoes can be thought of as just one more type of tomato in the wide range of fresh tomatoes available to consumers. The existence of other tomato types influences the growth of greenhouse tomatoes and vice versa. Greenhouse and field tomatoes compete in some markets, but not in all. The third major factor affecting the greenhouse tomato industry is the rapid growth of production and the resulting decline in prices. Profitability and competitiveness will be an increasing challenge for growers. All of these factors will influence the future evolution of the North American greenhouse tomato industry.

Seasonality and Structure of the Industry

Seasonality is a major force affecting the North American fresh tomato industry, both greenhouse and field tomatoes. In the winter, field tomatoes are only available from Florida and Mexico. Over time, the industry has developed relationships that cross national borders and provide a relatively seamless supply of field tomatoes from different regions across the seasons (fig. 1). While greenhouse tomatoes can be grown anywhere at any time of the year, issues of profitability still impose seasonality. Even in a greenhouse, growers ignore Mother Nature at their peril. Increasingly, greenhouses are carefully situated to minimize the cost of achieving the ideal tomato growing conditions for the targeted market window. Following the pattern established by the field tomato industry, the greenhouse tomato industry has also developed a web of business relationships that provide

² FOB price is the average, unweighted unit price received at the shipping point in the production region. FOB prices exclude freight and insurance costs.

Figure 1

North America greenhouse tomato and fresh field tomato shipping seasons by region

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Field grown	California											
	Florida											
	Rest of U.S.											
	Sinaloa, Mexico											
	Baja California, Mexico											
	Canada											
Greenhouse	Canada											
	U.S. ¹											
	Sinaloa, Mex.											
	Imuris, Sonora, Mex.											
	Central Mexico											
	Baja California, Mexico ¹											

¹Many U.S. and Baja California, Mexico, greenhouse industry locations do not produce year-round, but there is year-round production in the aggregate.

Source: U.S. Department of Agriculture, Agricultural Marketing Service; estimates by Cook and Calvin.

greenhouse tomatoes from various regions in different seasons. In an increasingly integrated industry, national borders pose few barriers.³ Marketing firms use marketing agreements, joint ventures, and, to a lesser extent, foreign direct investment to ensure smooth supplies across seasons.

Canada was the first big greenhouse tomato producer in North America and is still the leader, with an estimated 42 percent of North American production in 2003 (table 1). The Canadian industry is centered in Delta, British Columbia, and Leamington, Ontario (fig. 2). Long, relatively mild, summer days in these regions are ideal for growing greenhouse tomatoes, and Canadian production is a market force during the March to December period. The Achilles heel of the Canadian greenhouse tomato industry is its lack of winter supply. As greenhouse tomatoes have become a mainline commodity, retailers are increasingly demanding consistent year-round volumes from their suppliers.

The principal U.S. greenhouse tomato growers produce year-round and the U.S. industry accounted for 30 percent of North American production in 2003. The four largest greenhouse tomato firms in the United States are now located in Arizona, Texas, Colorado, and coastal southern California, and account for 67 percent of domestic production. It is difficult to find a location that provides both profitable winter and summer production. With such high investment costs for greenhouses, growers are reluctant to consider using them for only part of a year. The profitable winter market helps the year-round U.S. producers withstand the very low prices during the summer season when Canadian volume inflates supplies. However, expanding winter production in Mexico will likely reduce prices and increase competitive pressure on year-round U.S. growers.

Mexico's major advantage in the greenhouse tomato industry is its ability to produce during the winter months—the same edge it holds in field tomato production. Some growers only produce in the winter but there are also important year-round suppliers. Mexican greenhouse tomato production

³ With NAFTA, tariff barriers no longer exist, but nontariff barriers can still affect the market (Calvin and Barrios, 1998). Growers have several trade protection remedies at their disposal, chief among them protection under anti-dumping laws. The Fresh Tomato Suspension Agreement between the Mexican and the U.S. tomato industries is a prime example of a nontariff barrier. It establishes a price floor on U.S. imports of fresh tomatoes from Mexico.

Table 1—North American fresh tomato industry—greenhouse and field grown comparison, 2003¹

Item	Units	United States	Canada	Mexico	North America
Greenhouse tomato production	Metric tons	159,664	220,114	148,300	528,078
Greenhouse tomato area	Hectares	330	446	950	1,726
Average greenhouse tomato yield	Metric tons/hectare	484	494	156	378
Fresh field tomato production	Metric tons	1,594,241	26,882	1,804,000	3,425,123
Fresh field tomato area	Hectares	50,304	1,813	63,300	115,417
Average fresh field tomato yield	Metric tons/hectare	32	15	28	25
Greenhouse share of total fresh production, by country	Percent	9	89	8	13
Greenhouse share of total fresh area, by country	Percent	1	20	1	20
Estimated U.S. greenhouse imports from: ^{2, 3}	Metric tons	n.a.	130,154	125,970	256,124

¹ Excludes processing tomato area and production in all three countries.

² Official imports of greenhouse tomatoes are thought to be underreported for Mexico due to tariff code misclassification; 58,357 metric tons of greenhouse tomato imports from Mexico were reported by the U.S. Department of Commerce in 2003. The figure shown here includes estimated additional miscoded imports, based on information from industry sources obtained by Cook and Calvin.

³ Imports of greenhouse tomatoes from outside North America totaled 24,093 metric tons.

n.a. = Not applicable

Sources: Statistics Canada, Ontario Greenhouse Vegetable Growers, British Columbia Vegetable Marketing Commission, U.S. Department of Commerce, interviews by Cook and Calvin, USDA, National Agricultural Statistics Service.

Figure 2

Selected North American greenhouse tomato production areas



• Dot = greenhouse production.

Source: Interviews by Cook and Calvin.

totaled 28 percent of North American production in 2003, and the industry is growing rapidly. The seasonal pattern in Mexico is still in flux as growers experiment with various levels of technology in different regions. While U.S. and Canadian greenhouse growers use relatively homogeneous production systems, Mexican producers are experimenting with a range of protected culture methods (see box, “What Is a Greenhouse Tomato?”). The choice of technology often depends on the length of the potential production season in a particular location.

In Mexico, large field tomato grower-exporters in Sinaloa on the northwest coast and the Baja California peninsula are experimenting with protected culture, either shade houses or greenhouses, near their field operations. Because of its hot, humid summers, Sinaloa, the principal fresh field tomato-exporting region in Mexico and a leading greenhouse exporter, is a winter producer only. Humidity often raises the costs of cooling to unprofitable levels. Growers there have less incentive to invest in the highest technology greenhouses because the limited shipping season reduces the return on investment. Nevertheless, the technology levels and yields used in coastal areas are improving, with more growers moving into midlevel technology systems to improve yields, quality, and marketing.

Several clusters of greenhouses are also emerging in temperate, higher altitude areas in central and north central Mexico, and in Imuris in northern Sonora, near the U.S. border. In these areas, growers have the potential to produce year-round, and, as a result, more growers are investing in high-technology greenhouses similar to those in Canada and the United States. As greenhouse production in temperate, noncoastal areas expands, Mexico will become more of a competitive force in all seasons.

Trade is an important component of the North American greenhouse industry because of seasonality. Trade is also critical because of the uneven size of the consumer markets in the three North American countries. The United States, the largest consumer market in North America for greenhouse tomatoes, imports more greenhouse tomatoes than it produces. In 2003, about 36 percent of the domestic U.S. supply of greenhouse tomatoes was produced in the United States, 30 percent was imported from Canada mostly during the summer, and another 29 percent from Mexico mostly during the winter (with the remainder extra-NAFTA imports). In recent years, imports have increased more rapidly than domestic production. Exports to the United States are very important for both Canada and Mexico. Sixty percent of Canada’s production is exported and virtually all to the United States. Almost all marketable greenhouse tomatoes in Mexico are sold to the United States or Canada. There is limited Mexican demand for greenhouse tomatoes at this time, although it will undoubtedly grow. Neither the United States nor Canada exports greenhouse tomatoes to Mexico.

Trade is complicated by the fact that during parts of the year, growers in all three countries are in the market simultaneously. Seasonal overlaps have at times led to turbulent relationships between some groups of producers. In March 2001, six U.S. greenhouse tomato firms brought a dumping suit against the Canadian greenhouse industry. Canadian growers reciprocated in November 2001 with a case against the entire U.S. fresh tomato industry—greenhouse and field. The U.S. growers lost their case against Canada—the

What Is a Greenhouse Tomato?

To take a broad view, tomato production can be divided into open field and protected agriculture. Protected agriculture is a wide category of production methods providing some degree of control over various environmental factors. There is a continuum of control and cost starting with simple shade-house structures and ending with high technology greenhouses. Growers have choices with respect to the type of structure to protect their production, the degree of environmental control to adopt within the structure (passive or active), and whether to grow in soil or use hydroponics. A shade house is a temporary structure that supports shade cloth, a type of screen, that provides passive control of the environment by shading the plants from excessive sunlight and wind. A shade house can also provide a barrier to insect vectors, such as white fly, that carry viruses. A greenhouse provides opportunities for active environmental control such as controlling light, air temperature, humidity, and carbon dioxide levels to achieve higher yields. Hydroponics is a production system where plants are grown in a nutrient solution with an artificial medium to provide mechanical support to the root system. Artificial growing mediums include rockwool, coir, sawdust, tezontle (a ground volcanic rock used in Mexico), and perlite. Within protected agriculture there is a wide range of technologies that can be combined depending on a grower's environmental and financial considerations, as well as risk preferences.

There is no official USDA or other Federal definition outlining the requirements for a tomato to be labeled as "greenhouse." With the rapid growth of greenhouse tomato production has come serious industry debate regarding whether tomatoes produced with any type of protected agriculture can be labeled as greenhouse. In September 2004, the State of California adopted a definition requiring tomatoes labeled as greenhouse to be grown in "a fixed steel structure using irrigation and climate control, in an artificial medium that substitutes for soil." This means that any tomatoes labeled as greenhouse and marketed in California must be grown hydroponically. No other such restrictive regulations exist elsewhere in North America.

In this report, we break protected agriculture into two broad categories: shade house and greenhouse, the latter not limited to hydroponics but requiring a fixed, permanent structure (see appendix 1). There is a range of greenhouse technologies that can be loosely defined as low-, medium-, and high-technology greenhouses. Here, we define a low-technology greenhouse as involving only a fixed, permanent structure with limited or passive environmental control. A medium-technology system involves greater environmental control and/or the addition of hydroponics. A high-technology system requires both fully active environmental control and hydroponics.

Much of the U.S. and Canadian greenhouse industries favor defining greenhouses as high-technology systems only; all the large commercial U.S. and Canadian firms fit this definition. However, the full continuum of protected agriculture exists in Mexico. So, for the purposes of this report, a narrow definition would ignore an important and growing segment of the North American industry. To summarize, we discuss all of protected tomato production where appropriate, but we focus primarily on greenhouses, defined to include all fixed structures, regardless of technology level and growing medium, but to exclude shade houses.

DOC found dumping but the U.S. International Trade Commission (ITC) did not find injury to the U.S. industry, which it broadly defined as all fresh tomato products, not just greenhouse tomatoes. The Canadian growers withdrew their allegation before the Canadian government officials reached a final negative determination in the case. More recently, growers in all three countries have sought greater coordination to meet demand for year-round supply.

Greenhouse Tomatoes as Part of a Trend Toward More Differentiated Products

The increasing interest of U.S. consumers in produce variety is one factor behind the growth of the greenhouse tomato industry. Product differentiation is now the norm in the fresh tomato industry, for both field and greenhouse tomatoes, with variation based on shape (round, roma, grape, pear), size (large to very small), degree of ripeness, color (red, orange, yellow, and green), and variety. Development of new types of tomatoes is faster for greenhouse production than open field production, which allows greenhouse growers more opportunity to target growing consumer interest in variety. The first producers of a popular new tomato product can garner substantial profits, at least for a few years. The popular tomato-on-the-vine (TOV), or cluster tomato, is only grown in greenhouses, which gives greenhouse producers a competitive edge (see box, “Tomato Variety Expands”). It is not clear that consumers always recognize TOV as a greenhouse product, but they do recognize it as something new and appealing. Almost every other type of tomato can be grown in either greenhouses or in open fields.

Greenhouse tomatoes generally have better cosmetic appearance and redder color than field tomatoes; but some field tomatoes may be just as attractive to many consumers. Some consumers seem to perceive greenhouse tomatoes as having superior flavor to field grown tomatoes; however, flavor is a subjective attribute and not all consumers agree. Flavor can vary substantially depending on varieties, seasons, maturity level at harvest, handling practices, and time in the distribution system, for both field and greenhouse tomatoes. While greenhouse tomato growers may be most recognized for striving to improve flavor as a point of differentiation, the number of field growers emphasizing this attribute today is growing. However, the consistency of production and quality, including flavor, can more easily be maintained in climate-controlled greenhouse production than in open field conditions.

Greenhouse tomatoes are grown with few if any pesticides, although many field tomatoes are also grown with integrated pest management techniques and some are certified to be pesticide-residue-free. Greenhouse tomatoes are exposed to fewer environmental hazards than open-field tomatoes, reducing the chance of microbial contamination. These characteristics appeal to some of the increasingly affluent North American consumers concerned with food safety issues.

While it is not always clear whether most consumers can distinguish between greenhouse and field tomatoes, retail buyers are probably more interested in the differences. Most greenhouse tomatoes are sold in retail markets, which represent about half of U.S. tomato consumption. Greenhouse tomato growers provide greater consistency than field growers in

Tomato Variety Expands

The North American greenhouse tomato industry began with the beefsteak tomato, which is a round tomato, with larger sizes generally preferred and receiving the highest prices. It looks similar to a field tomato, except that the calyx (stem) is left attached as a marketing strategy to differentiate it from its field equivalent.

TOVs are rapidly becoming the dominant tomato type in U.S. greenhouses. TOV varieties were developed in Italy in the early 1990s and then taken up by growers in the Netherlands. North American growers began producing TOVs in the late 1990s. These tomatoes, four to six in a cluster, are smaller than beefsteaks and are still attached to the vine. The stem imparts a strong tomato smell that appeals to consumers as being indicative of good flavor and freshness. These tomatoes also have a longer shelf life than beefsteak tomatoes since they are smaller and have a thicker skin. Greenhouse growers initially positioned TOVs in the marketplace as having superior taste.

Greenhouse growers are trying to distinguish themselves and discover the next blockbuster greenhouse tomato product. There has been an explosion in offerings for TOVs with respect to size and shape. Cherry TOVs, sometimes called cocktail tomatoes, have become an important category. One U.S. company, with all its production in Mexico, pioneered this small tomato product and has dominated the category. Other companies, encouraged by the popularity of cherry TOV, have begun to develop competing products. Campari tomatoes, a type of cocktail tomato, which is midway in size between a traditional TOV and cherry TOV, are a growing component of greenhouse supply. The seed company that owns the variety only licenses it to three firms. Similar tomato varieties known by different names are available from other growers, as well as roma and mini roma TOV. In general, there is active experimentation with specialty varieties, including small beefsteak tomatoes. Growers in Canada are also experimenting with heirloom tomatoes, as well as a few small growers in the United States.

There are two types of round field tomatoes—mature green and vine ripe. Mature green tomatoes are the backbone of the U.S. fresh field tomato industry and are the major type of tomato grown in Florida and California, with minimal production in Mexico. They are harvested at an early stage; while still green, they are sufficiently mature to ripen after harvest when treated with ethylene gas, the plant's natural ripening agent. Some shippers both treat and pack tomatoes at their packinghouse. But mature green tomatoes are often sent to repackers near consumption centers where they are treated and then repacked according to color just before marketing. This introduces another link in the marketing chain and increases the transaction costs for mature green tomatoes. Mature green tomatoes are firm, have a long shelf-life, and slice well. They are also one of the lower cost tomatoes. Mature green tomatoes are the dominant tomato in food service, particularly in the fast food industry.

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Vine ripe tomatoes are harvested at a slightly riper stage and ripen fully without ethylene treatments. During the winter, most of the vine ripe tomatoes consumed in the United States come from Mexico, with Florida as a minor supplier. During the summer, southern California and Baja California are the main suppliers. Mexican round tomato exports are almost entirely vine ripe. While the vine ripe tomato may appeal to some high-end foodservice firms, most sales have traditionally been to the retail market, in part due to a generally higher cost than mature greens. However, with short supplies of mature green tomatoes in the fall of 2004, foodservice buyers were more willing to try other types of tomatoes as substitutes. This may lead to some shift in foodservice preferences over time.

Fresh roma tomatoes (also known as plum tomatoes) grew rapidly in the 1990s, in part due to retail demand from the expanding Mexican consumer segment, and more recently due to their expanding use in foodservice menus. They are grown primarily in Mexico, with California and Florida also garnering part of this market.

Other types of field tomatoes growing in popularity include such specialties as cherry, grape, pear, organic and heirloom tomatoes (older, often misshapen, varieties recognized for their flavor). While some of these tomatoes are grown in greenhouses, most are field grown. Grape tomatoes, in particular, represent a very important new product offering in field tomatoes.

volume, pricing, and product quality, since they are less subject to weather-induced variation.⁴ These attributes are highly valued by retailers. Retailers are also interested in products with less risk with respect to food safety. In addition, retailers are concerned about lowering transaction costs by reducing the role of middlemen, and large greenhouse tomato firms increasingly sell directly to retailers. Unlike mature green field tomatoes, greenhouse tomatoes can readily bypass repacking facilities for ripening or quality control. Direct sales are facilitated by offering consumer-ready and retail-ready packs. Year-round greenhouse shippers are offering retailers brands with promotional support, stable pricing via forward contracts, and other marketing services. Retailers tend to view them more as partners in implementing supply chain management goals, compared with fresh field shippers marketing via intermediaries.

Despite the rapid growth in the greenhouse tomato industry, in 2003, it was still a small share of total fresh tomato production in the United States and Mexico, just 9 and 8 percent, respectively. In Canada, however, greenhouse tomatoes now completely dominate fresh tomato production with an 89-percent share. The greenhouse share of U.S. fresh tomato consumption, 17 percent, is almost double the production share due to imports. Even though greenhouse tomatoes still constitute a minority share of the U.S. fresh tomato market, their influence is concentrated and growing in retail channels. Around 37 percent of all fresh tomatoes sold in U.S. retail stores are now greenhouse, compared with negligible amounts in the early 1990s.

⁴ Greenhouse supply may fluctuate with the level of solar radiation, the only factor growers cannot control unless they use lights.

The foodservice industry is not yet an important market for greenhouse tomatoes. Mature green field tomatoes dominate the foodservice market, which represents about half of U.S. fresh tomato consumption, where their firmness, excellent slicing characteristics, and long shelf life are highly prized. Other types of field tomatoes are increasing sales to food service, including roma and grape tomatoes. While greenhouse growers would like to develop a product more appropriate for the foodservice market, it has not happened yet. Greenhouse tomatoes have too high of a water content for many foodservice applications. Also, much of the foodservice market is focused on ingredient cost control, and prices are generally higher for greenhouse tomatoes than for field tomatoes.

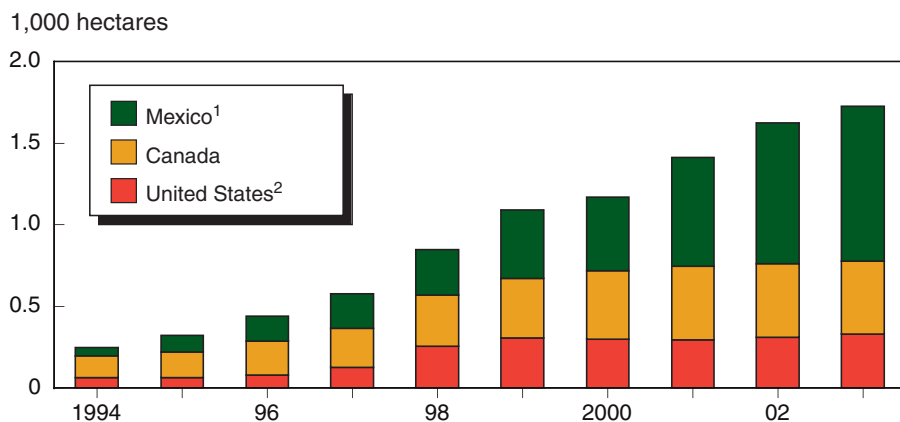
Rapid Growth and Declining Prices— Commoditization of the Industry

In the early days of the industry, greenhouse tomatoes were a rather insulated market niche that garnered high prices. However, between the early 1990s and 2003, greenhouse tomato area is estimated to have grown by 596 percent to 1,726 hectares (ha), starting from a negligible base—this despite the high cost of greenhouse construction (fig. 3).⁵ The flip side of rapid growth in the greenhouse industry has been the rapid decline in prices. Beefsteak prices hit a low in 1999, which had an important impact on the industry. TOV prices hit a low in summer 2004, which will affect future growth of this type of greenhouse tomato throughout North America. Growth in Canada and the United States is stabilizing, in part due to lower prices, and likely due to industry members keeping a watchful eye on Mexico, where rapid growth continues (fig. 4). Lower prices will affect profits of those who remain in this growing industry.

⁵ One hectare equals 2.471 acres.

As the industry has grown, greenhouse tomatoes have become closer to a commodity, subject to the same market pressures affecting other produce commodities. Commoditization is a common phenomenon in the world of

Figure 3
Estimated trends in North American greenhouse tomato area



¹ Excludes most shade house area.

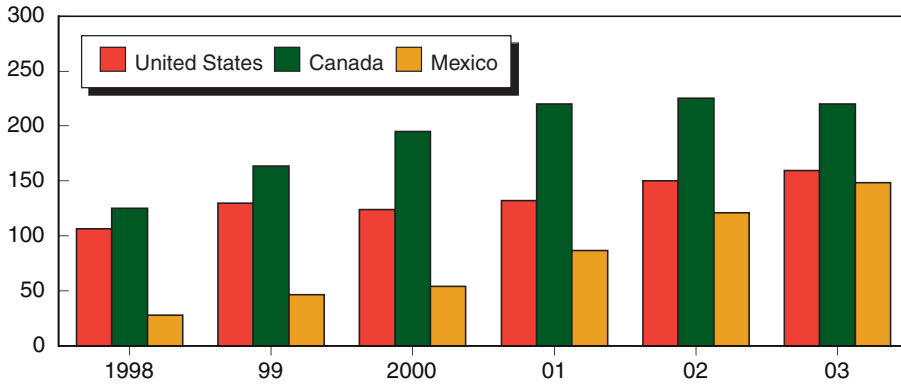
² Only large- and medium-size growers until 1998.

Sources: U.S. International Trade Commission; Asociación Mexicana de Productores de Hortalizas en Invernaderos (AMPHI); Statistics Canada; and estimates by Cook and Calvin.

Figure 4

North American greenhouse tomato production growth

1,000 metric tons



Sources: Statistics Canada; Ontario Greenhouse Vegetable Growers; British Columbia Vegetable Marketing Commission; and estimates by Cook and Calvin.

fresh produce as a new product transitions from a specialty product status to mainstream. For specialty niche products with limited supply, it is generally easier to command consistently high prices, in part because buyers place less emphasis on aggressive price negotiations with products that are not major contributors to the bottom line. With greenhouse tomatoes now a critical component of overall tomato category profitability, price plays a more important role in making the sale. This is particularly true in the summer when both greenhouse and field tomato supply are typically abundant. As greenhouse tomato volume increases, there is more potential to influence field tomato prices and vice versa.

Canadian Greenhouse Tomato Industry

Canada is the largest producer of greenhouse tomatoes in North America. The introduction of greenhouse technologies allowed Canada to assume a dominance in the greenhouse tomato industry that it never achieved in the fresh field tomato industry. The sophisticated technology and the favorable summer climate—long hours of daylight and relatively mild weather—generate the highest average national yield in North America—494 metric tons per ha in 2003. During the March to December season, Canadian production is a major force in the market. The chief constraint for the Canadian industry is its current inability to produce greenhouse tomatoes profitably during the midwinter period.

Structure and Location

The Canadian greenhouse tomato industry began to grow dramatically in the mid-1990s (table 2). Between 1992 and 2002, production increased by over 600 percent to 220,114 metric tons, fueled by growth in area (up 242 percent) and technology- and management-driven growth in yields (up 121 percent). Canadian production in 2003 was down slightly from the peak in 2002 due to production problems in British Columbia and a small decline in tomato area in Ontario. Some growers in Ontario switched from tomatoes to other greenhouse products, such as peppers and cucumbers, because of low tomato prices. The 2-percent decline in production in 2003 was the first in the Canadian industry's history. Lower market prices and uncertainty with respect to the trade disputes between the United States and Canada in 2001-02 slowed expansion. Some new greenhouse construction continues in

Table 2—Canadian area and production of greenhouse and fresh field-grown tomatoes¹

Year	Greenhouse tomato production		Field-grown tomato production (for fresh consumption)	
	<i>Metric tons</i>	<i>Harvested hectares</i>	<i>Metric tons</i>	<i>Harvested hectares</i>
1992	29,770	134	61,469	4,066
1993	32,844	143	78,522	3,349
1994	32,900	135	84,627	3,305
1995	41,898	158	79,533	3,215
1996	62,642	208	116,529	3,390
1997	78,100	241	59,791	3,357
1998	124,835	312	33,688	1,945
1999	163,630	364	29,657	1,623
2000	195,235	420	n.a.	n.a.
2001	219,936	465	33,473	2,671
2002	225,102	458	26,444	1,888
2003	220,114	446	26,882	1,813

n.a. = Data not available.

¹ Greenhouse data from 1994 to 1997 and all field-grown tomato data are from Statistics Canada. Data on greenhouse tomatoes from 1998 to 2003 are based on a combination of Statistics Canada, Ontario Greenhouse Vegetable Growers, and British Columbia Vegetable Marketing Commission data. See table 4 for more details.

Sources: Statistics Canada, British Columbia Vegetable Marketing Commission, Ontario Greenhouse Vegetable Growers, and calculations by Cook and Calvin.

Canada but mostly for production of other vegetables, although these structures could be converted for use for tomatoes at some later date. Moderate increases tomato area and production are expected in 2005.

Ontario dominates Canadian greenhouse tomato production with a 63-percent share of production (table 3), more than twice the share of the next highest producing region, British Columbia. Quebec and the other provinces account for only minor shares of the total. Growers in British Columbia ship tomatoes from March to late November. The shipping season for rival Ontario starts and ends about 3 weeks later. Most Canadian greenhouses ship the bulk of their volume from April through November (fig. 5 shows exports from Ontario and British Columbia to the United States, which reflect seasonal production trends).

Although there is a strong market incentive for Canadian growers to be year-round suppliers, the costs of producing during Canada's cold and low-light winter months are prohibitive in most cases. To respond to year-round demand, some greenhouse tomato shippers in Canada are developing alliances with producers in the United States and Mexico to augment their low winter supplies. Others have turned to foreign direct investment strategies. In 1996, a grower from British Columbia began producing greenhouse tomatoes in California and is a major source of winter supply in the Canadian market.

Canadian growers are devoting a large share of their tomato greenhouse area to TOV production. Industry analysts estimated Ontario TOV area at 40 percent of total greenhouse tomato area in 2003 and up to 50 percent in 2004. In British Columbia, 47 percent of area in 2003 and 66 percent in 2004 were dedicated to TOV (Driediger, 2004). Producing TOVs appeals to growers for a combination of market and agronomic reasons. TOVs generally sell at a higher FOB price than beefsteak tomatoes, although in the summer of 2004, TOV production growth pushed FOB prices for TOVs below beefsteak prices. Since TOV are smaller tomatoes there can be fewer quality problems relative to producing beefsteaks and a higher percent of tomatoes may be marketed as

Table 3—Canadian greenhouse tomato area and production by province

Year	Ontario ¹		British Columbia ²		Quebec		Others		Total ³	
	Production	Area	Production	Area	Production	Area	Production	Area	Production	Area
	<i>Metric tons</i>	<i>Ha</i>	<i>Metric tons</i>	<i>Ha</i>	<i>Metric tons</i>	<i>Ha</i>	<i>Metric tons</i>	<i>Ha</i>	<i>Metric tons</i>	<i>Ha</i>
1998	80,014	183	29,010	55	12,654	61	3,157	13	124,835	312
1999	106,612	221	41,824	71	11,690	58	3,504	14	163,630	364
2000	130,499	260	50,351	93	10,219	51	4,166	16	195,235	420
2001	145,204	301	57,845	100	12,422	50	4,465	14	219,936	465
2002	149,606	305	57,242	97	13,248	41	5,006	15	225,102	458
2003	138,346	275	63,013	115	12,841	37	5,914	19	220,114	446

Ha = Hectares.

¹ Ontario area is from Statistics Canada except for 2001 and 2002 data, which are from the Ontario Greenhouse Vegetable Growers.

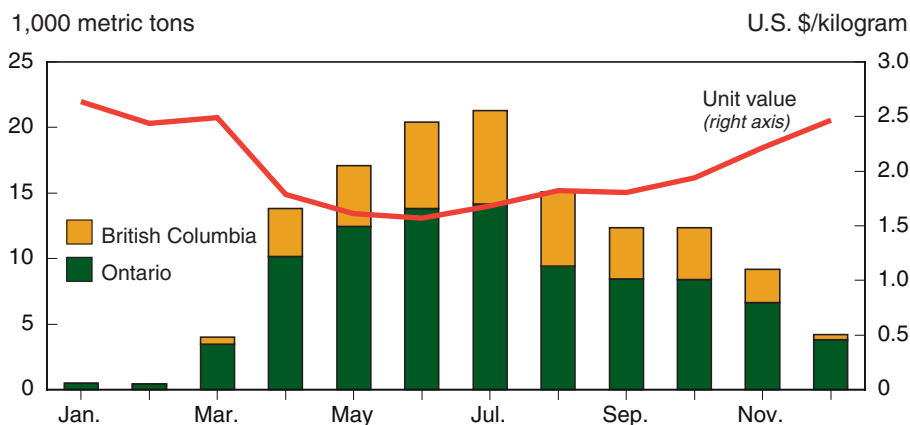
² 1998-2003 British Columbia production and area data are from the British Columbia Vegetable Marketing Commission instead of Statistics Canada. The British Columbia Vegetable Marketing Commission figures are higher than those of Statistics Canada.

³ Total Canadian production figures are based on Statistics Canada data for Ontario, Quebec, and Others, and British Columbia Vegetable Marketing Commission data for British Columbia. Therefore, the total national figures reported here are higher than Statistics Canada data.

Sources: Statistics Canada (various issues of *Greenhouse, Sod, and Nursery Industries* and various issues of *Production of Fruit and Vegetables*), British Columbia Vegetable Marketing Commission, Ontario Greenhouse Vegetable Growers, and calculations by Cook and Calvin.

Figure 5

Ontario and British Columbia greenhouse tomato exports to the United States, 2003¹



¹Unit values represent all exports, the export bar represents just Ontario and British Columbia since exports from other provinces are too small to show up on the figure.

Source: World Trade Atlas.

the top quality level, receiving the best prices. However, the sharp decline in TOV prices in summer 2004 has made TOVs less attractive and the industry is already changing the product mix accordingly.

While Canada has the largest production volume of greenhouse tomatoes in North America, its growers tend to be rather small. The largest greenhouse tomato operation in Canada in 2003 was 21 ha (Papadopoulos, 2003). In 2003, the largest greenhouse tomato firm in the United States was more than three times larger and leading Mexican firms were even larger.

Probably due to the smaller size of many Canadian greenhouse growers, much of the production is marketed jointly, providing more clout than indicated by any individual grower’s area alone. In 2000, five Canadian marketing firms (often also producers) accounted for 82 percent of greenhouse tomato exports to the United States (ITC, 2001). The forces encouraging consolidation of production and marketing in the global fresh produce industry, such as retail consolidation, are affecting the Canadian greenhouse industry as well (Calvin and Cook et al., 2001).

As Canada’s greenhouse tomato industry has grown, its fresh-market field-grown tomato industry, centered in Ontario, has declined (table 2). In 1992, field tomatoes accounted for 67 percent of fresh-market production, declining to 11 percent in 2003. With greenhouse tomatoes proving to be more profitable than field-grown in Canada, many field producers moved into greenhouse production. A few greenhouse tomato growers in Ontario also have some field production. The separate field-grown tomato industry for processing is still a major business in Canada.

Fresh Tomato Trade

Trade flows vary by type of tomato and season. Canada imports fresh field tomatoes from the United States and Mexico on a year-round basis. During

the winter, Canada imports greenhouse tomatoes from both countries, as well as smaller amounts from other countries. Canada exports greenhouse tomatoes to the United States during the rest of the year. All Canadian tomato exports are assumed to be greenhouse tomatoes, and virtually all exports are to the U.S. market. Canada does not ship any type of tomato to Mexico.

The growth of the greenhouse industry has changed net trade flows of fresh tomatoes between Canada and the United States. Canada is the largest market for U.S. fresh tomato exports (mostly mature green tomatoes destined for both retail and foodservice markets), accounting for 88 percent of total export volume in 2003. However, Canadian exports to the United States have grown dramatically over time in terms of quantity, while Canadian imports of U.S. tomatoes have remained relatively stable (fig. 6). In 2003, the United States became a net tomato importer from Canada in terms of volume, although it had already become a net importer in terms of value in 1999.

Canada's tomato exports to the United States compete with field-grown tomatoes from Florida and Mexico in the spring; field-grown tomatoes from California, the U.S. Eastern seaboard, and Mexico during the summer and early fall; and greenhouse tomatoes from the United States, Mexico, and northern Europe throughout the entire Canadian season (see fig. 1). During much of its season, Canadian production dominates the North American greenhouse market, and the high volume of low-cost summer production, combined with competition from other field and greenhouse tomato producing areas, drives down the market price. For example, the per kilogram (kg) price of imported Canadian tomatoes in June 2003 was only 60 percent of the price in January (see fig. 5).⁶

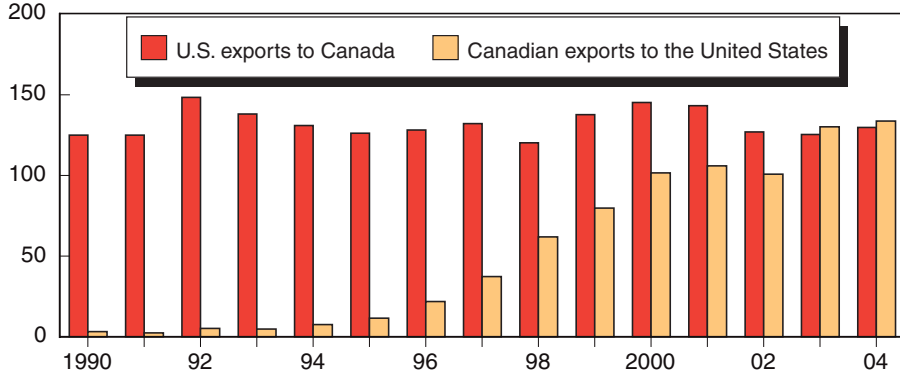
⁶ One kilogram equals 2.204 pounds.

As Canadian production increased in the latter part of the 1990s, the Canadian market (31.5 million consumers in April 2003) became relatively saturated, making the greenhouse tomato industry increasingly export dependent. With 291 million consumers in the United States in 2003, the growth in the Canadian industry appears to have been largely aimed at serving the expanding U.S. demand for greenhouse tomatoes. In 2003,

Figure 6

U.S.-Canadian fresh tomato trade

1,000 metric tons



Source: U.S. Department of Commerce.

exports accounted for 60 percent of domestic production, compared with only 23 percent in 1994 (table 4).

Exchange rates factored into the export boom in trade with the United States. Between 1990 and 2002, the Canadian dollar depreciated 34 percent against the U.S. dollar, based on average annual exchange rates, making the U.S. market increasingly attractive. In 2003, the exchange rate declined 11 percent, eroding some of the exchange rate advantage for Canada. In 2004, the exchange rate continued to decline. Simultaneously, the Mexican peso has been depreciating against the U.S. dollar, making Mexican tomatoes more competitive relative to Canadian product in the U.S. market.

Canada imports greenhouse tomatoes mostly during the midwinter. In 2003, Mexico was the largest supplier with 6,152 metric tons, followed by Europe, Israel, and Morocco with 4,176 metric tons, and the United States with 3,836 metric tons (fig. 7). Imports from non-NAFTA countries have decreased with the growth of the U.S. and Mexican industries. Actual greenhouse imports from the United States and Mexico may be higher if Canadian import statistics, like U.S. statistics, do not always correctly classify greenhouse shipments.

Industry in Ontario

Ontario is the largest producer of greenhouse tomatoes in Canada. The industry is centered around Leamington in southern Ontario, southeast of Detroit. This area has the single largest grouping of vegetable greenhouses in North America (Papadopoulos, 2003). Canadian production in both Ontario and British Columbia is concentrated geographically, which has resulted in strong input industries, a benefit not enjoyed by other producers in North America. The proximity of Leamington to major Canadian and

Table 4—Canadian greenhouse tomato supply and use

Year	Production	Imports ¹	Supply	Exports ²	Consumption	Consumption	Export	Exports to
						per capita	share	the U.S. ³
						Kilograms	Percent	Metric tons
1994	32,900	n.a.	n.a.	7,673	n.a.	n.a.	23	7,673
1995	41,898	4,235	46,133	11,716	34,417	1.17	28	11,712
1996	62,642	6,201	68,843	21,936	46,907	1.58	35	21,935
1997	78,100	7,961	86,061	38,373	47,688	1.59	49	38,373
1998	124,835	12,021	136,856	62,441	74,415	2.46	50	62,405
1999	163,630	11,012	174,642	80,130	94,512	3.10	49	80,117
2000	195,235	11,589	206,824	102,212	104,612	3.40	52	102,131
2001	219,936	11,577	231,513	106,691	124,822	4.01	49	106,626
2002	225,102	16,273	241,375	101,625	139,750	4.45	45	101,402
2003	220,114	14,159	234,273	131,456	102,817	3.26	60	130,868

n.a.=not available.

¹ In 1995, assuming all imports from EU, Israel, and Morocco are greenhouse and all else field grown. From 1996 to 2003, including official Canadian statistics on greenhouse imports from the United States and Mexico.

² Assuming all tomato exports are greenhouse tomatoes.

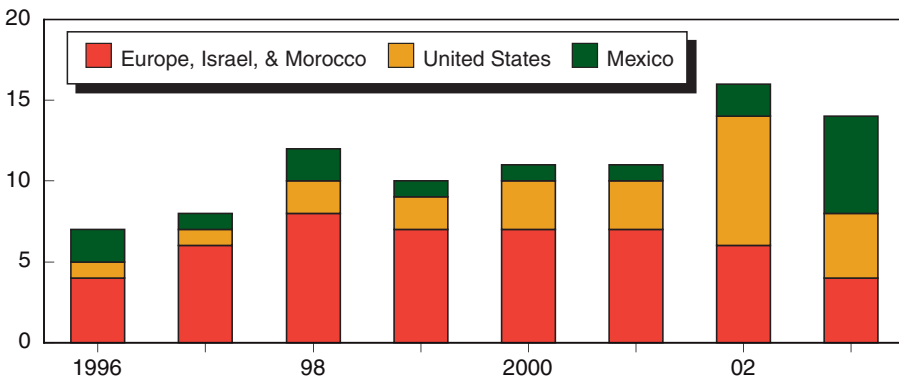
³ For 1994, using U.S. Commerce numbers of imports from Canada as a proxy for total Canadian exports. For 1995-2003 using Statistics Canada data on total exports.

Sources: Statistics Canada, British Columbia Vegetable Marketing Commission, Ontario Greenhouse Vegetable Growers, U.S. Department of Commerce, World Trade Atlas, and calculations by Cook and Calvin.

Figure 7

Canadian greenhouse tomato imports by origin

1,000 metric tons



Source: World Trade Atlas.

U.S. markets gives producers there a major advantage in terms of transportation costs (see fig. 2). In 2003, over 39 percent of Canada’s population lived in Ontario (with an additional 31 percent in Provinces to the east). Perhaps more importantly, Ontario is also closer to the eastern U.S. market than the big U.S. firms in the West and Southwest.

In 2004, there were 116 tomato growers in Ontario with an average size of 16 ha. The largest producers control a disproportionate share of production; growers with over 37 ha accounted for 7 percent of growers and 40 percent of area (Lutz, 2005). A small number of Ontario shippers dominate sales, assembling production from numerous growers and marketing volumes far exceeding their own production. Industry sources indicate that concentration has been increasing, with three firms marketing an estimated 65 percent of total provincial volume in 2004.

All Ontario growers of greenhouse tomatoes and cucumbers are required to belong to the Ontario Greenhouse Vegetable Producers’ Marketing Board (OGVG). The OGVG collects a fee from growers based on area in production to fund research, promotion, market development, and administration. This organization does not regulate production or restrict entry. The OGVG has statutory authority to license marketers, set a weekly minimum price, and revoke licenses from shippers who do not adhere to marketing requirements. In reality, in recent years, its authority has only been used to issue licenses. In 2002, OGVG licensed 34 sales agents, although only a small number are large enough to be major exporters. Currently, Ontario shippers sell at the best price possible and the OGVG works with growers to establish a weekly benchmark price, which is particularly useful to smaller growers trying to determine the value of their production.

About 80-85 percent of Ontario’s greenhouse tomato area is in plastic structures. Growers have found plastic to be advantageous given the region’s hot summers. Glass greenhouses, developed in the Netherlands with more limited light conditions, transmit more solar radiation than plastic, and excessive heat in summer can damage the plants. Plastic greenhouses are also cheaper to build than glass and generally have been considered to have

lower energy costs, though they must be replaced more frequently. Because Ontario is hot and humid in the summer, some growers reduce late summer production to avoid the higher production costs, quality problems, and lower prices (see fig. 5). British Columbia, with a milder climate, has a more gradual decline in exports from its July high. As competition grows in the North American industry, growers in all locations are seeking technologies that improve product consistency and reduce per unit costs by maximizing yields and efficiency. There is diversity of opinion about what type of technology will be the most profitable in Ontario in the future, but interest in glass greenhouses seems to be growing. Glass may improve production in the early and late parts of the season.

Industry in British Columbia

British Columbia is the second largest producer of greenhouse tomatoes in Canada, with 24 greenhouse tomato growers in 2004. The industry is centered near the town of Delta in the Fraser Valley near Vancouver. British Columbia has warm summer days and cool nights, good light (although less than Ontario), and low humidity due to the regulating effect of the Pacific Ocean. The climate is similar to that of the Netherlands, and most growers use Dutch-style glass greenhouses. Industry experts say that the more conditions deviate from those experienced in the Netherlands—the technology leader—the more effort is required to develop an appropriate technology. British Columbia greenhouse tomato growers have the highest average yields in North America—590 metric tons per ha in 2002 (a more normal crop year than 2003), compared with 491 metric tons for Ontario. While British Columbia is ideal in terms of climate, it is located far from major markets. Only 13 percent of the Canadian population lives in British Columbia, and growers there must rely heavily on the nearby U.S. west coast market for their customer base. In this market, British Columbia growers also compete with all the large producers located in the U.S. Southwest and West.

In British Columbia, production of greenhouse tomatoes, butter head lettuce, peppers, and long English cucumbers is regulated by the British Columbia Natural Products Marketing Act. The British Columbia Vegetable Marketing Commission administers the Act by controlling volume through area quotas (not production quotas) issued to individual greenhouse growers. This organization analyzes the market before allocating the permissible area, and quota fees are not charged. In 2003, the Commission authorized the last increase in tomato area. Production from this expansion will begin in 2005. In August 2004, the Commission gave the industry permission to initiate minimum prices for domestic and export sales. This authority was used in late August and September 2004.

In British Columbia, all sales, except sales via farm stands and municipal markets, must go through licensed sales agents. Up until 2002, all growers around Vancouver and on Vancouver Island had to market their production through BC Hot House, a former cooperative that incorporated in the mid-1990s. In 2001, BC Hot House accounted for nearly 40 percent of Canadian greenhouse tomato exports. The other producers outside of Vancouver and

the Vancouver Island area have very small production, and exporting is not a viable option.

BC Hot House is still the dominant British Columbia marketer, but it is no longer a monopoly. Two other groups received permission to begin marketing in 2002. In the aftermath of the dumping cases, the Commission imposed marketing conditions on the two new marketing agencies that required them to market to specific areas of North America through December 2003. While BC Hot House had traditionally focused on the West, it has begun to geographically diversify its markets, aided by a forward distribution center approach (establishing its own distribution centers close to major markets).

Mexican Greenhouse Tomato Industry

Mexico is the largest producer and per capita consumer of fresh tomatoes in North America. Therefore, its fresh tomato industry and domestic market figure prominently in the dynamics of the North American fresh tomato industry. To understand the evolution of the rapidly growing Mexican greenhouse tomato industry, it is important to put it in the context of the total Mexican fresh tomato industry. In Mexico, field growers play a key role in the greenhouse tomato industry, and field production dwarfs greenhouse production. The Mexican greenhouse tomato industry is also characterized by much more geographic and technological diversity relative to its NAFTA partners.

Exports are very important to the Mexican tomato industry. In 2003, Mexico exported 46 percent of its fresh tomatoes, with over 90 percent going to the United States, and most of the rest to Canada. While sizable volumes of field tomatoes grown by export-oriented growers may be sold domestically when domestic prices are more attractive, low domestic demand limits the share of greenhouse tomatoes that remain in Mexico to about 15 percent—often due to lower quality rather than as a strategic marketing choice. Because of Mexico's heavy emphasis on the United States as its primary export market for all tomatoes, significant changes in Mexico's field and greenhouse industries affect U.S. supplies. With this in mind, it is important to understand the nature of the Mexican field and greenhouse tomato industries by region, season, product mix, and grower type.

Seasonal and Geographical Concentration of Fresh Market Tomato Production

Mexican fresh field tomato production, excluding production for processing, totaled 1.8 million metric tons in 2003, more than 12 times the level of greenhouse tomato production (see table 1). While tomato production exists throughout Mexico, large volume commercial field tomato production is seasonally concentrated in a few locations, most prominently, the northwestern coastal State of Sinaloa (and to a much lesser extent southern Sonora) in December through April. The State of Baja California (formerly known as Baja California Norte) ships field tomatoes in the summer through fall. In the 1990s, the State of Baja California Sur emerged as a new but still lesser player than the State of Baja California in the field tomato industry, targeting a late winter/early spring market window that has since narrowed with the development of greenhouse production throughout North America. A few States in central Mexico, such as Morelos, San Luis Potosí, Michoacán, and Jalisco, produce fresh field tomatoes in the summer/fall, all with a domestic rather than an export market orientation.

A relatively small cohort of export-oriented, high-yielding producers serve as the principal players in the Mexican fresh tomato industry in their respective seasons, for both export and domestic use. Traditionally, Sinaloa and Sonora accounted for at least 70 percent of Mexican fresh tomato exports, while the entire Baja California peninsula accounted for most of the remainder. The bulk of Mexican field growers converting part of their area to protected culture are located in Sinaloa and the Baja California peninsula. Growers that

locate greenhouses close to their field tomato bases of operation extend their shipping seasons only marginally; hence, shipping seasons remain similar.

The Sinaloa Fresh Tomato Industry

The Sinaloa field tomato industry includes a cluster of around 40 high-technology export-oriented producers with extensive field tomato growing and marketing experience. Many of these producers are forward-integrated grower-shippers with sales operations in Nogales, Arizona. These growers are some of the best capitalized in the Mexican horticultural sector. Most of Mexico's processing tomato production is in Sinaloa, with product moving between fresh and processed markets according to relative prices.⁷ The bulk of the State's production is centered in Culiacán, which enjoys freeze-free winters, making it a principal source of winter supply to the North American fresh tomato market. In April, production from Los Mochis and Guasave in northern Sinaloa typically supplants declining volumes from the Culiacán area. Because of the longstanding economic strength of this cluster of innovative tomato growers, the input industry is very strong in Sinaloa, contributing to the relative competitiveness of Sinaloa growers.

According to the Confederación de Asociaciones Agrícolas del Estado de Sinaloa (the statewide growers' organization known by its acronym CAADES), 2003/04 tomato area (both fresh and processed) totaled 25,584 ha. The industry is still overwhelmingly field oriented, but with substantial experimentation with protected culture. Much of the protected culture is shade house, but plastic greenhouse tomato operations range from under 5 ha to a few in the 40 to 60-ha category. Growing in soil is more common than using hydroponics. While Sinaloa's warm, humid climate is not suitable for year-round greenhouse production, its benign winter climate enables it to target the lucrative winter fresh market for both field and greenhouse tomatoes. Well-capitalized, innovative field growers ensure an interest in and the capacity for the development of protected culture tomato production, if it proves to be economically viable.

The Baja California Peninsula Fresh Tomato Industry

The bulk of the Baja California peninsula tomato industry consists of around 50 growers in the State of Baja California, mainly in the coastal San Quintín Valley, marketing through about 12 shippers. Most tomato growers remain open field for the majority of their production, though some are experimenting with protected culture, primarily shade house (see box, "Spanish Protected Culture Tomato Industry" for a comparison). San Quintín is located about 150 miles south of the U.S. border and has a relatively dry climate with winter temperatures too low for field production. Hence, the region is contra-seasonal to Sinaloa, with growers shipping field tomatoes to both domestic and export markets from summer through fall, unless disease conditions cut short the season. The Baja California field tomato shipping season overlaps with those in California and the U.S. eastern seaboard, Florida in the fall, and also competes with central Mexican field tomato production in the domestic market. Baja California Sur competes with all these regions in the fall. The region's protected

⁷ Unlike the U.S. industry, the Mexican fresh field tomato industry is not a dedicated industry. Rather, it produces for both the fresh and processing markets, with the vast majority of production sold for fresh use. Most tomatoes sold for processing are grown in Sinaloa, and secondarily in southern Sonora.

Spanish Protected Culture Tomato Industry

The conversion in Mexico from field production to lower technology-protected culture production is similar to that occurring in recent decades in Spain, the principal off-season greenhouse tomato supplier to Europe. In 2001, Spanish tomato protected culture area was over 16,400 hectares (about half concentrated in Almería), the vast majority of which is passive shade house systems, but with technology continuing to improve. Despite the Netherlands being the global leader in greenhouse technology and yields, Spain's lower technology and lower-cost approach, benefited by natural seasonal and climatic advantages, has succeeded in eroding the Dutch share of the European greenhouse tomato market. This example is likely relevant to Mexico's evolving role in the North American industry. Spain has succeeded in competing effectively with the Dutch greenhouse tomato industry with average protected agriculture tomato yields of 93 metric tons per hectare, compared with 456 in the Netherlands (Ministerio de Agricultura, Pesca, y Alimentación, 2004; Productschap Tuinbouw, 2004). While Spain targets a winter market, it now exports year-round. Hence, the Mexican protected agriculture average tomato yields (156 metric tons per hectare) have already surpassed Spanish yields.

culture production overlaps with summer/fall greenhouse production throughout North America as well.

Baja California growers have shifted away from round to roma tomatoes, a product in which they have more of a competitive advantage relative to U.S. shippers. Roma export shipments increased as a share of total Baja tomato shipments from 45 percent in 1997 to 68 percent in 2003. Roma tomatoes are more suited to the region's growing conditions and require less capital investment. Hence, much of the experimentation with protected culture there has focused on romas, making Baja California an exception in the North American industry.

Production regions in the State of Baja California Sur are located around 700 miles from the U.S. border. Field tomato production has been relatively limited and traditionally focused more on the late winter and early spring periods, when prices are higher and can better support the additional transportation costs to the border. There are fewer than ten major tomato growers and exporters.

In Baja California Sur, climate conditions permit growers to produce in the winter with relatively low-technology greenhouses. In the early 1990s, a major Sinaloa field tomato grower started a large plastic greenhouse operation in Baja California Sur, capable of shipping in the fall through late spring. The climatic conditions that enable the Baja California Sur greenhouse industry to target the fall through spring window likely help explain the location of the largest greenhouse exporter in the Baja California peninsula in the southern part of the peninsula (the Todos Santos area), rather than in the San Quintín Valley.

In contrast to growers in Sinaloa, field tomato growers in the Baja California peninsula face compelling water, land, labor, and disease constraints.

As a result, production tends to be more erratic from year to year, resulting in less well-capitalized growers on average than in Sinaloa, perhaps contributing to the slower development of protected culture production there. As summer/fall shippers, the growers of Baja California tend to have lower season average prices than do growers in Sinaloa, who target the higher priced winter market. This tends to reduce growers' ability to recoup the higher investment costs associated with protected production. Growers in the State of Baja California require high fall prices to earn a favorable return, whether production is open field or protected culture. Disease problems have limited fall open-field volumes in recent seasons, making it of interest to consider protected culture to ensure volume during the fall when prices are typically above the summer levels.

For all Mexican protected culture growers, attractive economic returns are highly dependent on selling at a price premium relative to open-field product. For growers in the Baja California peninsula, there are some special considerations in this regard since their tomatoes enter the United States through California. To achieve price premiums, some Baja growers have marketed their shade house tomatoes as greenhouse. In September 2004, the State of California put in place a new regulation covering greenhouse tomatoes handled or marketed in California, which is where tomatoes from the Baja California peninsula enter the United States. The regulation defines greenhouse tomatoes as tomatoes grown in fixed structures using hydroponics. Since this definition excludes shade house tomatoes and tomatoes grown in plastic greenhouses (fixed structures) without hydroponics, it may limit the ability of growers in the Baja California peninsula to obtain price premiums relative to field tomatoes. This rule change may cause growers to reevaluate the potential net returns from protected production. Growers may choose to market their protected culture tomatoes as hothouse, in which case it will be up to the market (largely commercial buyers) to decide if there is a significant point of differentiation relative to those meeting the greenhouse definition. Hothouse simply implies some type of protected culture and the lack of any formal definition allows for substantial flexibility in its use and application.

Central Mexican Fresh Tomato Production and Beyond: Greenhouse Becomes a Factor

Most of the field tomato production in central Mexico still occurs primarily in the summer and remains oriented almost exclusively toward the domestic market rather than the export market. Summer production in central Mexico is subject to either an abundance or shortage of rain, adversely affecting tomato quality and yields and the ability of growers to ensure consistent shipments of field tomatoes. Furthermore, many field tomato producers in central Mexico are smaller farmers, not well capitalized and without significant investments in packing, cooling, marketing, and food safety infrastructure.

Not surprisingly, investments in greenhouse tomato production in temperate central Mexico are largely coming from outside the region's traditional field-grown tomato sector, and include new entrants to agriculture. Investors are attracted by the yield potential of greenhouses located at relatively high

altitudes (around 2,000 meters), with good light conditions and dry, mild climates. The temperate climate allows for year-round production, increasing the likelihood of positive returns on investments in technology. Hence, the greatest investments in greenhouse technology and the highest yields tend to occur in central rather than coastal Mexico. Central Mexico has experienced a gradual expansion in medium- and high-technology greenhouses for over a decade, with the rate of expansion accelerating in recent years. With its favorable conditions, central Mexico will likely play a major role in the evolution of the country's greenhouse tomato industry. Most operations are less than 12 ha but two are in the 40-ha range.

As in other major growing regions, there is heterogeneity within the central Mexican greenhouse tomato industry. The largest exporter of greenhouse tomatoes in Mexico is Desert Glory, a U.S. firm operating in Jalisco and Colima with low-technology plastic greenhouses specializing in cherry TOVs. Desert Glory is also the largest greenhouse tomato operation in North America, in terms of area. Jalisco's mild climate enables Desert Glory to ship tomatoes year-round, but its low-technology operations result in low yields.⁸

Investors seeking tomato growing areas relatively close to the U.S. border and capable of year-round shipping are exploring high-altitude sites in north central locations, such as Chihuahua and Zacatecas. Medium- and high-technology greenhouse operations have been started in high-altitude locations near Mexico City, such as a 40-ha Bionatur TOV tomato project in the State of Mexico, outside of Toluca, and in parts of what is known as the Bajío, such as Querétaro.⁹ While operations in this area are disadvantaged by high costs to ship to the U.S. border, they are well positioned to serve the emerging demand from Mexico's rapidly growing supermarket sector for premium quality products with improved food safety characteristics. Market diversification may prove increasingly important for operations in the region as the U.S. market becomes saturated.

A still small but growing cluster of high-technology operations using glass greenhouses has emerged in the northern Sonora desert in the Imuris area, near the border with Nogales, Arizona. Part of the expansion in this sector has come from Sinaloa-based growers aiming to extend shipping seasons and invest in areas more suited to greenhouse production. This location is convenient because Sinaloa tomato growers ship their product through Nogales and have their marketing operations there, too, making it a source of consolidated supply for buyers. Although its climate is dry, Imuris is less than 900 meters in altitude, meaning that the summertime desert heat impedes year-round shipping. A few growers, following the lead of a nearby firm in Arizona, are investing in expensive pad and fan cooling systems (appropriate only in dry locations), in the belief that the potential economic benefits warrant the cost. Whether northern Sonora succeeds as a source of consistent year-round tomato shipments will in part depend on summer average price trends and their effect on profitability.

Some State governments in Mexico have encouraged greenhouse projects as a way to offer greater employment opportunities to low-income rural households. The labor-intensive (relative to crops like field corn and beans) and indoor working conditions of greenhouses are an attractive option to governments in high-unemployment areas with minimal high-value field agricultural alterna-

⁸ Cherry TOVs also have substantially lower yields than beefsteak or regular TOVs.

⁹ The Bajío is a temperate, high altitude plain north of Mexico City centered around the States of Querétaro and Guanajuato, and comprising parts of Michoacán and Aguascalientes. It is one of the richest agricultural areas in Mexico.

tives. While constrained State budgets limit direct support, Mexican greenhouse industry experts indicate that in some cases investors can receive loan guarantees as well as local tax and other investment incentives.

Mexican Greenhouse Tomato Industry Structure and Size

Currently, Mexico has some greenhouse tomato production in almost half of its 31 States. Greenhouse industry expansion is coming not only from field tomato growers, but from existing as well as new greenhouse tomato growers, including investors new to agriculture. Based on interviews with growers and industry experts, Mexican greenhouse tomato production in 2003 is estimated at 148,300 metric tons (see table 5). The Mexican greenhouse tomato industry overtook the U.S. industry in area planted in 1995 and surpassed the Canadian industry in 1999, reaching about 950 ha in operation in 2003.¹⁰ These area estimates exclude most shade house operations and focus on greenhouses (fixed structures) whether or not production is in the soil or using hydroponics.¹¹ In 2003, additional shade house tomato area in production may have totaled as much as 350 ha. Since the end of the 1990s, a combination of rapid growth in Mexican area and improving technology has combined to erode the gap in total production volume relative to that of the U.S. greenhouse tomato industry.

However, Mexico lags behind each of its northern neighbors in terms of technology and yields due to a combination of factors, including location/climate, and product mix. Around 30 percent of Mexico's greenhouse tomato area is comprised of low-yielding greenhouses growing cherry TOV in Jalisco and Colima. Much of the remaining area is in warm, coastal, seasonal field tomato areas at low altitudes (Sinaloa and the Baja California peninsula), which do not produce greenhouse yields comparable to those obtainable in temperate zones for similar technology levels. In 2003, Mexico's average greenhouse tomato yield is estimated at 156 metric tons per ha, compared with nearly 500 metric tons per ha in the United States and Canada. When cherry TOV production is excluded, Mexico's average greenhouse yield increases to 181 metric tons per ha in 2003.

Table 5—Estimated Mexican greenhouse tomato area, production, and exports, 1998-2003

Item	1998	1999	2000	2001	2002	2003
<i>Metric tons</i>						
Production	28,000	46,200	54,000	86,450	120,960	148,300
<i>Hectares</i>						
Area	280	420	450	665	864	950
<i>Metric tons</i>						
Exports to the United States ¹	26,600	43,889	51,300	82,128	102,816	125,970

¹ We assume that all Mexican exports are destined for the United States although a small share go on to Canada.

Sources: Industry interviews conducted by Cook and Calvin; the Asociación Mexicana de Productores de Hortalizas en Invernaderos (AMPHI).

¹⁰ Total greenhouse constructed area is somewhat higher, but some tomato operations were out of production in 2003.

¹¹ The Mexican greenhouse grower association, Asociación Mexicana de Productores de Hortalizas en Invernaderos, A.C. (AMPHI), estimates that all protected tomato area, including shade house and greenhouse, may surpass 1,500 ha in 2004. AMPHI is a voluntary trade association of greenhouse vegetable growers. It has no regulatory power but provides a forum for information exchange and representation.

Although Mexico's greenhouse tomato industry has many small operations with less than 5 ha, the industry structure is already highly concentrated. According to estimates by Cook and Calvin, three mostly low-technology firms controlled about 535 ha, or around 56 percent of total greenhouse tomato area (excluding shade house) in Mexico in 2003. The three firms are based in Jalisco, Baja California Sur, and Sinaloa. In 2003, each firm had a minimum of 60 ha. The next tier of producers is in the 40-ha range, with all regions of the country represented. In 2003, the estimated eight-firm concentration ratio in Mexico's greenhouse tomato industry was 74 percent.

Originally, Sinaloa field growers who ventured into protected culture tomatoes focused on production of beefsteak tomatoes, a product similar to their field tomatoes. But the TOV share of total production has grown, reaching 15 to 20 percent of all Mexican greenhouse tomato production in 2003. Some growers are also diversifying into specialty tomatoes, such as Campari tomatoes. As Mexican growers gain experience with greenhouse tomato production, they are likely to follow the market trend toward a more diversified product mix.

As more new players enter Mexico's greenhouse tomato market, the development of effective marketing channels will become more of an issue. Marketing channel fragmentation is a threat to profitable marketing for firms in all three countries. U.S. and Canadian greenhouse firms are increasingly seeking marketing alliances with Mexican greenhouse producers to supplement or provide them with the majority of their winter supplies. The challenge in these alliances is to constructively market the volumes of Mexican partners during the shoulder seasons (seasonal overlaps) and for year-round Mexican producers during the summer as well. Since supply is abundant in Canada and the United States during these periods, the growers supplying these firms may view the Mexican product as competition. Positioning of product, in part based on minimizing transportation costs from each production region to specific markets, can help these alliances to improve efficiency and market coverage for all parties.

An alternative may be the eventual emergence of large Mexican greenhouse shippers that consolidate volumes among several Mexican greenhouse growers in different regions to achieve consistent year-round volumes, imposing strict quality control, and developing direct linkages with key U.S. buyers. Growers in Ontario follow this strategy. Attitudes among Mexican greenhouse growers and large shippers and their ability to collaborate will influence the likelihood of such ventures. The growers in the best position to lead a collaborative effort are Sinaloa-based growers, due to their high level of industry organization and an industry structure centered on forward-integrated grower-shippers who operate their own distributorships in Nogales, Arizona (Calvin and Barrios, 1998). Of course, leaders may emerge among greenhouse-only players as well.

Protected Culture Technology and Other Considerations

In general, Mexican greenhouse tomato growers attempt to adapt technology packages, structures, and seed varieties from Spain, the Netherlands, Israel,

Canada, the United States and elsewhere, substituting local inputs where possible and desirable. While Mexican growers benefit from foreign research and development, they still face the challenge of identifying their own area-specific appropriate technologies, largely without the support of domestic public research and development. Not surprisingly, greenhouse suppliers have a strong influence on the technology decisions made in Mexico. Industry sources report that decisions are sometimes made based on the availability of supplier credits rather than the best technology package for the location. Governments of the Netherlands, Israel, and Spain are active in promoting adoption of their country's technology via preferential credits and other assistance. A scarcity of capital, experienced greenhouse management personnel, and technological know-how in Mexico is reportedly to blame for investments in less-than-ideal technology packages, with many initial attempts at greenhouse tomato production generating disappointing results.

According to the Asociación Mexicana de Productores de Hortalizas en Invernaderos (the Mexican greenhouse growers' association known by its acronym AMPHI), Mexico's protected culture area comprises plastic greenhouses (52 percent), shade houses (44 percent), glass greenhouses (2 percent), and other (1 percent). In the United States, winter producers need to use glass to maximize light transmission during the short days and to facilitate heating. For year-round producers in Mexico with longer winter days and less extreme winter weather, plastic structures may be more appropriate than glass. High-technology systems in plastic structures are proving to be capable of producing tomato yields of around 450-500 metric tons per ha and even higher in the ideal locations. But as of 2003, AMPHI estimated that only 13 percent of Mexico's protected culture tomato area had active environmental control systems. According to estimates by Cook and Calvin, the share of greenhouse area with active environmental control systems is higher, at about one-third.

In Mexico, glass greenhouses use hydroponics, but only a few plastic greenhouses do, though the number is growing. Industry suppliers estimate that only around 30 percent of hydroponics systems in Mexico use the high-cost imported rock wool as a growing medium. Most systems use cheaper yet effective substrates such as tezontle.

As the Mexican industry grows, it is attracting more attention and investment from suppliers, and better quality, lower cost local alternatives are emerging. This development will help to reduce investment costs over time. Similarly, as growers determine the best locations (combining both market and yield considerations), investments should generate higher net returns. A few Sinaloa- and Baja-based field and protected culture growers have been constructing greenhouses in noncoastal areas capable of longer shipping seasons. If successful, these efforts will spawn more year-round operators focused on producing consistent, high-quality volumes with competitive costs.

In general, those coastal field tomato growers who have been experimenting with protected culture are tending to expand area and invest in upgraded technology and management, particularly in Sinaloa. Even though Sinaloa is not the best area for achieving maximum greenhouse yields, growers there may find converting a portion of their crop mix to protected production to

be an effective business strategy. However, in both the Baja California peninsula and Sinaloa, some field tomato growers have found greenhouse production to be much more demanding in technology and management than anticipated. Those that are further along on the learning curve have an advantage over newcomers and are better positioned to withstand any periods of low prices.

Although net returns for greenhouse production are not always higher relative to open field production, protected culture methods may reduce several types of risk. Greenhouses provide protection from rain and growers with greenhouses may be among the few with typical volumes of high quality tomatoes of any type during periods of inclement weather, enabling them to benefit from above average prices. Both shade house and greenhouse production generally increases substantially the export-quality share of production, improving average pricing. Where greenhouse production succeeds in boosting yields substantially relative to open field, it can dramatically decrease the number of workers for a given level of output. Growers view recruiting and managing fewer workers as an important advantage. Furthermore, in order to achieve superior quality, many greenhouse growers invest in greater worker training relative to open field growers. This can pay off in several ways, including lower worker turnover. Shifting to protected culture can also decrease food safety risk and offer greater food safety assurances to buyers. Indeed, responding to rising retail demand for greenhouse tomatoes fits into growers' greater emphasis today on customer service, potentially reducing market risk by creating greater customer loyalty.

The relative potential returns from alternative technology packages vary significantly by area (see appendix 2 for more detail on this topic). Rain is rare during the State of Baja California's shipping season, and shade houses may be sufficient to reduce risks and improve returns, without requiring investment in more capital-intensive greenhouses. However, risk of disease is greater in shade house than in greenhouse operations. Due to especially high disease risk during the fall in the northern part of the Baja California peninsula, growers could eventually determine that greenhouse production is required to ensure fall volumes. Currently, some growers are experimenting with what is referred to as "hybrid" structures, a combination of shade house and greenhouse technology. This may provide many of the benefits of greenhouses, including reduction of disease risk, at a lower cost. The process of identifying the most economically viable technology packages is newer and less advanced than in Sinaloa.

Greenhouse Tomato Exports

It is estimated that 2003 Mexican greenhouse tomato exports to the United States were 125,970 metric tons (see table 5). Appendix 3 provides details on problems with data. This approaches Canada's level, which was 130,154 metric tons in 2003. Although Mexico's total greenhouse tomato production remains much lower than that of Canada, Mexico's export share is estimated at 85 percent, compared with 60 percent in Canada.

Mexico's higher export orientation means that it is capable of surpassing Canada as the principal supplier to the U.S. greenhouse market before it surpasses Canada in total production volume. Indeed, if production in Mexico continues its current rate of growth, while production in Canada and the United States remains relatively stable, Mexico is set to eclipse the U.S. and Canadian greenhouse industries in the near term. Ongoing improvements in technology and yields in all Mexican greenhouse regions will generate better and more consistent tomato quality. Until now, lack of uniformity has sometimes caused Mexican tomatoes to receive price discounts relative to key supplying regions. As quality improves, Mexico will become a more formidable competitor in export markets. However, demand for greenhouse tomatoes should also be stimulated by a consistently high-quality North American product, regardless of origin.

The Impact of the Greenhouse Tomato Industry on the Fresh Field Tomato Industry

The greenhouse tomato industry is having an impact on field tomato growers, whether they diversify into greenhouse production themselves, or just have to adapt to more market competition as the share of greenhouse production increases. Total U.S. fresh tomato imports from Mexico temporarily peaked in 1998, before beginning to rise again in 2001 and reaching a historic high in 2003 (table 6). Market-driven product diversification into greenhouse, grape, and roma tomatoes has likely contributed to Mexico's recent export growth. Since total imports from Mexico did not

Table 6—Mexican fresh tomato exports to the United States, by type

Year	Tomato type ¹					Total
	Cherry	Grape	Greenhouse ²	Regular ³	Roma	
<i>Metric tons</i>						
1990				352,312		352,312
1991				353,577		353,577
1992				183,116		183,116
1993				400,494		400,494
1994				376,032		376,032
1995	40,889			391,797	160,377	593,063
1996	41,975			429,710	213,992	685,678
1997	39,281			409,229	212,098	660,609
1998	50,307			415,848	267,899	734,053
1999	49,980		3,728	303,970	257,467	615,145
2000	37,834		27,468	277,995	246,585	589,882
2001	40,249		33,398	312,077	293,495	679,219
2002	39,291	16,915	42,140	309,262	315,817	723,425
2003	32,379	25,086	58,357	323,456	345,892	785,170

¹ The roma and cherry tomato codes were established in 1995, greenhouse in July 1999, and grape tomatoes in 2002. Prior to the establishment of these codes these tomatoes would have been reported as regular tomatoes.

² This table uses official DOC data which underreport actual volumes due to tariff code misclassification. Actual greenhouse imports may be around 67,000 metric tons higher in 2003.

³ The "regular" category captures any tomatoes, not specified in another separate tariff code category. As other categories have been added, this category is increasingly just round tomatoes—both vine ripe and mature green tomatoes.

Source: U.S. Department of Commerce.

surpass the 1998 level until 2003, the growth in greenhouse tomatoes up to that time simply displaced part of the decline in field tomato volume, without a net gain. However, given the relatively recent creation of the tariff codes for roma, cherry, greenhouse, and grape tomatoes (and continuing misclassification problems with the existing codes), it is not possible to measure the true changes in shares over time, by tomato type, of U.S. imports of Mexican fresh tomatoes.

But the expanded codes provide an improved snapshot of the shares in 2003, as calculated by the official DOC data. These data show that greenhouse tomatoes represented 7 percent of U.S. imports of Mexican tomatoes, significantly lower in share than round field tomatoes (41 percent) or romas, but higher in share than either cherry or grape tomatoes. If estimated miscoded greenhouse tomatoes were included, the greenhouse share of total U.S. imports of Mexican tomatoes could rise to 16 percent (based on a total of 125,970 metric tons, as noted earlier), and the round field share could decline to 33 percent.

As the importance of greenhouse tomatoes increases, growers in Sinaloa, the undisputed leaders of the fresh tomato export industry, face increased competition from greenhouse growers in other regions. In addition to contributing to a changing product mix, the emergence of the geographically dispersed greenhouse tomato industry in Mexico has begun to reduce the market share of total fresh tomato exports entering in Arizona, as measured by DOC crossings data. In 2003, 66 percent of Mexico's fresh tomato exports crossed in Arizona, primarily Nogales (down from 70 percent a decade ago), compared with 28 percent entering into California from the Baja California peninsula and 7 percent crossing the border in Texas (table 7). Since much of the greenhouse volume from central Mexico crosses in Texas, these data put in perspective the still-small share of greenhouse volumes from this region compared with the combination of field and greenhouse production from the traditional industry leaders Sinaloa and Baja California.

DOC import crossing data only reflect total imports at any port of entry from Mexico, with no indication of volume by growing region. Sinaloa's share of Arizona imports can be estimated by comparing DOC data with tomato export data from the State of Sinaloa, as reported by CAADES. In 2000, 85 percent of Mexican tomatoes exported through Arizona were from Sinaloa; in 2003, Sinaloa's share plummeted to 56 percent.¹² These data highlight the emergence of new competition for Sinaloa tomato growers, both field and greenhouse, also exporting through Nogales. Those vying for shares include the high-technology and high-yield growers in Sonora and lower-technology greenhouse growers in west central Mexico, Jalisco in particular. Sinaloa's dramatic drop in share reflects an absolute decline in its exports during a period of export growth for the country as a whole. Analysis of tomato export data for the State of Sinaloa shows that total tomato exports, all types, declined from 348,113 metric tons in the 1999-2000 season to 272,993 metric tons in 2003-04 (CAADES, 2004). The decline in Sinaloa's tomato exports, both in absolute and relative terms, is clear evidence that the emerging greenhouse industry is already having a competitive impact on Sinaloa.

Not only has the competition increased, but the competition has a higher quality orientation and it extends to both export and domestic markets.

¹² Although rain during the Sinaloa season was likely a factor contributing to lower export volumes.

Table 7—U.S. imports of fresh tomatoes from Mexico, by type and State of entry, 2003

State	Type ¹	Volume	Share
		<i>Metric tons</i>	<i>Percent</i>
Arizona	Cherry	17,127	2.2
	Grape	19,304	2.5
	Greenhouse	30,916	3.9
	Regular ²	239,401	30.5
	Roma	210,117	26.8
Total		516,864	65.8
California	Cherry	12,340	1.6
	Grape	5,589	0.7
	Greenhouse	3,934	0.5
	Regular ²	78,639	10
	Roma	115,954	14.8
Total		216,456	27.6
Texas	Cherry	2,899	0.4
	Grape	213	0
	Greenhouse	22,937	2.9
	Regular ²	5,311	0.7
	Roma	19,700	2.5
Total		51,059	6.5
Other		608	0.1
Total		784,988	100

¹ Official greenhouse imports are estimated to underreport actual volumes due to tariff code misclassification. Estimated greenhouse imports were 125,970 metric tons in 2003, but the total tomato import volumes (all types combined) per State of entry were unaffected.

² Regular tomatoes are any tomato not elsewhere specified. In 2003, most regular tomatoes were vine ripe, with a small amount of mature green round tomatoes.

Source: U.S. Department of Commerce, as compiled by Cook and Calvin.

Greenhouse production may be export oriented, but some new greenhouse producers are still in the process of achieving the quality and consistency levels required to be competitive in the export market; tomatoes that do not meet export standards may be sold on the domestic market. Furthermore, as rapid growth in the Mexican supermarket sector creates demand for consistently high-quality fresh produce with food safety assurances, Mexican internal demand for greenhouse tomatoes will likely expand significantly over the next decade.

Field tomato growers in Sinaloa have the most experience with protected culture, the greatest financial resources to invest in technology, and the ability to shift between field and alternative protected culture approaches as markets evolve and send different price signals. Since Sinaloa can experience rain during its growing season, and if greenhouse tomatoes continue to receive price premiums, growers may come to favor plastic greenhouses over shade houses. However, given the relatively short shipping season and the high cost of hydroponics, much of this greenhouse production may remain in the soil, and marketed as greenhouse, without reference to hydroponics. The existence of several large forward-integrated grower-exporters already embarked on developing more direct linkages with buyers for field and greenhouse tomatoes provides a robust model.

In contrast, field tomato growers in Baja California generally have less experience with protected culture. Production in the northern part of the peninsula still targets the shoulder seasons and the summer rather than the winter when prices are highest. Baja experiences with plastic greenhouses have been mixed. Much of Baja is not viewed by greenhouse technology experts as offering the best conditions for greenhouse construction. On the other hand, water and disease pressures, longstanding labor shortages, and food safety concerns should all assure continued experimentation with protected culture.

Once winter greenhouse tomato production expands enough to meet market demand, the relative competitiveness of different Mexican export regions will become more important. The combination of higher transportation costs to the U.S. border and lower average yields relative to the mainland may cause the U.S.-landed per unit costs of Baja California Sur greenhouse tomatoes to be at a competitive disadvantage relative to Sinaloa and central Mexico products (or San Quintín if winter production were to emerge there). Nevertheless, within the next 5 years, the most profitable field versus protected culture technology packages in different regions of the Baja California peninsula should emerge.

However, some of the recent attempts to locate greenhouse operations in north central and central Mexico have to date not met expectations, sending less optimistic signals to outside investors and State governments about the potential returns from greenhouse investments. Although greenhouse location decisions in central and north central Mexico may continue to be partly influenced by the economic incentive programs of State governments, these programs may be less available, just as the availability of venture capital may decline in response to underperformance of some of the recent high-technology projects. Hence, while the Mexican greenhouse tomato industry will continue to expand, the recent explosion in area may be unsustainable. Yields will undoubtedly improve markedly in most regions, but since a large portion of the greenhouse investments is being made in coastal areas, the average national yield in Mexico is not expected to reach that of its northern neighbors.

U.S. Greenhouse Tomato Industry

The U.S. greenhouse tomato industry is the second largest in North America, after Canada, but imports still exceed domestic production. In 2003, four large firms dominated the industry, operating high-technology greenhouses and producing on a year-round basis. The ability to produce year-round is a key strength of the U.S. industry. Remaining profitable with more winter competition from Mexico as well as summer competition from Canada will be a challenge.

The U.S. greenhouse industry has gone through a period of adjustment, with firms looking for the most profitable business model. Firms have changed locations, production seasons, marketing alliances, and product lines. Most of the large firms that do their own marketing are now looking further afield to Canada and/or Mexico to acquire additional production to achieve more year-round consistency in production volumes or to expand product lines. Firms are juggling greenhouse assets, alliances, and distribution strategies to improve profitability.

Area and Production

In 2003, U.S. greenhouse tomato growers produced an estimated 159,664 metric tons on 330 ha of greenhouses (table 8).¹³ In that year, the U.S. greenhouse industry comprised four large firms with production ranging from 34 to 67 ha each, a small number of medium-size greenhouses ranging from 3-16 ha each, and a large number of very small greenhouses.

In 2003, the four large U.S. firms—Eurofresh, Inc., Village Farms, Houweling Nurseries, and SunBlest (which now owns most of the former Colorado Greenhouse operations), produced greenhouse tomatoes on 203 ha.¹⁴ In 2002, these four firms accounted for 67 percent of total U.S. greenhouse tomato output. In 2003, Village Farms had a total of 53 ha in Marfa and nearby Ft. Davis, Texas, and in Ringgold, Pennsylvania. Eurofresh had 67 ha in Willcox and Snowflake, Arizona.¹⁵ SunBlest operated 32 ha in Colorado and a 17-ha greenhouse in Virginia. Houweling operated a 34-ha greenhouse in coastal

Table 8—Estimated U.S. greenhouse tomato production and area

Item	1998	1999	2000	2001	2002	2003
<i>Metric tons</i>						
Production						
Total	106,594	129,727	123,831	131,995	149,912	159,664
<i>Hectares</i>						
Area						
Total	257	308	299	294	310	330
Large (17 hectares +)	166	210	198	193	187	203
Medium (3-16 hectares)	16	30	23	23	45	49
Small (less than 3 hectares)	76	67	78	78	78	78

Sources: U.S. International Trade Commission for total area and production from 1998-2000; area by firm size, all years, and all data after 2000 are estimates by Cook and Calvin.

¹³ There are only two government sources of published data providing information for 1998-2000. The U.S. Census of Horticultural Specialties (USDA, National Agricultural Statistics Service, 1998) reported 161 ha of greenhouse tomato production in 1998, although this appears to be low, apparently because at least one large firm did not report its area. The next census will cover production in 2008. The only other public estimates on area and production, for 1998-2000, come from the ITC's antidumping investigation against Canadian greenhouse growers. The ITC published industry estimates for 1998-2000, with an estimate of 299 ha of greenhouse tomatoes in the United States in 2000 and production of 123,831 metric tons (U.S. ITC, 2001). This is fairly consistent with another estimate of 304 ha for 1999 (Snyder, 1999).

¹⁴ In 2004 a new firm, Sun Valley, took over the Virginia greenhouse operated by SunBlest in 2003, increasing the number of large greenhouse operations to five. Eurofresh expanded production in 2004 to bring its area up to 87 ha.

¹⁵ Eurofresh built its first greenhouse without a cooling system but soon recognized that would be a problem. All subsequent greenhouses were built with cooling systems, and, in 2003, the original greenhouse was retrofitted with cooling, expanding North American summer supply without any growth in area for this firm.

Oxnard, California. Eurofresh was started by Dutch greenhouse growers and investors. Houweling Nurseries is owned by a Canadian greenhouse grower. Three of the four firms both grow and market their own production; Houweling markets through firms located in British Columbia.

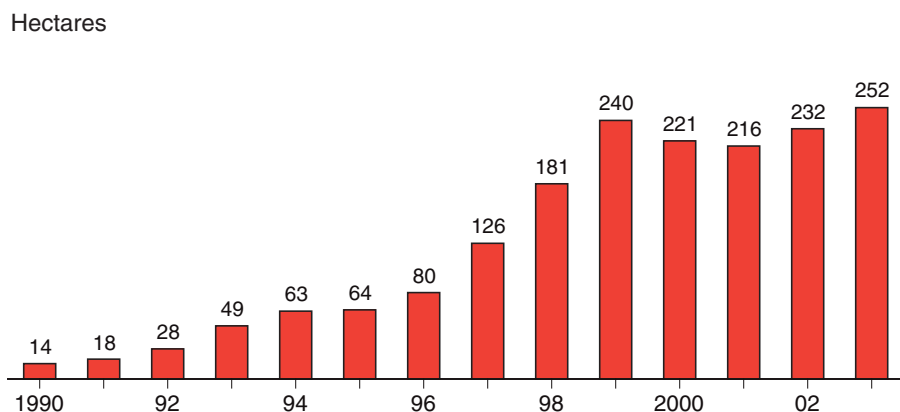
A group of seven medium-size firms produced on 49 ha in 2003. These firms produced an estimated 11 percent of total U.S. greenhouse volume in 2002. The medium-sized firms were located throughout the United States—New York (two firms), Minnesota, Nebraska, New Mexico, Arizona, and Nevada. Some of these firms market their own production in local or regional markets, and some sell via larger U.S. and Canadian marketers.

Small greenhouse production totaled an estimated 78 ha 2003. This group produced an estimated 22 percent of greenhouse tomatoes in 2002.¹⁶ These growers are assumed to be spread throughout the United States; the 1998 Census of Horticultural Specialties reported tomato greenhouse operations in every State. Small producers usually concentrate on local sales to farmers' markets and retailers interested in offering local produce to their customers (Snyder, 1999). Because of the focus on local sales, these small growers can harvest at a very ripe stage and still get their tomatoes to market at their peak. Very little is known about these small greenhouse growers.

Change in Greenhouse Area Over Time

Between 1996 and 1999, medium- and large-size greenhouse area increased about 200 percent, from 80 to 240 ha (fig. 8). The four largest U.S. firms increased area by 213 percent. The larger firms expanded due to strong retail demand and to facilitate selling directly to retail chains, which prefer to concentrate their purchases with a few large, year-round suppliers for a particular product. While U.S. production was increasing, so, too, was production in the rest of North America. Prices fell to levels that made repaying heavy debt load difficult (ITC, 2001). Two of the large U.S. firms experienced serious economic difficulties. One firm, which had a number of

Figure 8
U.S. greenhouse tomato area for firms with at least 3 hectares



Source: Interviews by Cook and Calvin.

¹⁶ We assume that the area for small firms in 2003 is equal to the number in 2000 when ITC published estimates of total area and production. The number of ha for small producers comes from the ITC estimate of 299 ha in total in 2000 minus our estimates, based on interviews, for large and medium-size greenhouses in that year. A similar procedure was used to estimate production. Using the U.S. Census of Horticulture for 1998, which provides some information on area in greenhouses by State, gives a point of comparison. After eliminating States where no area was reported because of disclosure problems and States where large and medium-size farms were located, to avoid the possibility of counting them as small farms, there were 39 ha in 32 States. So 78 ha for 50 States seems plausible. With 501 operations and 39 ha in 32 States, the average operation was very small—only 0.07 ha. If this group has been growing since 2000, our estimate of total area is low. Very little information is available about small greenhouse operations over time. A Florida survey shows substantial variation over a decade (Hochmuth and Hochmuth, 2004). In 1991, Florida had 9 ha in greenhouse tomatoes, but this number declined to 2 ha in 1996 before increasing to 7 ha in 2001.

problems in addition to low prices, was finally liquidated and another greenhouse firm acquired most of its assets.

Low prices affected both existing and new or expanding greenhouses. After 1999, several large firms sold greenhouses or took them out of production. One firm increased production in other areas more suited to its business plan, while discontinuing operations in other areas. Some of the greenhouses that were sold continued producing tomatoes while others were put to different uses such as bedding plant production. Several were torn down. In 2003, the total area for the medium- and large-size firms increased to 252 ha, topping the previous high of 240 ha in 1999. Some of the medium- and large-size greenhouses planned expansions for late 2004 and 2005, although low summer prices in 2004 may have put these plans on hold.

Change in Greenhouse Locations

Over time, there has been a major shift in location for the largest U.S. greenhouse firms as owners tried to align production with the most profitable market windows. Many of the early greenhouses targeted the summer months, the traditional Canadian season. Firms found their volumes winding down just as prices started to go up in the fall. Over time, U.S. firms began to focus more on opportunities in the winter.

Colorado Greenhouse was the first large U.S. greenhouse operation, starting back in the late 1980s. Initially, all its production was in Colorado. Village Farms began production in 1991 and Eurofresh began in 1992, both in Pennsylvania. All of these early greenhouses were cogeneration operations with powerhouses. Power plants could gain exemptions from some Federal regulations by producing heat to be used in another business activity such as greenhouse production. Greenhouses received heat at a lower cost than available from other sources. Typically, the power plant owned the greenhouse and leased it to the greenhouse operator. As a result, the locations were not necessarily selected with greenhouse objectives in mind.

The early northeastern U.S. greenhouses had the advantage of being near urban centers, minimizing transportation costs to market and maximizing retail shelf-life potential; however, they could not produce profitably year-round. While strong seasonal firms still operate in the Northeast, firms that decided to target the year-round market moved to States with warmer winter climates.

Colorado Greenhouse, Eurofresh, and Village Farms all turned to the Southwest for expansion. None of their new greenhouse operations is a cogeneration facility tied to a powerhouse. Each was selected solely for agronomic and economic reasons—the right environmental conditions for the market windows the firms wanted to target.¹⁷ The new locations maximize production during the high-priced winter season. The desert Southwest provides strong light levels, low humidity, high altitude (that gives warm days and cool nights), good water, and natural gas. On the negative side, high summer heat may require greenhouse cooling, and adapting Dutch technology to new environmental conditions can be a challenge. Also, these areas are far from major population centers east of the Mississippi River, increasing transportation costs to market. In addition, since these greenhouses are often

¹⁷ A similar phenomenon may occur in Mexico. Some field tomato producers currently experimenting with greenhouses near their field operations, which is convenient, may eventually shift to areas that are selected for maximizing production and profits.

in relatively isolated locations, far from major horticultural production areas, attracting labor, at all levels, can be difficult.

Eurofresh was the first to relocate, moving to Arizona in 1992. In 1997, Village Farms began production and harvesting from new greenhouses in Texas, gradually shedding most of its northeastern operations. Colorado Greenhouse also went further south, opening two greenhouses in Estancia and Grants, New Mexico, in 1998 and 1999. Canadian operations also opened in the southern and western United States. Some firms went further south. One U.S. grower of cherry TOVs started out in Texas and then built greenhouses in Mexico to augment winter production. This firm eventually dropped its U.S. production and expanded its Mexican production; in terms of area, it now operates the largest greenhouse in North America.

New Building Declines and More Complicated Business Relationships Increase

As greenhouse tomato prices have fallen in recent years, construction of new greenhouses has slowed in the United States. Firms have been buying and selling existing greenhouses, with known characteristics, in an effort to achieve the correct balance of supply throughout the year. There is also more emphasis on alliances, joint ventures, and marketing agreements between firms in different locations to achieve the same results.

In 1999, Colorado Greenhouse was the first of the large U.S. producers to attempt a joint venture with a Mexican grower to supplement its winter volume. According to industry experts, differences in technology and quality levels appear to have caused this joint venture to fail (ITC, 2001). Other joint ventures have been more successful. For example, in 2003, Village Farms announced a joint supply venture with BC Hot House that will provide the Canadian firm with more winter supplies from the United States and vice versa. U.S. and Canadian firms also market for Mexican firms.

Technology

The technology of the medium- and large-size U.S. firms is relatively uniform—glass greenhouses with active climate control and hydroponics. This is the same technology used in the Netherlands and British Columbia, Canada. Some of the earliest Colorado Greenhouse operations were plastic but they are no longer in tomato production. A glass greenhouse is an advantage when trying to maximize winter sun reaching the plants and controlling the environment if it is necessary to cool in the summer. Average yields for the large firms are high, 534 metric tons per ha (with top yields reaching about 700). Small-size greenhouses use a range of technologies, with some using low- or medium-technology greenhouses.

Product Mix

In 2000, large-scale greenhouse tomato production in the United States comprised 58 percent beefsteak production and 42 percent TOV production (ITC, 2001). In 2003, production for the four largest producers was esti-

mated at 36 percent beefsteak, 60 percent TOV, and 4 percent smaller TOV. Smaller TOVs are a rapidly growing sector of the industry. The medium-size growers had a smaller share of production in TOV than the largest firms—38 percent for TOVs in 2002. Small growers generally produce beefsteak tomatoes.

In 2003, the large- and medium-size greenhouses in the United States focused exclusively on growing tomatoes, unlike some of their Canadian and Mexican competitors who also produce greenhouse cucumbers and bell peppers. Two of the big U.S. firms experimented earlier on a small scale with peppers before deciding to specialize in tomatoes. In 2004, one large grower began producing greenhouse cucumbers on a small scale. Three of the large firms market greenhouse cucumbers and peppers, acting as agents for other growers or buying product outright. Houweling's production is marketed through two firms in British Columbia who also sell greenhouse cucumbers and peppers. Decisions on the breadth of product line are an important part of the strategic choices of greenhouse vegetable shippers, figuring into their relative competitiveness. Frequently, buyers express a preference for dealing with wider line suppliers within a category of products so that they can concentrate purchases with fewer firms and reduce sourcing transaction costs. On the other hand, risk and cost factors may discourage some greenhouse tomato firms from product diversification.

Greenhouse Tomato Organizations

U.S. greenhouse growers do not have organizations that can impose minimum prices like growers in British Columbia and Ontario, who have this authority even though they rarely use it. Nor do they have organizations that can restrict area such as in British Columbia. With four large growers located in different States, it may be difficult for the greenhouse tomato industry to band together to form organizations of the type that are common in the U.S. fresh field tomato industry. The California and Florida fresh field tomato industries have separate grower organizations with the power to impose minimum prices.¹⁸ However, difficulties in achieving grower consensus and participation have sometimes limited the use of this authority.

Marketing

Greenhouse tomato marketing practices are often distinct from those used for field tomatoes. Since mature green tomato growers often send their product to repackers, they lose control over the product and how it is marketed. Greenhouse growers do not have this problem. Greenhouse tomatoes are more of a consumer-ready product and a growing share of sales are direct to retailers, avoiding wholesale intermediaries. Most greenhouse firms have opened forward distribution centers near major markets to ensure strong customer service. Forward distribution centers in close proximity to customers enables firms to offer a high level of service, including the ability to promptly supply fill-in orders and to ensure top quality upon delivery. Some Canadian and Mexican firms are also adopting this model.

Greenhouse tomato marketing has the advantage of a more predictable supply stream and quality than field production. Both greenhouse and field

¹⁸ For example, the Florida Tomato Growers Exchange provides Capper-Volstead exemption from anti-trust laws, allowing growers to meet to discuss marketing problems and set minimum prices for their tomatoes, if they so desire.

tomato producers use contracts with buyers but the level of forward contracting appears to be higher for greenhouse tomatoes. Greater supply stability reduces cost and price uncertainty, facilitating contracts and helping to increase buyer loyalty.

Greenhouse tomato marketing is more brand-oriented than for field tomatoes. Greenhouse tomatoes are typically marked with price lookup stickers, like field tomatoes, but with the name of the company also displayed. Brand orientation requires a twelve-month supply; if a brand is only available for part of the year a valuable asset is not being maximized. However, research on consumer attitudes regarding fresh produce brands indicates a low level of awareness and loyalty, likely due in part to intra- and inter-seasonal variations in quality (Fresh Trends, 1990; 2002). Greenhouse tomato producers are not exempt from low consumer brand awareness in the fresh produce department.

Total U.S. Greenhouse Tomato Supply: The Role of Imports

Imports play an important role in U.S. supply. In 2003, estimated greenhouse tomato imports totaled 280,217 metric tons, compared with domestic production of 159,664 metric tons (table 9). Import volumes have been growing more rapidly than domestic production. In 2003, U.S. greenhouse tomato exports totaled only 3,827 metric tons, all to Canada.

Table 9—Estimated U.S. fresh tomato supply and consumption, including field-grown and estimated greenhouse tomato volume

Year	Greenhouse production	Field-grown production	Total production	Estimated greenhouse imports ¹	Estimated field imports ²	Total imports
<i>Metric tons</i>						
1998	106,594	1,492,591	1,599,185	139,683	707,637	847,320
1999	129,727	1,696,844	1,826,571	169,191	571,550	740,742
2000	123,831	1,764,020	1,887,851	191,312	538,694	730,006
2001	131,995	1,710,088	1,842,083	226,404	597,157	823,561
2002	149,912	1,795,682	1,945,594	238,756	620,746	859,502
2003	159,664	1,594,241	1,753,906	280,217	659,239	939,457
Year	Greenhouse supply ³	Total fresh supply	Fresh exports	Total fresh consumption	Fresh consumption per capita	Greenhouse share of fresh consumption
<i>Metric tons</i>				<i>Kilograms</i>		<i>Percent</i>
1998	246,277	2,446,505	129,863	2,316,642	8.4	10.6
1999	298,919	2,567,313	151,659	2,415,654	8.6	12.4
2000	315,143	2,617,857	186,133	2,431,724	8.6	13.0
2001	358,399	2,665,645	180,615	2,485,030	8.7	14.4
2002	388,668	2,805,096	150,638	2,654,458	9.2	14.6
2003	439,882	2,693,362	142,473	2,550,889	8.8	17.2

¹ Assuming all imports from the EU, Israel, Morocco and Canada are greenhouse. Imports of greenhouse tomatoes from Mexico are estimated, taking into account not only official U.S. Department of Commerce greenhouse statistics but additional volume not thought to be captured in official statistics, due to miscoding as other tomato types.

² Field-grown tomato imports estimated by subtracting estimated greenhouse tomato imports from total fresh tomato imports, as reported by the U.S. Department of Commerce.

³ Here we assume greenhouse supply is equal to consumption. We are ignoring small exports to Canada (3,827 metric tons for 2003) because of concerns regarding data reliability.

Sources: Compiled by Cook and Calvin from USDA, National Agricultural Statistics Service, U.S. Department of Commerce, and greenhouse tomato production and import estimates from Cook and Calvin.

U.S. greenhouse tomato imports by source have changed dramatically (table 10). If total estimated Mexican imports are considered, rather than official DOC numbers, in 2003, Canada represented 46 percent of the total, followed by Mexico with 45 percent. Europe, Israel, and other sources of greenhouse tomatoes accounted for much smaller shares. As late as 1997, Europe was still the largest source of U.S. greenhouse imports. Imports from Europe were overtaken by Canada in 1998 and Mexico in 1999, according to official data. If the estimates of Mexican imports are correct, Mexico may soon become the principal source of U.S. imports of greenhouse tomatoes in terms of quantity.

U.S. imports of greenhouse tomatoes from its NAFTA partners have trended upwards over time, excepting imports from Canada in 2002. In 2001, U.S. growers sued Canadian growers for dumping greenhouse tomatoes. Dumping margins, applied between October 2001 and March 2002, put a temporary damper on Canadian exports. U.S. imports of Canadian greenhouse tomatoes declined by 5 percent in 2002, relative to 2001. In April, 2002, the ITC rejected the U.S. greenhouse tomato growers' case and DOC instructed U.S. Customs and Border Protection to refund any dumping duties already collected. In 2003, U.S. imports from Canada surged 30 percent, but not all due to resolution of the dumping suit. U.S. import demand also expanded because of weather-induced subnormal U.S. production volumes of field tomatoes, causing more buyers to seek out greenhouse products.

According to official DOC statistics, the United States imported \$365.5 million worth of greenhouse tomatoes in 2003. There is no way to estimate the value of undercounted greenhouse tomato imports from Mexico, so analysis of value relies solely on DOC data. Comparing import shares of value to import shares of quantity shows that on average, Canada and non-NAFTA sources receive a price premium relative to Mexico. This is a func-

Table 10—U.S. greenhouse tomato imports, by origin¹

Year	Canada	Mexico ¹		Europe	Israel	Others	Total ¹	
		Official	Estimated				Official	Estimated
<i>Metric tons</i>								
1990	3,075			1,306	2,126		6,507	
1991	2,672			3,028	1,107		6,807	
1992	5,214			2,927	1,918	3	10,061	
1993	4,733			9,677	2,262		16,672	
1994	7,673			10,426	1,822	3	19,924	
1995	11,655			14,822	1,320		27,797	
1996	21,769			27,270	2,302	6	51,348	
1997	37,504			41,020	3,264	3	81,791	
1998	61,729		26,600	46,620	4,734		113,083	139,683
1999	79,554	3,728	43,889	41,908	3,833	7	129,030	169,191
2000	101,390	27,468	51,300	34,711	3,728	183	167,480	191,312
2001	105,680	33,398	82,128	34,798	3,723	75	177,674	226,404
2002	100,499	42,140	102,816	31,000	4,294	146	178,080	238,756
2003	130,154	58,357	125,970	19,244	4,821	28	212,604	280,217

¹ These official DOC data for imports of Mexican greenhouse tomatoes may substantially underestimate true trade levels due to misclassification of greenhouse tomatoes with other tomato tariff codes. Mexican estimates for 1998-2003 are based on industry knowledge. Official Mexican imports only begin in July 1999 when the greenhouse tomato tariff code was established. The data reported in this table include all tomato imports from the EU, Israel, Morocco and Canada, even if they were not coded as greenhouse since we know that only greenhouse tomatoes are imported from these countries.

Sources: U.S. Department of Commerce, as compiled by Cook and Calvin, and estimates by Cook and Calvin.

tion of two factors. Mexico has a relatively large share of lower priced beef-steak tomatoes in its exports, and Mexican greenhouse tomatoes sometimes face lower prices due to perceived or real quality problems. The industry is striving to improve its quality reputation to avoid prices being discounted relative to the competition.

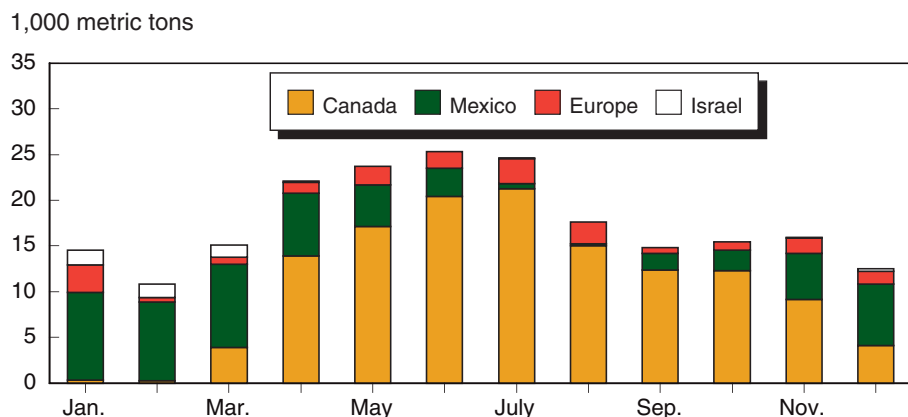
Figure 9 shows DOC data on greenhouse tomato imports by month for 2003. Again, analysis relies on DOC data since it is not possible to apportion the additional estimated greenhouse tomato imports across months. In 2003, Canada's highest level of exports to the United States was during July, but they were strong throughout the year except for the December through March period. In 2003, Mexico exported greenhouse tomatoes to the United States on a year-round basis but with most shipments in the November through June period. Because there is no greenhouse tomato tariff code for the period July 15 to August 31, Mexican summer imports are undercounted. Nevertheless, despite Mexico's positioning as a winter producer, a comparison of monthly U.S. imports in 2003 and 2004 shows that much of the gain in Mexican volumes up through November 2004 came in the spring and fall, not the midwinter (fig. 10). The large increase in greenhouse tomato imports in December 2004 appear to be a harbinger of a very large increase in winter volume. In January 2005, greenhouse tomato imports were up 91 percent from the previous year. Clearly, Mexico is now becoming much more of a competitive factor for both the Canadian and U.S. greenhouse tomato industries. USDA's Agricultural Marketing Service began to publish U.S. greenhouse tomato shipments in late 2004.¹⁹ Soon it will be possible to analyze monthly patterns of total supply, not just imports.

Putting U.S. greenhouse tomato imports in context relative to total fresh tomato imports shows that in 2003, according to the DOC, greenhouse tomatoes were equivalent to 23 percent of the 939,457 metric tons of U.S. fresh tomato imports. Since greenhouse tomatoes are generally higher value than field tomatoes, they contributed 37.5 percent of the \$1.047 billion worth of U.S. fresh tomato imports in 2003. Clearly, greenhouse tomato imports are entering the U.S. market not as a low-cost foreign production option, but due to U.S. demand for what is perceived to be a premium product.

¹⁹ For the last 3 months of 2004, the U.S. share of total greenhouse supply in the United States was 22 percent in October, 38 percent in November, and 39 percent in December (USDA, AMS, 2004).

Figure 9

Monthly U.S. greenhouse tomato imports from major suppliers, 2003

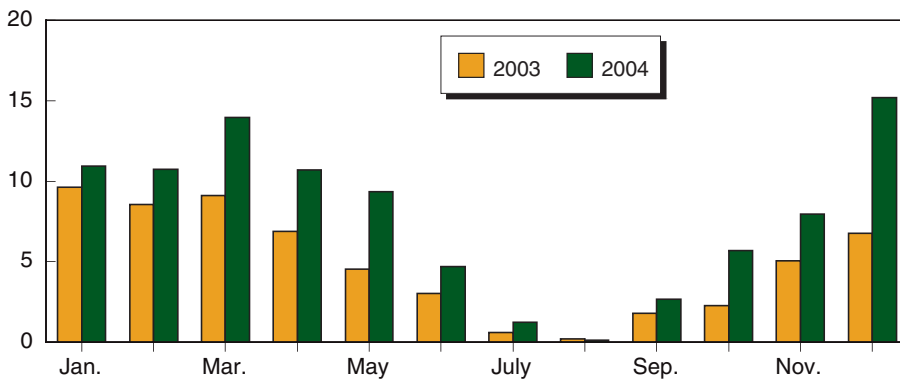


Source: U.S. Department of Commerce.

Figure 10

Growth in U.S. monthly imports of Mexican greenhouse tomatoes

1,000 metric tons



Source: U.S. Department of Commerce.

Market Analysis: Price and Consumption Trends

While consumer demand for greenhouse tomatoes was growing in recent years, it was sometimes outpaced by even more rapid growth in supply. This led to two periods of very low prices, first for beefsteak tomatoes in the late 1990s and then for TOVs, in the summer of 2004. As the greenhouse industry has grown, there has been more interaction between greenhouse and field tomato prices.

Data limitations pose a challenge for analysis of prices (see appendix 4, “Data on Greenhouse Prices in the U.S. Market”). Utilizing the limited available data on prices of Canadian and Mexican greenhouse tomato imports, as well as data on U.S. wholesale market prices, provides a partial picture of price trends.

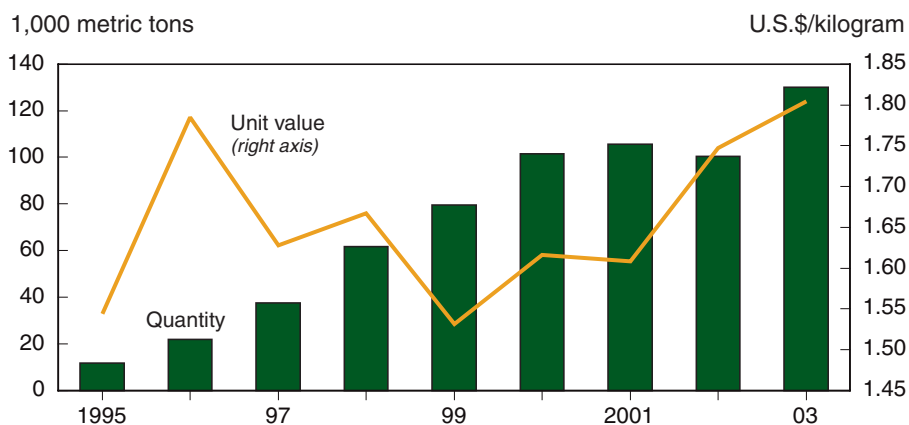
Impact of Rapid Production Growth on Prices

In 1999, the unit value of imported Canadian greenhouse tomatoes, mainly beefsteak tomatoes at that time, hit a low of U.S. \$1.53 per kg (fig. 11). The U.S. fresh tomato industry was particularly concerned in the summer of 1999, when Canadian greenhouse tomatoes were reportedly sold in California at prices lower than field tomato prices (*The Produce News*, 1999). Prices increased in 2000, in part because total U.S. greenhouse supply increased very little in 2000 [U.S. production dipped although imports continued to climb (see table 9)], allowing consumer demand to catch up with supplies. After 2000, Canadian import data provide less information on prices for beefsteak tomatoes. Trade data aggregate beefsteak, TOV, and specialty tomatoes into a generic greenhouse category and the higher Canadian import prices after 2000 partly reflect the changing product mix over time.

Data on Mexican import prices provide more recent information on beefsteak prices. USDA’s Agricultural Marketing Service (AMS) started

Figure 11

U.S. imports of greenhouse tomatoes from Canada, in quantity and value



Source: U.S. Department of Commerce.

collecting data on Mexican beefsteak tomatoes entering through Arizona in 1999. Since then, the highest 4-month average price for Mexican beefsteak tomatoes was in 2000, up substantially over the low 1999 average, verifying the trend seen in the Canadian import data for 2000 (fig. 12). The rapid shift of growers in the United States and Canada to TOV production reduced market pressure on beefsteak tomato prices. From 2000 to 2004, there was no clear trend in winter prices of imported beefsteak tomatoes in the Nogales market. Since winter supply was still relatively low, Mexico had been able to maintain fairly stable winter beefsteak prices in the face of overall increases in greenhouse production. However, expanding supplies in winter 2005 caused prices for Mexican beefsteak tomatoes to fall to an all-time January low. The industry reports that summer beefsteak tomato prices have increased somewhat in the last 2 years due to declining availability in the United States and Canada.

TOV growers report that their prices declined gradually with production increases until the summer of 2004, when prices fell dramatically due to a sudden production surge throughout North America. Wholesale market prices, the only information available for TOV prices over several years, did not appear reliable for judging trends.²⁰ AMS only began collecting FOB price data on Mexican TOVs in April 2004.

Greenhouse and Field Tomato Prices

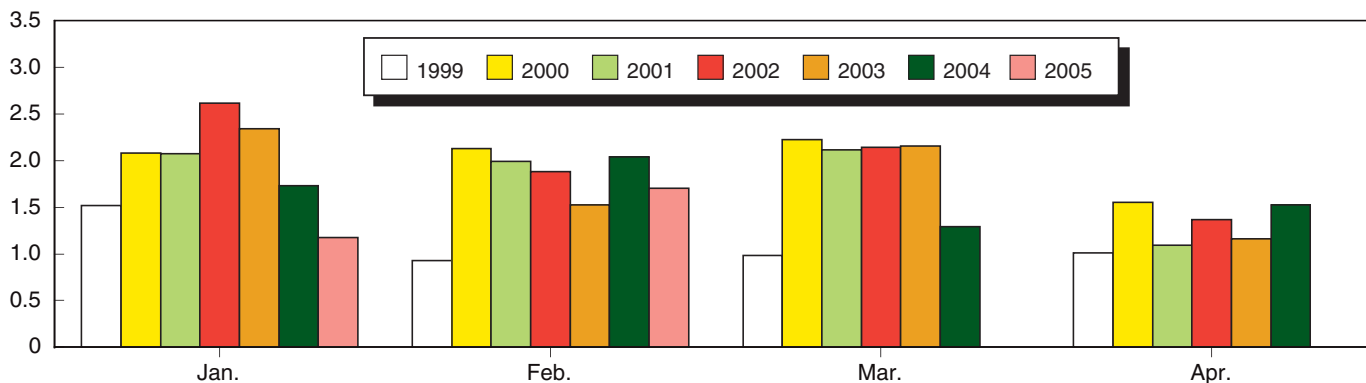
Prices of fresh field tomatoes are volatile. Daily prices may vary due to transportation problems or adverse weather conditions in both supply and demand regions. Weather can shift the start or end date for any production region, relative to its typical season, and this can cause either excess supplies or shortages, and sometimes sizable swings in prices for certain types of tomatoes. For example, an unusually large gap between availability of vine ripe tomatoes from Sinaloa, Mexico, and the beginning of the vine ripe season in California and Baja California, Mexico, might cause buyers to drive up the price of available vine ripe tomatoes rather than switch to greenhouse or mature green tomatoes for a brief period. Supplies of greenhouse tomatoes are less prone to unexpected price swings than field tomatoes, but weather can still

²⁰ Analysis of Canadian TOV prices in the Boston wholesale market from 2001 to September 2004 shows a general price increase through 2003. Greenhouse producers discount this view of pricing trends. The publicly available wholesale spot market price data, which are available from AMS, may be less representative than in the past. Greenhouse shippers are sending less to wholesale markets as they focus on direct sales to retail buyers.

Figure 12

Mexican beefsteak greenhouse tomato FOB prices, Nogales, Arizona¹

\$/kilograms



¹ Beefsteak FOB prices are for size 22.

Source: U.S. Department of Agriculture, Agricultural Marketing Service.

impact production and prices. For example, unexpectedly cold weather can slow production and unanticipated hot weather can speed up production. Field tomato prices can affect greenhouse tomato prices and vice versa.

While some buyers may switch from one tomato type to another depending on price, not all view different types as substitutes. As a result, prices for different types of tomatoes do not always follow the same trend. Among three types of buyers—final consumers at retail stores, buyers for the retail stores, and buyers for foodservice establishments—the consumer at the retail store may be the most flexible. The availability of many types of tomatoes in most retail stores would tend to increase the price elasticity of demand. If the price of one type of tomato increases, many consumers will substitute another less expensive type of tomato.²¹ Some consumers may not even recognize all the distinctions between types of tomatoes.

Consumer research highlights the difficulty in generalizing about consumer preferences for fresh tomatoes (*The Produce News*, 2004; Hughes, 2005). This research showed that Hispanic consumers strongly preferred field grown tomatoes. About one-third of non-Hispanic consumers strongly preferred field grown tomatoes, one-third preferred greenhouse, and one-third had no preference. Hispanic consumers were very knowledgeable about tomato types and selected across types based on specific intended uses (e.g., romas for salsas). In contrast, non-Hispanic consumers purchased more based on emotion, weighting appearance and ripeness at harvest as prime attributes. They were much more likely to substitute between types for the same intended use, depending on appearance and price. Hispanic consumers placed the most weight on price, partly contributing to their preference for field tomatoes, but the firmness and slicing characteristics of round field tomatoes were also valued.

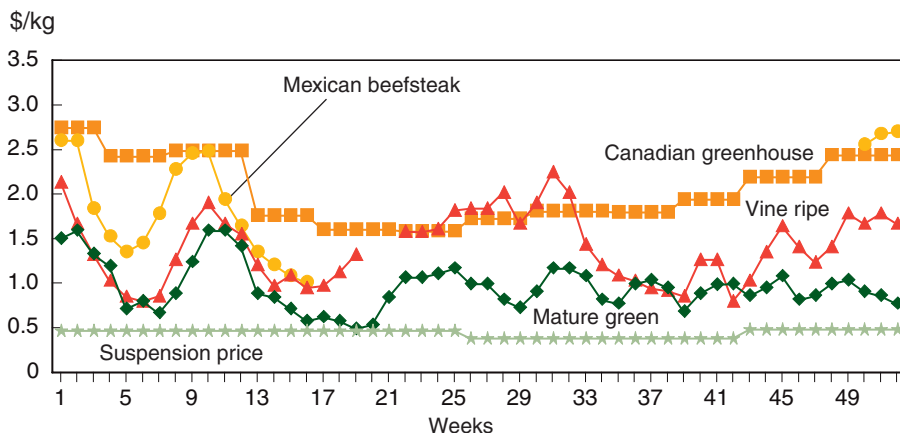
Buyers for the retail stores may not be as flexible as many consumers. For example, a retailer that traditionally buys a very small amount of greenhouse tomatoes might not be able to acquire a larger quantity at short notice in the event of a scarcity of field tomatoes—particularly with forward contracting reportedly more common in the greenhouse sector. In periods of short supply, retailers often simply decrease shelf-space. Buyers for foodservice firms may be even less flexible. The foodservice industry consumes a large part of the mature green supply and in general does not substitute other tomato types that do not stand up to their very specific requirements, regardless of relative prices, making demand quite inelastic. Once an item is placed on a menu, foodservice operators are often willing to pay high prices to ensure its availability.

Data on prices of greenhouse tomatoes imported from Canada (monthly trade unit values) and Mexico (weekly FOB) provide an idea of the price range of greenhouse tomatoes in the U.S. market. In 2003, greenhouse tomatoes generally enjoyed a price premium over other types of tomatoes, but the premium varied throughout the year and during the summer there was one period when vine ripe prices topped greenhouse prices (fig. 13). The high greenhouse prices in the winter explain why growers try to acquire winter production in warmer U.S. or Mexican locations. Prices decline beginning in April as Canadian greenhouse production becomes available

²¹ Efforts to estimate demand elasticities for field and greenhouse tomatoes have yielded inconsistent results with both negative and positive cross-price elasticities (Thompson, 2003).

Figure 13

Weekly fresh tomato FOB prices in the United States, by type, January-December 2003¹



¹California mature green tomato FOB prices are for 25-pound boxes of extra large size, with a grade of 85 percent U.S. 1 or better. Florida mature green tomato FOB prices are for 25-pound boxes of 5x6 size, with a grade of 85 percent U.S. 1 or better. California and Mexican vine ripe FOB tomato prices are for two-layer flats of 19 pounds of 4X5 size. Mexican greenhouse FOB prices are for beefsteak tomatoes in Nogales, Arizona, in a one-layer box of 15 pounds of size 22 tomatoes. Canadian greenhouse prices are a monthly unit value for imports of all greenhouse tomatoes, not a specific type or size. The suspension price is the minimum price program administered by the U.S. Department of Commerce; Mexican tomatoes cannot enter the United States at a price lower than the suspension price (Calvin and Barrios, 1998).

Sources: U.S. Department of Commerce; U.S. Department of Agriculture, Agricultural Marketing Service, Market News Service.

and remain low until November. Florida field production also increases in April adding to the supply of fresh tomatoes.

Mexican greenhouse beefsteak prices generally follow the broad trends in round field tomato prices although prices are usually higher. The Canadian greenhouse tomato price represents both lower priced beefsteak and higher priced TOV tomatoes so it should usually be higher than the Mexican beefsteak price. In March, Mexican prices equalled the monthly Canada price for 1 week, but if weekly data were available, Canadian prices might have still have been greater than Mexican prices. The Mexican industry is younger than the Canadian industry, and quality may still be less consistent as growers develop their ideal production systems. However, in December, as the new season began for many Mexican growers and the Canadian season wound down, Mexican prices exceeded Canadian prices.

Mature green tomatoes generally have the lowest FOB price of all those shown.²² Vine ripe tomatoes usually sell at a price between those of mature green and greenhouse tomatoes, but in the summer of 2003, vine ripers were selling at a higher price than greenhouse tomatoes. Weather problems reduced the summer supply of vine ripe tomatoes in California, Baja California, and the east coast, all contributing to above-average vine ripe prices. This prompted some Baja greenhouse growers to remove the calyxes from their tomatoes and market them as field grown, vine ripe tomatoes.

Local wholesale market prices may not follow national FOB prices closely, but they do show prices for the range of products available in the market. In

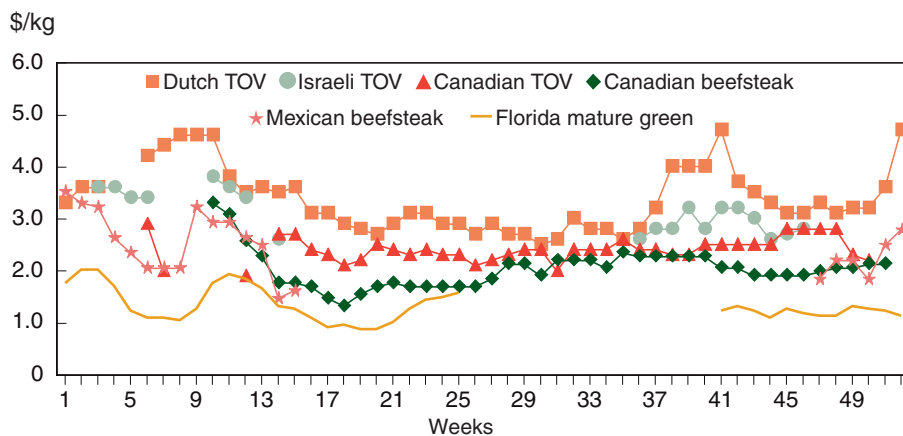
²² Roma tomatoes, not shown, typically receive the lowest price of all tomato types.

the Boston wholesale market in 2003, Canadian TOV prices averaged 27 percent higher than Canadian beefsteak prices (fig. 14). Dutch greenhouse tomatoes are reputed to be of very good quality and are sold at a price premium over North American greenhouse tomatoes.

Figure 15 shows FOB prices in 2004 for major tomato types. As the greenhouse industry has grown from a niche to a commodity market, the interaction between greenhouse and field prices has become more marked. This is particularly true in 2004, which had very unusual pricing patterns. Because greenhouse production is still relatively small, compared with field tomato production, and is thought to face a more elastic demand, greenhouse tomato supplies should have much less effect on prices for field tomatoes than do field tomatoes on greenhouse. In fall 2004, mature green tomatoes were in short supply due to hurricanes in Florida and poor weather conditions in other growing regions. Buyers substituted vine ripe and greenhouse tomatoes for mature green tomatoes where possible. High mature green FOB prices pulled up beefsteak greenhouse prices from the very low summer 2004 levels. Beefsteak prices also followed mature green prices down in December. According to the industry, TOVs, which are not as obvious a substitute for large round tomatoes, also increased in price but not to the same degree as beefsteak tomatoes. Earlier in summer 2004, a record high supply of greenhouse tomatoes caused greenhouse prices to decline, reportedly making them even more attractive to retail buyers and placing a damper on demand for fresh field tomatoes. With greater supply has come an increased willingness on the part of consumers, retailers, and foodservice users to experiment with tomato types.

Figure 14

Weekly fresh tomato prices in the Boston wholesale market, by type, January-December 2003¹

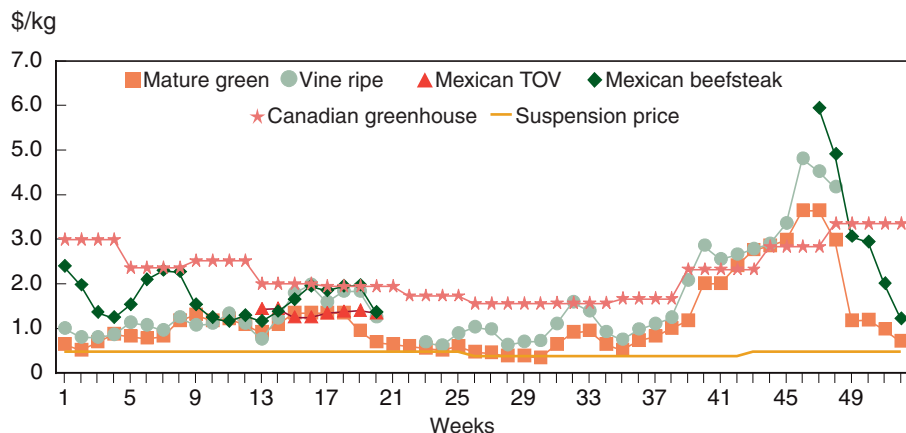


¹Florida mature green tomato wholesale prices are for 25-pound boxes of 5x6 size, with a grade of 85 percent U.S. 1 or better. Mexican and Canadian beefsteak wholesale prices are for a one-layer box of 15 pounds of size 22 tomatoes (if Mexican 22's were not available, the closest available size was used). Dutch, Israeli, and Canadian TOV are all for 11-pound boxes of large (or medium if no large was available) tomatoes.

Source: U.S. Department of Agriculture, Agricultural Marketing Service, Market News Service.

Figure 15

Weekly FOB prices for selected greenhouse and field tomatoes, January-December 2004¹



¹California mature green tomato FOB prices are for 25-pound boxes of extra large size, with a grade of 85 percent U.S. 1 or better. Florida mature green tomato FOB prices are for 25-pound boxes of 5x6 size, with a grade of 85 percent U.S. 1 or better. California and Mexican vine ripe FOB tomato prices are for two-layer flats of 19 pounds of 4X5 size. Mexican beefsteak FOB prices are for tomatoes in Nogales, Arizona, in a one-layer box of 15 pounds of size 25 tomatoes. Mexican FOB prices in Nogales for 15-pound boxes of large (or medium if no large was available) TOVs. Canadian greenhouse prices are a monthly unit value for imports of all greenhouse tomatoes, not a specific type or size. The suspension price is the minimum price program administered by the U.S. Department of Commerce; Mexican tomatoes cannot enter the United States at a price lower than the suspension price (Calvin and Barrios, 1998).

Sources: U.S. Department of Commerce; U.S. Department of Agriculture, Agricultural Marketing Service, Market News Service.

Consumption Analysis for Fresh Tomatoes

Annual U.S. per capita consumption of fresh tomatoes was an estimated 8.8 kg in 2003, a gain of 30 percent since 1985 (see table 9). Data used to calculate per capita consumption are not true consumption data from consumer surveys but rather disappearance data (production for the fresh market plus imports, minus exports equals disappearance—a proxy for consumption).²³ In 2003, U.S. per capita greenhouse tomato consumption was an estimated 17.2 percent of total fresh market tomato consumption—up from 10.6 percent in 1998. If we assume that the foodservice industry uses around half of all tomatoes and they are all field tomatoes, per capita greenhouse tomato consumption at retail would be over 30 percent.

More detail on trends in retail consumption of fresh tomatoes from 1999-2003 is provided by syndicated scanner data that measure actual weekly sales of products in selected retail stores across the United States in terms of quantity and value. Scanner data are difficult to use and should be considered only an estimation of actual retail consumption trends.²⁴ Retail trends in fresh tomato sales vary significantly when comparing the quantity (physical volume) sold versus dollar value. While the greenhouse share of quantity sold is increasing, the share of value sold is declining.

²³ The estimates presented here differ from ERS’s per capita numbers, which only include U.S. production for tomato types with production reported by USDA’s National Agricultural Statistics Service (NASS) (ERS, July 2004). The estimates by Cook and Calvin include U.S. greenhouse tomato production but still exclude domestic production of cherry and grape tomatoes, also unreported by NASS. Hence, these figures still somewhat underestimate total per capita consumption of fresh tomatoes.

²⁴ A few firms assemble scanner data from supermarkets and then sell the data to analysts. However, as large chain stores move in and out of the sample, some changes may be due more to the new sample configuration than to actual trends in sales. Some product look-up (PLU) or universal product codes are used in every store but some codes are specific to individual stores. We used a subset of codes that were consistent across each year. We excluded the rest of the data from the analysis presented here. The excluded share ranged from 9 to 5 percent of the total quantity sold. This category included some tomatoes that were difficult to pin down as either field or greenhouse, items with obscure codes, and items that were not consistent across years.

Quantity Trends

Total tomato quantity sold increased 6 percent between 1999 and 2003, while the field category (including round, roma, cherry and grape tomatoes) quantity sold declined 2 percent and greenhouse quantity sold increased 24 percent (fig. 16). According to scanner data, greenhouse tomatoes made up 37 percent of the weekly quantity of tomatoes sold in the average U.S. supermarket in 2003, fairly consistent with the earlier estimate of 30 percent based on disappearance data. While this is impressive considering that greenhouse tomatoes represented a negligible share of retail fresh tomato sales in the early 1990s, the greenhouse share was already 31 percent in 1999, indicating a gradual maturing of the category.

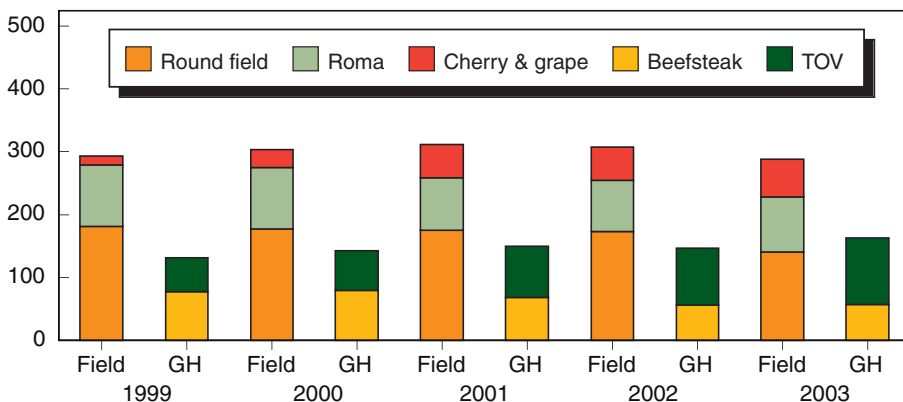
Since 1999, the more striking change has been the shifting product mix within the greenhouse tomato category, more so than growth in the quantity sold. In 1999, beefsteaks and TOVs accounted for 18- and 13-percent shares, respectively, of the average retail quantity sold of fresh tomatoes. In 2003, beefsteak tomatoes had a 13-percent share of the average quantity sold of all fresh tomatoes in retail stores. In the same year, the TOV share increased to 24 percent, replacing beefsteak as the greenhouse tomato of choice. The rapid growth in TOV quantity sold over this period appears to have come at the expense of beefsteak tomatoes rather than stimulating a major gain in the greenhouse tomato category.

Even though absolute volume had declined for the combined field tomato category, it still represented the majority of fresh tomatoes sold at retail in 2003. Round (mature green and vine ripe) and roma field tomatoes contributed 50 percent of the quantity sold in 2003—31 percent of all tomato volume was round field and 19 percent was roma tomatoes. However, the downward trend for these traditional field tomato leaders is readily apparent. The combined round and roma share of total retail fresh tomato quantity sold was 66 percent in 1999, 43 and 23 percent, respectively, for round and roma tomatoes. However, field tomato growers intro-

Figure 16

Average weekly quantity of fresh tomatoes sold per retail store¹

Kilograms



GH = Greenhouse.

¹Only major product codes are included.

Sources: California Tomato Commission and The Perishables Group.

duced new products that slowed the decline in the overall field share. In 2003, cherry and grape tomatoes, which are primarily field grown, accounted for 13 percent of the total retail quantity of tomatoes sold, up 302 percent in physical volume since 1999. Clearly, dynamism in the fresh tomato category has not been limited to greenhouse tomatoes.

The declining round field tomato category, like the greenhouse category, has experienced major shifts in the composition of sales. Breaking round field tomatoes into mature green and vine ripe tomatoes shows a dramatic change in share within the round tomato subcategory. In 1999, mature green tomatoes made up approximately 78 percent of the retail quantity sold of round tomatoes, compared with 39 percent in 2003, with the quantity sold of vine ripe tomatoes benefiting.²⁵

With the loss in retail market share, the Florida and California mature green industries are increasingly dependent on the foodservice sector, particularly the fast food industry, which prefers a firm slicing tomato—characteristics found in the mature green tomato. Greenhouse tomatoes, with their higher water content and generally higher prices, are not attractive to the fast food industry. Consumption of food, including tomatoes, in foodservice channels has been on the rise since 1960. The away-from-home share of food expenditures was 47 percent in 2003, up from 24 percent in 1960 (USDA, ERS, Food CPI Briefing Room, table 1). Furthermore, the fast food industry represented 38 percent of the sales of meals and snacks consumed away from home in 2003 (USDA, ERS, Food CPI Briefing Room, table 17).

Although there has been a slowing in the growth of food eaten away-from-home, firms are interested in offering more health-conscious menu items, and tomatoes are being added to more menus. The composition of fast food meals is changing in favor of more produce and more high-value produce. McDonald's is among the top five foodservice buyers of grape tomatoes for use on some of its new salad offerings (*The New York Times*, 2005). While grape tomatoes are high priced, they hold up well in salads since they are not sliced. If greenhouse tomato growers were to develop a less juicy variety, such tomatoes might become more attractive to foodservice buyers, with the potential to be positioned as a premium product in some offerings. Still, the higher greenhouse price should work against any large-scale conversion. In the meantime, lack of demand from the foodservice sector, except for the very small upscale restaurant channel, will be a weakness of the greenhouse industry and the primary strength of fresh field tomatoes.

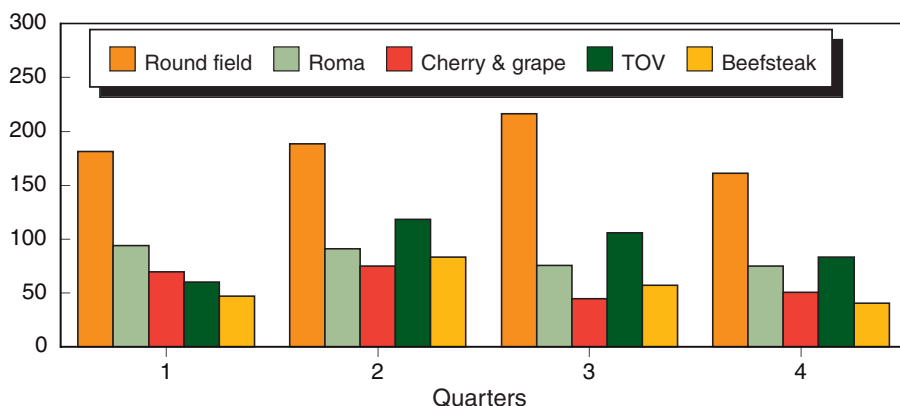
Sorting the retail scanner data by quarter and region adds depth to the picture of greenhouse tomato consumption. In 2002, quantity sold for both TOV and beefsteak greenhouse tomatoes peaked in the second quarter (fig. 17). While these trends follow well-known production patterns, consumer data allow quantification of the difference in supply between different seasons. Beefsteak tomatoes were at their lowest level in the fourth quarter, just 48 percent of the second quarter level for quantity sold. TOV sales were lowest during the first quarter, with volume only 51 percent of second quarter volume. During the winter, the total greenhouse tomato supply is limited mainly to production in the western and southwestern United States and Mexico, and as noted earlier, Mexico has a relatively low volume of TOV production. The first quarter of the year has the lowest physical sales

²⁵ It is difficult to separate out mature green and vine ripe tomatoes with scanner data. Repackers and retailers do not always distinguish between the two, which may be mixed together. This analysis relies on just three PLU codes that the industry thinks are the most representative of mature green and vine ripe tomatoes (3151, 4064, 4063).

Figure 17

Average weekly quantity of fresh tomatoes sold in retail stores, 2002¹

Kilograms



¹Only major product codes are included.

Sources: California Tomato Commission and The Perishables Group.

volume and highest prices for all greenhouse tomatoes. The field tomato (combining round, roma, and cherry/grape tomatoes) share of sales also peaks in the first quarter, with 76 percent of quantity of tomatoes sold in that quarter. The prices in the first quarter were 38 percent higher than the second quarter for TOV and 32 percent higher for beefsteak, reflecting the lower first quarter supply.

National analysis hides many regional variations in sales patterns. For example, in 2002, the beefsteak tomato share of quantity sold in different regions ranged from 3 percent to 25 percent. For TOV, shares ranged from 10 percent to 23 percent. Differences in regional consumption habits and the proximity of suppliers and the types of tomatoes they offer both play an important role in the seasonal and geographic differences.

Value Trends

While the quantity of all tomatoes increased 6 percent from 1999 to 2003 in the scanner data sample, the value of tomatoes sold increased 47 percent. Average prices increased for all tomato types except TOVs over this period (table 11).²⁶ When round, roma, and cherry/grape tomatoes are combined into a broad field grown tomato category, the field tomato share of retail tomato dollar sales actually increased from 58 percent in 1999 to 61 percent in 2003. The increase is largely due to the growth in the value of the cherry and grape category which increased 429 percent (fig. 18). While the greenhouse tomato value increased 44 percent, its share declined from 42 to 39 percent, because overall greenhouse growth in value was lower than for field tomatoes. This provides further indication that the greenhouse tomato category is maturing, and highlights the need for continuing product innovation to maintain consumer excitement and retail support. The changing product mix explains part of the increase in the total value of tomatoes sold between 1999 and 2003, with consumers showing a preference for higher value, specialty tomatoes. In 2003, the highest priced tomatoes were cherry and

²⁶ Growers frequently complain that pricing trends at the retail level do not follow FOB pricing trends. In this case, declining retail TOV prices are consistent with industry reports of declining FOB trends. However, beefsteak retail prices rose despite limited evidence suggesting no increase in FOB prices in the 2000-2003 period.

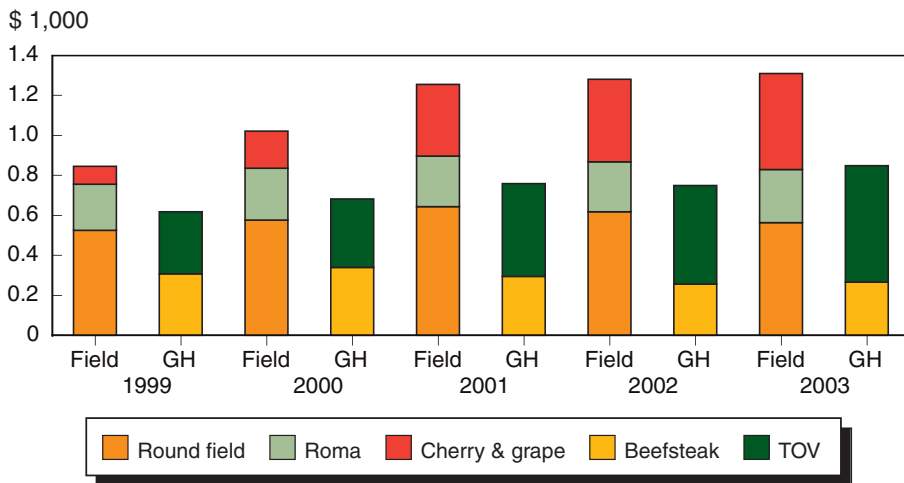
Table 11—U.S. average retail fresh tomato prices, by type

Type	1999	2000	2001	2002	2003
<i>Dollars per kilogram</i>					
Round field	2.90	3.27	3.68	3.58	4.01
Roma	2.35	2.61	3.05	3.04	3.03
Cherry and grape	6.12	6.54	6.66	7.40	6.90
Beefsteak	3.99	4.30	4.35	4.59	4.73
TOV	5.70	5.42	5.72	5.43	5.47

Sources: California Tomato Commission and The Perishables Group.

Figure 18

Average weekly fresh tomato sales value per retail store¹



GH = Greenhouse.

¹ Only major codes are included.

Sources: California Tomato Commission and The Perishables Group.

grape tomatoes, followed by TOV and beefsteak greenhouse tomatoes. Round and roma field tomatoes had the lowest prices.

Additional data from the Perishables Group put recent changes in the tomato category in perspective within the overall fresh produce department; from 2000/01 to 2002/03, tomatoes moved from third place to first in average U.S. produce departments in terms of sales. Industry analysts speculate that when greenhouse tomatoes were successfully introduced at substantially higher prices than field grown tomatoes, retailers saw that consumers were willing to pay higher prices than previously thought for tomatoes. This insight allegedly caused many to raise prices for field tomatoes, narrowing the gap between greenhouse and field tomato average prices. Many consumers appear to have felt that greenhouse and specialty tomatoes, such as grape tomatoes, represented a better value (price/quality relationship), and traded up in their tomato buying choices. In 1999, the average per kg retail price of a mature green field tomato was equivalent to 66 percent of the average price of a beefsteak tomato and 46 percent of the price of a TOV. By 2003, the price of a mature green field tomato represented 75 percent of the beefsteak tomato price, and 65 percent of the TOV price.

Impact of Greenhouse Tomatoes on the Fresh Field Tomato Industry

U.S. greenhouse and fresh field tomato production have both continued to grow. Growers of mature green tomatoes have faced the most change with the decline in retail demand for their product; however, growth in foodservice demand has compensated for lost retail sales. Greenhouse tomato production is the latest in a string of developments that have put market pressure on the mature green tomato industry, the traditional backbone of the U.S. fresh tomato industry. The smaller vine ripe industry also faces increased competition from greenhouse tomatoes. The vine ripe is now the preferred round field tomato in retail channels, and its retail sales have been increasing. However, unlike mature green tomatoes, vine ripers have limited foodservice demand.

U.S. Field Tomato Industry

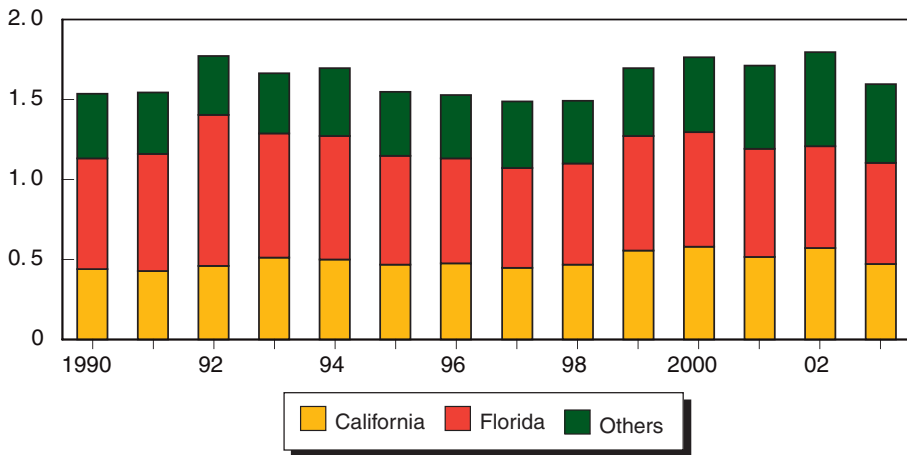
Florida and California are the primary domestic sources of fresh field tomatoes in the United States, accounting for 40 and 29 percent, respectively, of the U.S. field tomato production in 2003 (fig. 19).²⁷ Thirty-one other States produce fresh tomatoes commercially, making fresh market field tomatoes one of the more geographically diversified horticultural crops grown in the United States. Total U.S. production has fluctuated since 1990, and the average since 2000 is up 8 percent over the average in the 1990s. Florida's field tomato production fell while that of California and other States is up. Clearly, strong seasonal demand for locally or regionally produced fresh field tomatoes during the 1990s benefited numerous States. While total production increased, U.S. fresh field tomato area planted declined with the average since 2000 down 2 percent from the average in the 1990s (fig. 20). Yields have increased in all regions, particularly in the other States.

²⁷ In 2003, weather problems hampered fresh field production in California, as well as summer production in regions east of the Mississippi River. In 2002, California's share of U.S. fresh field tomato production was 32 percent, Florida's share was 35 percent, other States contributed 33 percent.

Figure 19

U.S. fresh field tomato production¹

Million metric tons



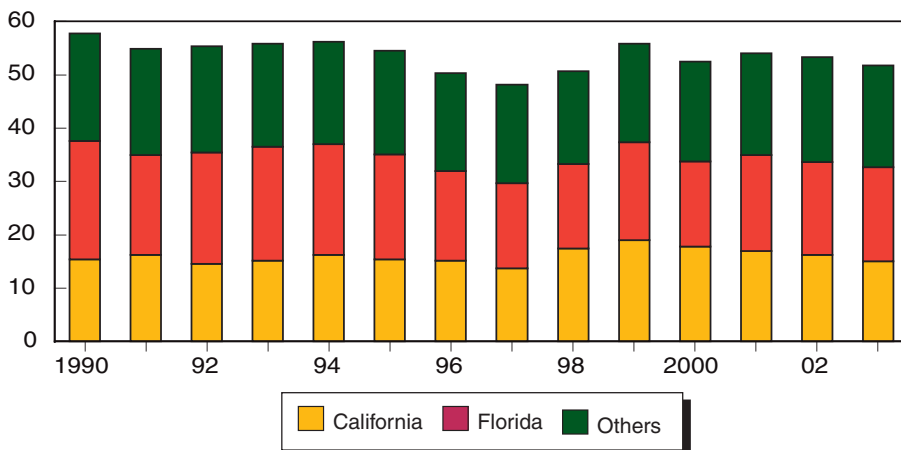
¹Excludes cherry and grape tomatoes.

Source: U.S. Department of Agriculture, National Agricultural Statistics Service.

Figure 20

U.S. field tomato planted area¹

1,000 hectares



¹Excludes cherry and grape tomatoes.

Source: U.S. Department of Agriculture, National Agricultural Statistics Service.

Traditionally, Florida and the California Central Valley have produced mature green tomatoes. U.S. vine ripe production is concentrated in southern California along the coast (San Diego to the Oxnard area), where temperatures are moderate, in contrast to the California Central Valley. Four firms produce the bulk of the California vine ripe crop. Climate limits the ability of most growers of mature green tomatoes to grow vine ripe tomatoes in their current locations.

Vine ripe tomatoes were not always strong competition for mature green tomatoes in the retail sector. Before the early 1990s, vine ripe tomatoes had poor shelf-life characteristics, compared with mature green tomatoes. In the late 1980s, a California firm and a few Mexican firms in Sinaloa began growing extended shelf life (ESL) vine ripe tomatoes.²⁸ These new vine ripe tomatoes had better color than mature green tomatoes and held up just as well, a major improvement over the softer, older varieties. ESL tomatoes are typically harvested at a later maturity level, which contributes to an attractive red color. The emergence of the ESL tomato was critical to improving the competitiveness of the fresh field export tomato industry in Mexico (Sparling and Cook, 2000). By 1994, most Mexican growers had adopted the new ESL varieties to improve product quality and grower profitability. Most of the Baja California and southern California vine ripe growers adopted ESL tomato varieties shortly thereafter. This improved vine ripe tomato greatly intensified competition for mature green growers, offering a year-round alternative to retailers.

In addition, the market strength of mature green tomatoes has been challenged by other field varieties that are gaining in consumer popularity. Mature green growers have been able to capture some of that growth by producing roma, grape, cherry, and other types of tomatoes.

Expansion of the greenhouse tomato industry has also pressured vine ripe tomato growers. Vine ripe and greenhouse beefsteak tomatoes have similar

²⁸ ESLs are also known as long shelf-life varieties.

characteristics—both are large and red and sold in retail channels. In summer 2003, due to vine ripe tomato shortages, prices of vine ripe tomatoes occasionally rose above greenhouse beefsteak prices, leading some Baja California growers to sell their greenhouse beefsteak tomatoes in the United States as vine ripe tomatoes. Fears over more competition spurred the State to establish a legal definition of greenhouse tomatoes produced or marketed there.

In summary, during the early to mid 1990s, the U.S. mature green industry first felt the effects of greater retail competition from ESL vine ripe tomatoes. Then, in the late 1990s, both mature green and vine ripe tomatoes were confronted with the expanding supply of greenhouse tomatoes.

Response of U.S. Field Tomato Growers to Increased Competition

Both Florida and California growers have tried to adapt to changing consumer preferences, but they face several agronomic challenges. The tomato varieties developed for the Florida climate are better harvested and handled as mature greens rather than vine ripens. In the 2002-03 season, 73 percent of Florida field tomato sales (by weight) were mature green tomatoes, down from 86 percent in 1997 (table 12). Eleven percent of mature green tomato production was harvested at a vine ripe maturity stage. The very popular grape tomato was first grown in Florida although it is now grown elsewhere, too.

None of the large U.S. tomato greenhouses operate in Florida, which comprises only small greenhouses (less than 3 ha). The conventional wisdom is that the humid, warm climate precludes any large-scale greenhouse production in Florida. Unless new vine ripe varieties for the Florida climate are developed, the industry will probably remain focused on mature greens.

In recent years, the product mix of the California fresh market tomato industry has been changing in favor of vine ripe, roma, and small but growing volumes of specialty tomatoes, such as heirloom, grape, cherry, and various colored tomatoes (orange, yellow, etc.). The California Tomato Commission provides statistics on mature green, vine ripe, and roma tomato shipment volumes. From 1997 to 2002, the share of mature green tomatoes in California trended downward from 77 percent to 69 percent. The upswing in mature green tomato share in 2003 was due to poor weather conditions that had a particularly adverse effect on vine ripe tomatoes.

In 2002, 22 percent of tomato shipments tracked by the California Tomato Commission were vine ripens, up from 16 percent in 1997. However, much of the vine ripe production is on leased land in coastal areas with high rents, water costs, and urbanization pressures. While California has succeeded in shifting some area to vine ripe tomato production, its ability to shift further is limited. Unless tomato varieties are developed that allow for profitable vine ripe tomato production for a shorter season in a warmer climate, the California Central Valley is likely to remain a producer of mature green tomatoes.²⁹ As a result, the California industry is not currently well suited to respond to the growing consumer demand for vine ripe tomatoes. However,

²⁹ Current production of vine ripe tomatoes requires staking, an expensive practice only warranted in long season production areas. Production over a longer season increases yields and improves the return on investment from stakes.

Table 12—Diversification of tomatoes grown in traditional field tomato areas

Type of tomato by region	1997	1998	1999	2000	2001	2002	2003
<i>Percent of quantity produced</i>							
Florida ^{1, 2, 3}							
Mature green	86	84	76	73	73	70	73
Vine ripe	14	13	14	14	13	13	11
Roma	n.a.	n.a.	8	9	8	10	7
Cherry	n.a.	3	2	4	2	2	2
Grape	n.a.	n.a.	n.a.	n.a.	4	5	7
Total (metric tons)	542,940	649,267	750,425	787,967	732,978	770,356	690,474
California ^{2, 4}							
Mature green	77	71	70	69	66	69	72
Vine ripe	16	21	20	21	23	22	16
Roma	7	8	10	10	11	9	11
Cherry	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1
Total (metric tons)	464,718	462,056	462,056	436,983	437,100	462,006	421,028
Mexico ^{2, 5}							
Vine ripe	62	57	49	47	46	43	41
Roma	32	36	42	42	43	44	44
Cherry	6	7	8	6	6	5	4
Grape	n.a.	n.a.	n.a.	n.a.	n.a.	2	3
Greenhouse	n.a.	n.a.	1	5	5	6	8
Total (metric tons)	660,609	734,053	615,145	589,882	679,219	723,425	784,988

n.a. = Not applicable.

¹ Florida data for 1997 only are from the Florida Tomato Commission which tracks round tomatoes. These data do not include a small portion of production in northwestern Florida. Data for all other years are from the USDA, Agricultural Marketing Service, *Tomato Fax Report*, which includes all production and major types of tomatoes. Vine ripe tomatoes in Florida are grown as mature green tomatoes but harvested at the same stage of maturity as vine ripe tomatoes.

² New tomato categories of tomatoes are added in each region as new production becomes important. In the United States, the mature green tomato category may include other varieties of tomatoes before they received separate breakouts. For Mexico, vine ripe tomatoes are the residual category.

³ The Florida season runs October 1-September 30. Data for 2003, for example, refers to the 2002/03 season.

⁴ The California Tomato Commission reports data for mature green, vine ripe, and roma tomatoes. Cherry tomato data are from the USDA, Agricultural Marketing Service *Tomato Fax Report*.

⁵ These figures use exports to the United States as a measure of production trends in the Mexican export-oriented industry. Assuming that all Mexican round tomatoes are vine ripe although a small portion is mature green.

Sources: USDA, Agricultural Marketing Service, *Tomato Fax Report*; Florida Tomato Commission; California Tomato Commission; and U.S. Department of Commerce.

it must be remembered that new varieties transformed the Mexican industry in the early 1990s, so it is not impossible to conceive of similar developments that could benefit California and Florida.

California roma production has been increasing but Baja California tomato growers serve much of the U.S. summer demand for romas. The AMS *Tomato Fax Report* reports cherry tomato shipments, which accounted for less than 1 percent of total California fresh tomato shipments in 2003. No statistics on California grape tomato production or shipments are available.

There are no annual statistics on greenhouse production in California. Only one of the four large greenhouses in the United States is located in (coastal) California. This greenhouse has successfully adapted technology to the environment, but it is surrounded by other agricultural operations that make it vulnerable to pest problems not faced by more isolated greenhouses. California has numerous small greenhouse operations, but they primarily serve

local markets. The Central Valley is not an ideal location for greenhouses due to hot summer weather, which limits the shipping season and the potential for earning a return on investment. Furthermore, greenhouse operations on the California coast face high land, water, and labor costs, as well as increasing environmental regulations and constraints. On the other hand, precisely because of these constraints, some California coastal vine ripe growers might someday view greenhouses (which use land and water more efficiently) as a more viable alternative than field production—market prices warranting.

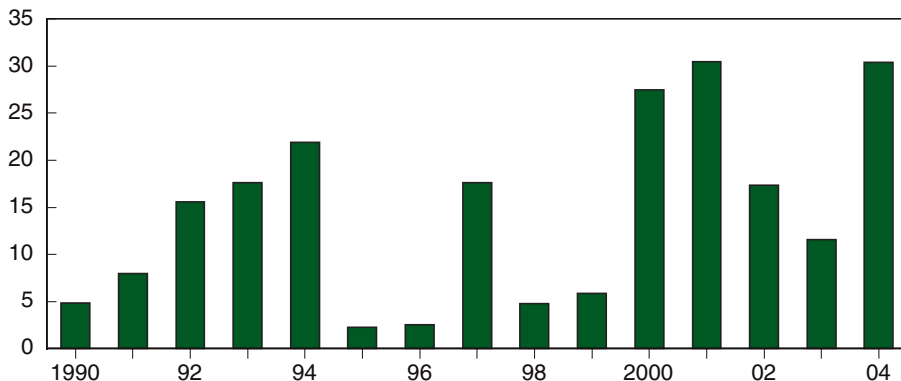
In general, both Florida and most California field production areas seem unlikely spots for future greenhouse development. In addition, the high costs of greenhouse production pose a barrier to field producers (see box, “Economic Barriers to Entry: Comparison of Greenhouse vs. Field-Grown Fresh Tomato Unit Costs”). The financial difficulty of large U.S. greenhouse firms in the late 1990s and the well-publicized financial restructuring of some leading U.S. greenhouse tomato firms, (in conjunction with a complicated marketing situation during the dumping disputes), seems to have limited the interest of California and Florida tomato growers in venturing into greenhouse production. At least one U.S. field tomato shipper is expanding into greenhouse tomatoes by marketing for other growers (*The Packer*, 2003). This provides a broader product line with less investment and risk. But as the greenhouse industry has grown, there does seem to be increasing interest on the part of some field growers to at least investigate the possibility of greenhouse production in other locations.

The growth of the Mexican greenhouse tomato industry may be having an impact on U.S. field tomato exports to Mexico. Traditionally, U.S. field tomato exports to Mexico were small and sporadic, with demand only in periods of short supply in Mexico (fig. 21). However, Mexico is still the second largest export market for U.S. tomatoes, and California growers, the primary U.S. exporters to Mexico, have viewed Mexico as an important market outlet. Now, California growers are concerned that summer greenhouse production in Mexico may be able to fill part of that demand. In early summer 2004, Mexican greenhouse quality problems and lower U.S. summer prices for greenhouse tomatoes kept a significant amount of green-

Figure 21

U.S. fresh tomato exports to Mexico

1,000 metric tons



Source: U.S. Department of Commerce.

Economic Barriers to Entry: Comparison of Greenhouse vs. Field-Grown Fresh Tomato Unit Costs

Greenhouse tomato production is more expensive than field production, due to dramatically higher investment costs, as well as higher variable, or operating, costs. For example, a high technology greenhouse may cost from \$600,000 to over \$1 million in construction (plus site purchase and improvement) costs per hectare just to begin operation, excluding variable growing costs. U.S. industry experts estimate that an initial investment of \$1.25 million per hectare is required when also including the inputs for the hydroponics growing system, such as the artificial growing medium.

These greenhouse costs compare with average pre-harvest costs (including overhead, depreciation and capital costs) of \$3,100 per hectare in the California Central Valley and from \$12,500 to \$16,000 per hectare in Florida, depending on the region and season. Of course, substantial variation in per unit production costs can exist between growers in the same growing regions, based on individual cost and yield performance, regardless of whether production is open field or protected. Per-unit production costs can also change significantly over time as growers gain experience.

Average U.S. and Canadian greenhouse yields frequently approach 500 metric tons per hectare per season, compared with U.S. average field tomato yields of 34 metric tons per hectare in California and 36 metric tons per hectare in Florida. The most efficient and experienced greenhouse growers in the United States and Canada may reach 700 metric tons per hectare. But higher yields do not offset the higher investment and variable costs, making per unit greenhouse production costs higher than field, in all three NAFTA countries and for all technology levels. In the past, greenhouse tomatoes generally received a hefty price premium over field tomatoes that helped compensate for higher per unit costs of production. But with the rapid increase in greenhouse production, prices have declined and the differential between field and greenhouse tomato prices has diminished.

house tomato production, initially intended for export, in Mexico, potentially competing with California fresh field tomato exports. However, despite these worries, U.S. fresh tomato exports to Mexico in 2004 were just short of the 2001 high due to a production shortfall in Baja California. The evolution of the Mexican fresh tomato market, both in terms of demand for imports and summer export availability of greenhouse tomatoes, will continue to affect the California industry.

Growing Pains: Conflict and Cooperation

The rapid growth of the greenhouse tomato industry in North America has put downward pressure on grower prices, which has been particularly hard for an industry with large investment costs. Regulatory options vary by country, but growers have made use of the available legal instruments, in particular, trade remedy legislation, to try to counter competition.

The first salvo in the effort to restrict competition was an antidumping case brought by the U.S. greenhouse tomato industry against the Canadian greenhouse tomato industry in 2001 (see appendix 5 for more detail). Canadian growers reciprocated in 2002 with a case against all U.S. fresh tomatoes growers, not just greenhouse growers. The U.S. case was rejected. The U.S. DOC found dumping but the ITC did not find damage (ITC, 2002). The critical issue in the failure to find damage was that the ITC decided that greenhouse and field tomatoes were “like” products. Therefore, a finding of damage was required for all U.S. tomato growers. The Canadian case was ultimately withdrawn although the Canadian government continued the case and reached a negative final determination. The United States only gained a temporary pause in the rapid growth of Canadian imports during part of 2001 and 2002 when some Canadian firms temporarily faced large dumping margins. In 2003, U.S. imports of Canadian greenhouse tomatoes resumed their earlier trend and increased 30 percent.

As the North American greenhouse tomato industry becomes more integrated, with some growers and marketers sourcing from all three countries to provide year-round supply, incentives for international trade disputes should gradually lessen. However, disputes may still arise and the emergence of the greenhouse tomato industry as a source of competition to the field industry raises the probability of disputes.

In 2002, after the antidumping cases were resolved, fresh tomato producers in Canada, the United States, and Mexico established the North American Tomato Trade Work Group (NATTWG) to address trade issues among the three trading partners. Initially, NATTWG was an advisory committee to the Consultative Committee on Agriculture under the Canada-U.S. Free Trade Agreement, which excluded Mexico as an official member. In 2003, it was reorganized as an advisory committee to the NAFTA Committee on Agriculture, giving official membership to all three countries. NATTWG’s mandate is to seek resolution to those issues that may restrict trade between the three countries; domestic sales of any of the members are beyond NATTWG’s purview. However, since the North American tomato industry represents a broad range of producers, there can sometimes be conflicting agendas even within the same country on matters of international trade, complicating interaction within the forum. Nevertheless, the hope is that an organized forum to explore issues of potential conflict and cooperation may diffuse conflict and build more constructive relationships.

Collaboration within the NATTWG forum has enabled the industry to benefit from joint initiatives in several areas, such as harmonization of different types of standards among the NAFTA countries. A NATTWG effort succeeded in harmonizing Canadian and U.S. field tomato arrival standards, with Canada adopting the U.S. standard, benefiting U.S. exporters shipping to Canada. Pesticide residue tolerances between the United States and Mexico have been harmonized, and Canadian standards are in the process of being harmonized. Mexican members of NATTWG recently supported the U.S. effort to encourage Mexico to adopt the U.S. tolerance on stems and leaves in fresh tomato cartons. If this policy is adopted it will benefit U.S. exporters to Mexico by eliminating this nontariff trade barrier. A joint effort to update the decades-old USDA grading standards for greenhouse tomatoes is likely to succeed.

At NATTWG's request, AMS agreed to publish weekly greenhouse shipments, provided it could secure full participation of the large U.S. greenhouse firms, as well as Agriculture Canada. In October 2004, AMS began publishing weekly U.S. and Canadian shipment data in its *Tomato Fax Report*. Mexican data were already available for tomatoes entering via Nogales during the winter season. Reported shipments cover the largest five greenhouses in the United States, but AMS hopes to eventually expand participation to include other firms. Shipment data do not distinguish between types of greenhouse tomatoes. Providing shipment data is relatively inexpensive. Canada collects its own data and sends it to AMS weekly. U.S. firms also send data on a weekly basis. With such a concentrated industry, obtaining even more sensitive price data will likely remain a challenge. The high level of forward contracting reported in the greenhouse tomato industry will also work against price reporting efforts as AMS only reports daily FOB prices, not contract prices.

Another policy tool available to U.S. growers is the ability to define "greenhouse tomato." In the early days of the industry, most production was in Canada and the United States in fairly homogenous greenhouses. But with the entrance of Mexican growers with a wide variety of protected culture systems, including lower technology and lower investment cost systems, high-technology and high-investment North American greenhouse producers have searched for a way to define a greenhouse product as the kind they themselves produce. To date, there is no North American consensus on the definition.

The State of California and the Florida fresh tomato Federal marketing order both have definitions, although they are quite different. In September 2004, the California Department of Food and Agriculture adopted a rather limiting definition. To be labeled as greenhouse, any tomatoes produced, or sold, in that State must be "produced in a fixed steel structure with climate control, irrigation, and grown in a medium that substitutes for soil." This effectively precludes much of the protected culture tomatoes grown in the Baja California peninsula (which enters the U.S. at the California border) from being labeled and marketed as greenhouse. In contrast, Florida's tomato marketing order exempts greenhouse tomatoes, among others, from its regulations and defines greenhouse as simply "tomatoes grown indoors." Hence, Florida's definition is the most all-encompassing, and since it is used merely to exclude certain tomatoes from the provisions of the Florida

Federal fresh tomato marketing order, it has no direct regulatory implications for the greenhouse tomato industry.³⁰

The idea of defining greenhouses to exclude some growers can be viewed from two perspectives, in part depending on whether consumers perceive a distinction between the two types of tomatoes based on the production system. If the consumer only cares about final quality and if the quality is the same in a high-technology and low-technology operation, a restrictive definition could be viewed as purely protectionist with the higher cost producer trying to restrict market opportunities for the lower cost producer. Alternatively, if consumers perceive some quality difference in the two types of tomatoes and prefer tomatoes grown in a high-technology greenhouse, there could be a benefit to defining greenhouse more restrictively. Consumers would be misled if producers with lower technology operations market a lower quality tomato but consumers think they are getting a higher quality tomato produced in a higher technology operation. Potential consumer dissatisfaction could hurt the reputation of the high-technology industry, undermining its investment and ability to offer a premium product. If a high-technology grower cannot get a higher price than a lower technology grower because consumers cannot identify its product, the grower may cease to offer that product. As more tomatoes grown with a variety of protected culture options become available from Mexico, it remains to be seen whether retailers and consumers will differentiate hydroponically grown tomatoes relative to lower technology greenhouse or shade house options, and be willing to pay a premium.

³⁰ Florida tomato growers, however, did investigate using their marketing order requirements to require greenhouse tomato producers to meet the Florida industry standards for field tomatoes. On August 22, 2002, Florida petitioned the USDA Secretary of Agriculture to change its marketing order to eliminate the exemption for greenhouse and hydroponic tomatoes (USDA, Agricultural Marketing Service, 2002). This proposal would impose grade and size regulations on greenhouse tomato growers in their State although Florida grows very few greenhouse tomatoes. The proposed Florida marketing order would impose the same standards applied to their growers on any imported greenhouse tomatoes during the period when the order is in operation (see Calvin and Barrios, 1998, for discussion of the Florida tomato marketing order). While foreign greenhouse producers would have no difficulty meeting grade requirements, the size requirements could serve as an import barrier for TOV, which are typically smaller than regular field tomatoes. Nothing has come of this proposal; USDA asked for more justification and the Florida Tomato Committee has not yet responded.

Conclusions

As evidenced by the emerging greenhouse tomato market, the North American fresh tomato industry is no longer just a field grown tomato industry. In 2003, over 17 percent of total (retail and foodservice) fresh tomato consumption in the U.S. market was estimated to be greenhouse grown. Even though greenhouse tomatoes remain a minority player in the industry, they have expanded beyond niche status and are playing a more influential role in fresh tomato markets. As a larger factor, greenhouse tomatoes are increasingly influenced by supply and demand trends in the fresh field industry, and vice versa.

Seasonality remains one of the most important factors shaping the North American fresh tomato industry. The greenhouse industry has seasonal production patterns similar to the fresh field industry, despite the fact that production takes place indoors. Supply varies over time and by location, and marketers often try to extend their seasons to periods with lower production and higher prices, sometimes by producing or marketing from more than one location. Trade is critical for shippers to ensure smoother year-round supply. An increasingly integrated North American greenhouse tomato industry has developed, providing the variety of tomato products that consumers demand throughout the year. Leading greenhouse marketers are investing in brands and promotional expenditures, making it even more critical to source from other regions, where necessary, to achieve year-round supply.

Between 1998 and 2003, North American greenhouse tomato area grew 160 percent and production grew 103 percent, reflecting the emergence of the lower technology and lower yield Mexican industry. While growth in the Canadian and U.S. industries has been stabilizing, the Mexican industry continues to expand.

Despite the rapid growth in greenhouse tomatoes, the fresh field tomato industry, led by mature green tomatoes, still dominates U.S. foodservice channels, which represent around half of total fresh tomato consumption. Greater demand for mature green, roma, and grape tomatoes in foodservice channels enabled the U.S. field grown round tomato industry to expand production by 17 percent between 1990 and 2002.³¹ The main impact of greenhouse tomatoes has been felt in retail channels, where greenhouse products now account for around 37 percent of the quantity of fresh tomatoes sold, and 39 percent of the value. Retail field tomato sales increased through 2001 but now have begun to decrease, with greenhouse and grape tomatoes substituting for round field tomato sales, mature green in particular. Vine ripe tomatoes have increased market share at retail, competing effectively against mature green tomatoes and acting as a substitute for beefsteak tomatoes during periods of short greenhouse supply.

The outlook for the U.S. mature green tomato industry depends on continued strong growth in foodservice demand. If foodservice demand falters, fresh field tomato growers would need to consider other alternatives, with serious structural adjustments likely. For example, growers could diversify into the greenhouse industry, either through alliances with existing producers or through direct investment. To date, field tomato growers have

³¹ Production in 2003 was slightly higher than in 1990, but since 2003 was an abnormal year for production due to weather problems, 2002 is a more appropriate year for comparison.

not considered the greenhouse industry an attractive alternative. Greenhouse tomato production is very capital- and technology-intensive, and rapid expansion was accompanied by mixed profitability results. Currently, none of the U.S. field growers operate greenhouses in the U.S., although at least one is marketing Mexican greenhouse tomatoes. Alternatively, growers could attempt to reposition field tomatoes through new varieties, products, and packs with more commercial appeal, such as the highly successful grape and heirloom tomatoes. Round field tomato growers may also decrease their reliance on marketing intermediaries (repackers and wholesalers) and develop more direct marketing relationships with retailers, part of the trend toward supply chain management and streamlining the distribution system. Becoming more integral supply chain partners could help growers compete for retail market share.

Greenhouse production can be seen as just one more development in a trend towards better quality and more diversified tomato offerings—vine ripe, organic, cherry, grape, pear, various colors—and part of the general trend toward growth in value-added produce. However, greenhouse tomatoes have now grown to the point where they can be described as a commodity, a common development in the world of fresh produce. For specialty niche products with limited supply, it is generally easier to command consistently high prices, in part because buyers place less emphasis on aggressive price negotiations with products that are not major contributors to the bottom line. With greenhouse tomatoes now a critical component of overall tomato category profitability, price plays a more important role in making the sale. This is particularly true in the summer when both greenhouse and field tomato supply are typically abundant.

In summer 2004, expanded North American greenhouse tomato production caused greenhouse prices to plummet. Faced with an eroding FOB price premium for greenhouse relative to field tomatoes, many retailers were unwilling to stock field tomatoes. Hence, field tomato prices fell even though field supply was at relatively normal levels for that time of year. In contrast, only a short time later in fall 2004, scarce field tomato volume created a shortage in total fresh tomato supply, causing both field and greenhouse tomato prices to soar. Clearly, as greenhouse tomatoes garner a larger share of total fresh tomato volume, changes in either greenhouse or field tomato volumes can greatly impact total fresh tomato supply, and in turn, prices for both.

It may be more difficult for the highly capitalized greenhouse tomato industry to withstand long periods of low prices, compared with the less capital-intensive field tomato industry. Although the summer field tomato industry also faces gluts, shipping volumes are staggered and weather- and disease-induced periods of short supply that act as market corrections are common. As indoor producers, greenhouse growers experience much greater consistency in production volumes throughout the season. The emergence of more North American greenhouse growers producing simultaneously over an extended spring through fall season will mean continued price pressure. However, in periods of (weather- or disease-induced) short field supply, such as fall 2004, greenhouse producers are best positioned to benefit, receiving exceptionally high prices. These trends put greenhouse growers in

a more similar position to field growers than many might have thought even a short time ago—still very much weather dependent and affected by large price swings—despite the fact that their tomatoes are grown indoors.

Where Is the Industry Headed?

The North American greenhouse industry is still in a state of flux, with firms trying to identify the most profitable combination of locations, technology, and marketing alliances to meet market demand in different seasons. Unfortunately, miscalculations by firms are expensive. There has been rapid turnover in greenhouses in the United States as marketers attempted to realign their supply to improve profitability. With the greenhouse tomato industry growing so rapidly and undergoing so much structural change, it is difficult to predict what the industry will look like in the near future.

Some industry analysts believe North America will move to the northern European system, where fresh tomato consumption is almost entirely greenhouse. But in North America, there are relatively low-priced field grown tomatoes available year-round. Shifting to the European model would require a massive consumer preference for greenhouse tomatoes over field tomatoes and a willingness to pay higher prices. On the other hand, greenhouse production has grown to the point where it can no longer be considered a fad. Growers have made significant investments and it is likely that there will always be demand for greenhouse tomatoes, just as demand for all kinds of value-added fresh produce is growing. As long as TOVs are popular and only greenhouse varieties are available, greenhouse tomato demand will be strong. The most likely scenario is a fresh tomato industry providing both field and greenhouse tomatoes, with greenhouse tomatoes continuing to erode the field tomato share of retail sales, and mature greens the most affected. The growth paths of the two types of tomatoes depend on consumer preferences and relative profitability of greenhouse and open field production.

Canada

Will Canada's greenhouse tomato industry continue to expand? There has been very little expansion in Canadian tomatoes over the last few years. However, some of the recent expansion in area for other greenhouse vegetables could shift easily to tomatoes if prices warranted. The Canadian greenhouse industry's advantages include a climate that contributes to the highest summer yields in North America and powerful industry clusters supported by excellent infrastructure, technology, capital, and management. However, the future of the two lead players, Ontario and British Columbia, may not be the same due to differences in their relative competitiveness. Although Ontario has an advantage in geographic proximity to major Eastern markets, British Columbia has a yield advantage and proximity to the West coast market. British Columbia's yield advantage originates from its mild climate, whereas Ontario faces late summer production problems caused by heat and humidity. British Columbia currently has a more concentrated marketing structure than Ontario that may help in meeting the needs of large buyers. On the other hand, Ontario's marketing structure is becoming less fragmented. The relative growth rates of regional markets for greenhouse tomatoes, and landed costs into these markets will be major determinants of inter-provincial competitive-

ness. The major weakness of the Canadian industry as a whole is the lack of winter production. Producing winter tomatoes in Canada would require expensive lighting systems, a technology that is not currently profitable for most growers. For now, Canadian firms must seek alliances with U.S. or Mexican firms in warmer climates to provide winter supplies of tomatoes.

United States

The primary advantage of the U.S. greenhouse tomato industry is that it can produce year-round, which enables it to capitalize on the higher priced winter market, unlike Canada. For U.S. greenhouse tomato firms, the expansion of North American summer supply has made them even more dependent on high winter prices to achieve year-round profitability. However, just as expanded Canadian exports eroded profitability for U.S. greenhouse firms during the summer months, future Mexican expansion could have a similar impact on U.S. firms producing during the winter. Furthermore, growing summer export volumes from Mexico may contribute to further erosion in average summer FOB pricing. However, an unassailable advantage of U.S. producers is that they enjoy the largest domestic market for greenhouse tomatoes in North America and face no trade barriers in this market. A potential disadvantage is that the United States does not have as strong an input supply infrastructure as in British Columbia and Ontario, where input firms are servicing homogeneous and geographically concentrated industries. Some U.S. firms are in relatively isolated locations, with less readily available services and the need for tailored varieties. On the other hand, isolation does reduce vulnerability to pest outbreaks and pressures from urbanization.

Mexico

The Mexican greenhouse tomato industry is still identifying the best locations and technology packages. There have been some costly errors, but greater experience with site selection, technology, management, and marketing is improving performance and raising the competitive bar. New industry entrants must shorten their learning curve as North American volume increases in all seasons. Mexico has the opportunity to substantially increase competition with the United States in the winter market, in particular. Whether it will meet that challenge remains to be seen. Mexico's industry has several disadvantages. Its more limited access to capital and substantially higher capital costs puts a serious constraint on an industry that relies on very large capital outlays.

The North American greenhouse industry is anxious for Mexico to develop a more uniform product quality. Otherwise, quality problems will undermine orderly marketing and U.S. and Canadian efforts to augment their off-season supplies. If the North American fresh tomato industry continues to provide a mix of greenhouse and field in the future, Mexican producers may be in the best position to service both needs since it is the only place where large shippers grow both field and greenhouse tomatoes. Sinaloa, Mexico, is North America's largest producer of vine ripe tomatoes, and these are the preferred type of round tomato within retail channels. Decisions made by powerful Sinaloa (and to a lesser extent Baja California) shippers, producing

both field and greenhouse tomatoes, are a key factor in the evolution of the Mexican fresh tomato industry. Their rate of transition from field to greenhouse production depends on relative yields, prices, and risks in these two tomato categories.

Independent, greenhouse-only tomato producers in central Mexico must be willing and able to invest in high-technology systems. Their future competitiveness depends on their ability to optimize location choices to facilitate extending shipping seasons, increasing yields, lowering per unit costs, and improving quality. They must also produce the right product mix and participate in strong marketing arrangements, either via alliances with U.S. and Canadian firms or partnerships with forward-integrated Mexican field tomato shippers that have diversified into greenhouse, or by investing in forward-integration with Mexican greenhouse partners. However it is achieved, consolidated shipping volumes and orderly marketing will be a critical factor in the Mexican industry's success.

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Appendix 1—Protected Agriculture Technologies

Shade House Production Systems

At one end of the protected agriculture continuum is a low-technology strategy involving shade houses, or in Spanish, *malla sombra* or *casa sombra*. A shade house is a simple structure to support shade cloth, a type of screen. This provides passive control of the environment by shading the plants from excessive sunlight and wind. Shade houses are expensive relative to open field production but are the lowest cost option within protected culture. Other structures which have plastic or glass roofs must support rain, snow and wind, and therefore require stronger, and more expensive, permanent structural support. Shade houses have been widely used for some time by growers in warm climates such as those in Spain, and more recently have been adopted by some export-oriented field tomato growers in Mexico.

These structures can be used to keep plants cooler on warm days, but provide no significant protection from cold air temperatures at night. Because of the relatively limited environmental control they provide, growers can extend shipping seasons only marginally. The most important benefits are generally much higher yields compared with open field production, and the potential for improved quality. Growers with shade houses typically grow their tomatoes in the soil rather than hydroponically. Some Mexican growers market these tomatoes as a greenhouse product. Other shade house growers do not attempt to differentiate their tomatoes from field tomatoes. Some refer to their product as hothouse tomatoes, which simply implies some type of protected culture. In Europe, where there is also a mix of high technology greenhouse and shade house production, buyers differentiate tomatoes based on quality, rather than the growing system, and labeling distinctions are unimportant.

Greenhouses—a Range of Technologies

At the other extreme of protected agriculture is the high technology greenhouse strategy involving a sturdy, permanent structure, with either glass, flexible film plastic, rigid panel acrylic, or polycarbonate roof and walls. High technology greenhouses may also include interior shade screens or energy-saving insulation curtains. With more protection from the elements, growers can control their environment to a high degree. This is active environmental control compared to the passive control provided by a shade house. The most sophisticated growers actively monitor and control light, air temperature, humidity, water, nutrients, and carbon dioxide levels in the structure to maximize profitable production, generally using hydroponics for water and nutrient management. These are the most expensive protected agriculture systems.

By providing all the plant's nutrients via hydroponics and regulating the environment, yields can be very high, as much as 15 times greater than field production per year. However, since the plant is completely dependent on human care and crop management for every requirement, there is little room

for error. Large hydroponics operations will usually have backup systems, including water and temperature control, as well as emergency power generation capability, since the tomato plants could die in the event of even a short disruption of services. For example, in hydroponic production a tomato plant may be watered 20 times a day in the winter and up to 40 times in the summer. Growing in soil, on the other hand, is much more forgiving since soil has a natural storage capacity that retains moisture and nutrients.

With hydroponics it is also important to avoid build up of soil-borne pests and diseases. With a field-grown tomato, the season ends and the field may lay fallow or be rotated into another crop. High-technology protected agriculture operations typically produce tomatoes over an extended season or year-round, year after year, and soilborne pests and diseases can be a problem. Using artificial growing mediums, like rockwool, break up the pest cycle since they are sterile and wrapped in plastic. Growers using hydroponics may be able to achieve better flavor than those growing in the soil. With hydroponics, growers can change the soil chemistry within minutes as opposed to days when growing in the soil (Jensen, 2005).

Even in a high technology greenhouse where the grower actively controls the environment, the outside environment does make a difference. The appropriate technology is site specific and may take several years to develop. There are numerous site location factors that must be considered.

In some cases a low technology greenhouse (just a permanent structure and production in the soil) may be enough to meet a grower's needs, particularly if the grower is producing for a short season and soil-borne illnesses are not a serious problem in that location. A medium technology operation could extend the season by adding more environmental control or boost yields by using hydroponics.

Appendix 2—Potential Returns From Fresh Tomato Protected Agriculture in Mexico

The relative scarcity and high cost of capital is a major influence on protected culture technology choices. After all, protected culture is very capital intensive, even at the lowest technology (shade house) level. Nominal Mexican interest rates are commonly in the 20-percent range and collateral requirements are high. In general, the more temperate the climate, the greater the payback from investing in technology, as the fixed costs can be paid back over a longer, potentially year-round, shipping season. Hence, coastal field tomato growers in Sinaloa and Baja with limited growing seasons tend to use protected culture for only a portion of their total tomato area and invest in lower technology packages, whereas greenhouse producers located in temperate areas without any field production tend to invest in higher technology. But even between two coastal, limited-season areas like the States of Sinaloa and Baja California, there are differences in the potential returns from investing in technology.

A comparison of partial information on relative costs of field and protected agriculture in Sinaloa, Mexico's principal tomato production and export region, puts alternative systems into perspective.¹ Public information on yields and costs are not available, but the following estimates from growers and industry suppliers help provide a sense of the magnitude of some of the differences in yields and costs for alternative production systems. Sources indicate that **total** production (fixed and variable) and harvest costs for high technology, drip-irrigated open field round tomatoes in Sinaloa are around \$14,000 to \$18,000 per hectare. Switching some area to protected culture requires growers to have access to much more capital per hectare. Construction costs alone for shade house operations, **excluding** variable production and harvest costs, generally surpass \$55,000 per hectare.

To make the technological jump to a plastic greenhouse requires \$110,000 to \$113,000 per hectare in construction costs, and this only involves a passive system with no ventilation, no heating, no computer system, and only rudimentary irrigation. Medium-technology plastic greenhouses with active ventilation, air heaters, improved irrigation systems, and a small computer cost from \$190,000 to \$270,000 per hectare to construct. Understandably, most protected culture investments in Sinaloa do not reach the medium-technology level and the few that do may cut costs somewhat by not installing heaters.

With high investment costs, it is critical to achieve maximum potential yields. In Sinaloa, yields of vine ripe tomatoes for the top export-oriented field tomato growers are 60-69 metric tons per hectare, compared with yields of 110-150 for lower technology plastic greenhouses growing in soil. The top medium technology greenhouse growers in Sinaloa achieve beefsteak tomato yields of 250-300 metric tons per hectare using hydroponics.

Sinaloa growers achieving target yields for shade house, low-technology greenhouses, and medium-technology beefsteak tomato greenhouses can all have investment costs per metric ton of around \$800, exclusive of variable

¹ Although the field production cost information is specific to Sinaloa, the protected culture costs are similar across regions.

costs, compared with around \$226 per metric ton for field tomato growers. Clearly, field growers expect lower risks, higher quality product, and higher average prices when investing in protected culture since the gain in yields does not compensate for the higher investment costs alone, not to mention the additional growing costs using protected culture.

In more temperate regions of Mexico, costs for plastic high-technology greenhouses with no cooling but warm water heating, carbon dioxide enrichment, and the best computer and irrigation systems range from \$440,000 to \$550,000 per hectare. Costs for the same system but with a glass greenhouse adds \$170,000 to \$280,000 per hectare. Adding a cooling system would require another \$90,000 to \$110,000 per hectare, such that the highest active technology greenhouses with heating and cooling can approach \$1 million in investment costs, when land and other infrastructure are included. Variable operating costs are also higher for higher technology greenhouses.

High-technology growers in central Mexico routinely achieve beefsteak yields above 500 metric tons per hectare, with some approaching 600 metric tons per hectare. Glass greenhouse growers in Imuris achieve yields of 400-550 metric tons. Investment costs for growers employing the highest technology greenhouses may range from \$1,000 to \$1,200 per metric ton. Since these types of operations largely exist in temperate areas without major commercial field tomato production, comparative field tomato growing costs are unavailable.

Low-technology greenhouse operations exist in both coastal and temperate areas, and yields vary by location for the same technology package. Many lower technology greenhouse producers in temperate, extended shipping season areas can achieve beefsteak tomato yields of 170 metric tons per hectare, compared with yields averaging only 75-85 metric tons for some growers in the Baja California peninsula, and the intermediate yields noted previously for Sinaloa.

Clearly, as field tomato growers invest in greenhouse technology, they will require substantially higher yields and higher prices to compensate for higher production costs per metric ton. Greenhouse industry leaders point out that growers investing in greenhouses must understand that it is a premium quality business, and high standards must be maintained for the industry to be competitive and maintain orderly markets.

While investment in technology is increasing, attention to management is also improving. In many cases this development may be more responsible for higher yields than changes in technology. Many growers have not yet reached the yield potentials for their technology level. The greenhouse business is not the same as the open field business, and early investors speak of a 3-5 year learning curve. Although a relatively benign climate in many areas has allowed for profitable investments in low- and medium-technology greenhouses, those growers with sufficient capital to make higher technology investments seem to perceive an economic benefit to doing so. Many argue that if capital were less of a constraint, given the same climatic conditions, there would be greater investments in technology than has been the case to date. Shifting from growing in the soil to hydroponics is an important transition mentioned by growers as they strive to improve yields and quality. Those

growers with both financial resources and knowledge of net returns from alternative technology packages are intensifying their technology and management investments. In addition to raising the technology bar necessary for competitiveness over time, this pattern should improve the Mexican greenhouse tomato's industry reputation for quality and consistency.

As more growers invest in technology in their drive to improve yields, the economic pressure to extend shipping seasons will likely build, as growers seek to recover the higher level of fixed costs. While Mexican growers hotly debate the relative net economic benefits of shipping during the summer when production in the United States and Canada is at peak levels and prices are low, higher investments in technology are more likely to persuade growers to adopt an extended season strategy. Hence, as Mexicans upgrade technology, even without any growth in area, production could expand significantly in the near term, due to the effect of both technology and marketing strategy choices on annual yields. Of course, in the medium to longer term, greenhouse investment costs will decline as more domestic input suppliers emerge, the quality of domestic inputs increases, and the most appropriate technology packages and structures for each region become apparent, helping Mexico to control costs.

Appendix 3—Data on U.S. Greenhouse Tomato Imports

At the urging of the U.S. fresh tomato industry, AMS Market News Service requested a Harmonized Tariff Schedule code number be established to identify greenhouse tomatoes. The greenhouse tomato code went into effect July 1, 1999 (see table). There are two greenhouse tomato tariff codes: one for March 1 to July 14 and September 1 to November 14; and another for November 15 to the last day of February in the following year. There is no greenhouse tomato tariff code for the period July 15 to August 31. During that time period, greenhouse tomatoes are classified as cherry, grape, roma, or other, underestimating annual greenhouse tomato imports.

There appears to be a problem of underreporting of true greenhouse tomato imports even during the 46 weeks of the year with data on greenhouse imports. Customs brokers at the borders may not report the tariff codes correctly. For example, virtually all U.S. tomato imports from Canada are greenhouse, yet the official trade statistics in 2000 only reported 61 percent of tomato imports during time periods with a greenhouse tariff code as greenhouse. By 2003, the share had increased to 94 percent, indicating an adjustment to the new codes by industry and customs brokers. For Canada, Europe, and Israel, we simply assume all fresh tomato imports are greenhouse (based on industry intelligence), correcting for any miscoding.

However, misreporting of Mexican greenhouse tomatoes greatly complicates measuring actual greenhouse tomato imports. Since Mexico ships both field grown and greenhouse tomatoes, it is impossible to make any assumptions regarding the share of fresh tomato imports that may be greenhouse. In 2000 only 5 percent of tomatoes from Mexico were classified as greenhouse during periods with a greenhouse tariff code, with the share increasing to 8 percent in 2003. Given the serious underreporting problem we feel this represents, we opt instead to estimate total greenhouse tomato imports from Mexico by extrapolating from production estimates obtained from Mexican producer interviews. For 2003, U.S. Department of Commerce (DOC) greenhouse tomato imports were only 46 percent of the estimated total imports of 125,970 metric tons.

The last NAFTA tomato tariff ended on February 28, 2002. Now that there are no tariffs on tomatoes in the NAFTA countries, there is reduced incentive for correctly assigning tariff codes. Similarly, there is no urgency for filing re-export paperwork. When the United States had a tariff, but Canada did not, firms filed paperwork for re-exports so they did not have to pay the U.S. tariff. At that time, U.S. re-export numbers were probably more accurate than they are now.

DOC trade data are available with a 2-month lag and only provide unit prices on a monthly basis—often useful for analysts but not for tomato traders. AMS Market News Service provides daily import volume and free-on-board (FOB) prices in its *Tomato Fax Report*. When customs brokers in Nogales file their paperwork with U.S. Customs and USDA's Animal and Plant Health Inspection Service (APHIS), they also pass their information, including tariff codes for all the tomatoes in a load, on to the Market News Service. Because of this special relationship, the Market News Service can break imports down by tariff

code for those tomatoes from Mexico entering the United States via Nogales during the September through July period. However, the data are only as good as the customs brokers' recordkeeping. In the past, the Market News Service relied on APHIS for information on the volume of tomatoes crossing into the United States in California and Texas. But APHIS, whose primary interest is pests, only broke tomatoes down into three categories: cherry, roma, and all others (including regular, greenhouse, grape, etc.), regardless of whether they were field or greenhouse grown. Beginning in the 2004-05 season, the Market News Service is receiving some information on greenhouse imports in Otay Mesa, California, and Texas.

In terms of volume entering the United States, U.S. Customs figures will always be less than or equal to the Market News Service. Firms in Nogales have 10 days to decide whether the tomatoes will be sold in the United States or another country and notify Customs of reexports. Customs subtracts re-exports from imports but the Market News Service does not. However, it is not clear how many firms actually inform Customs of reexports since there are no tariffs in either country. While the Market News Service uses U.S. Customs data for every other country, it uses its own shipment data from customs brokers for Mexico. Neither Customs nor the Market News Service receives any information on tomatoes sold in bond to Canada. One industry estimate puts the volume of tomatoes sold in bond at less than 10 percent of the total crossings (Calvin, 2004).

Beginning in October 2004, the Market News Service also began reporting weekly shipments of greenhouse tomatoes from Canada and the five largest U.S. greenhouse producers.

U.S. tariff codes for fresh tomatoes, 2003

Code	Category description
	Tomatoes, fresh or chilled:
	If entered during the period March 1 to July 14, inclusive, of the period from September 1 to November 14 inclusive, in any year
702002010	Greenhouse
	Other:
702002035	Cherry
702002045	Grape
702002065	Roma (plum type)
702002099	Other
	If entered during the period from July 15 to August 31, inclusive in any year
702004030	Cherry
702004045	Grape
702004060	Roma (plum type)
702004099	Other
	If entered during the period from November 15, in any year, to the last day of the following February, inclusive
702006010	Greenhouse
	Other:
702006035	Cherry
702006045	Grape
702006065	Roma (plum type)
702006099	Other

Source: Harmonized Tariff Schedule of the United States.

Appendix 4—Data on Greenhouse Prices in the U.S. Market

Ideally, market analysis would be based on U.S. free-on-board (FOB) shipping point prices for all types and sizes of greenhouse products. These data are not collected, so analysis rests on the limited available data.

FOB Prices

Neither the United States nor Canada provides FOB prices for its domestic greenhouse tomatoes. The AMS Market News Service (MNS) reports daily FOB point of entry prices of Mexican tomatoes, including greenhouse tomatoes, entering the United States in Nogales, Arizona, during the main season for winter tomato imports (from September through July). Most of the greenhouse production from Mexico enters during this period. Prices for some summer exports are missed, as well as those entering through other ports of entry. MNS reporting of beefsteak tomatoes began in 1999 and TOV in April 2004. TOV prices are not always published, however, since there are only a few shippers in some periods. MNS reporters call shippers in Nogales to get the daily prices for various sizes of greenhouse tomatoes. Market News does not call shippers in California and Texas for prices on Mexican greenhouse tomatoes; the volume of tomatoes is smaller there, and MNS does not report prices when the number of shippers is very small and might reveal individual firm information.

Trade data aggregate greenhouse cocktail tomatoes with all other greenhouse tomatoes. MNS does not provide any price data on greenhouse cocktail tomatoes because the majority of these tomatoes enter the United States through Texas. The only source of data related to cocktail tomatoes is U.S. Customs port of entry trade data on unit values of all greenhouse tomatoes entering in Texas during the greenhouse tariff period. In 2002, unit values in Texas for all greenhouse tomatoes were just under twice the unit value of greenhouse tomatoes entering through Nogales.

U.S. Department of Commerce (DOC) trade data

DOC trade data provide input unit values for imports (value of trade divided by volume of trade). These data only provide an aggregate greenhouse tomato unit value, not a value for different types of greenhouse tomatoes. This is the best data for looking at greenhouse trends over time from Canada. U.S. prices would likely be similar. But the data have problems, too. In particular, since production has been shifting rapidly from lower priced beefsteak to higher price TOV, pricing trends over time are not clear after about 2000. Imports from Canada in the winter months are very low, so the prices represent a thin market and may not be very representative of U.S. winter prices. Trade data are only available on a monthly basis.

Wholesale Prices

Wholesale prices for greenhouse tomatoes sold in the United States are available from MNS daily reports. This report uses weekly average price as derived from daily MNS prices. These data provide a way to compare prices of particular tomatoes from different countries that are being sold in the market. Wholesale markets may also reflect more local supply and demand conditions than national FOB price trends.

Retail Prices

In the United States, the Bureau of Labor Statistics provides average monthly retail prices for several vegetables, but not greenhouse tomatoes. Currently, the only source of data on greenhouse retail prices comes from private firms selling scanner data. Scanner data from participating firms are compiled into a database representing the weekly sales of particular products identified by price look-up or universal product codes for the average supermarket.

U.S. Dumping Case Against Canadian Greenhouse Tomatoes

On March 28, 2001, six U.S. greenhouse firms brought a dumping case against Canadian greenhouse growers. One of the key issues in the case was the definition of the relevant industry, specifically whether greenhouse and field grown tomatoes are “like” products. The U.S. greenhouse producers argued that greenhouse and field-grown tomatoes are not like products; the Canadian growers argued that they are. The definition of the domestic like product and industry is important for determining injury. A determination that greenhouse and field tomatoes are like products means that the U.S. International Trade Commission (ITC) would have to find that Canadian greenhouse imports caused injury to the whole U.S. fresh tomato industry, whereas a determination that greenhouse and field tomatoes are not like products means that the ITC would only have to find injury to greenhouse producers. The ITC considers several factors in making its case-by-case decision, but no one factor automatically defines the industry. The ITC looks for clear differences between products and not minor variations. Furthermore, the ITC is not bound by previous decisions on the same product. The six traditional factors used by the ITC in its domestic like-product examination are: physical characteristics and uses; interchangeability; channels of distribution; customer and producer perceptions of the products; common production facilities, production processes, and production employees; and price. In its preliminary injury determination on May 10, 2001, the ITC found that the relevant industry was just greenhouse tomatoes but that it intended to re-examine this issue in any final phase of the investigation because the evidence was mixed (ITC, 2001).

The U.S. Department of Commerce (DOC) announced preliminary dumping margins on October 2, 2001, and began collecting duties from Canadian growers (see table). After issuing preliminary margins, DOC continued to fine tune the margins. Margins are often changed during the course of an investigation. In the preliminary determination, the Canadian firms BC Hot House (BCHH) and Red Zoo received margins of 50.75 and 23.17 percent, respectively. The revised preliminary margins, announced on October 19, 2001, lowered BCHH’s margin to 33.95 percent. The high margins produced an uncertain environment for Canadian greenhouse growers.

After DOC issued its preliminary dumping margins, Canadian officials proposed a suspension agreement, but it was not accepted. In April, an attorney for Canadian growers was quoted as saying there was “not enough middle ground for a deal” (*The Packer*, 2002e). There was some speculation that the Ontario industry thought it would have low margins, compared with British Columbia, and might try to obtain segregated treatment (*The Packer*, 2002a). Ontario growers filed a NAFTA appeal to obtain a separate dumping margin from BCHH (*The Packer*, 2002d). This competition between Ontario and British Columbia might account for the lack of a middle ground.

DOC released the final dumping margins on February 19, 2002. Three of the Canadian companies had very small margins, and two had significantly higher margins—BCHH and Mastronardi (Red Zoo’s margin had decreased to 1.86 percent). On March 28, 2002, DOC issued an amended final determination of dumping duties (*The Packer*, 2002c). The duty for Mastonardi declined from 14.89 percent to 0.52 percent. Other changes were very small: BCHH declined from 18.21 percent to 18.04 percent, Red Zoo declined from 1.86 percent to 1.85 percent, and J-D Marketing declined from 1.53 percent to 0.83 percent. The duty for Veg Gro did not change. The “all other” duty increased from 16.22 percent to 16.53 percent since *de minimis* duties are not included in the calculation for this category.

On April 12, 2002, the ITC determined that greenhouse and field grown tomatoes were like products. ITC, based on the information gathered in its investigation, wrote that greenhouse and field grown tomatoes were part of a continuum of different types of tomatoes. Retailers provide consumers with a range of tomatoes, and the mix varies on a weekly basis. With respect to consumer preferences, the ITC received statements that greenhouse tomatoes might taste better than mature green tomatoes, but consumers tend to prefer locally grown vine ripe tomatoes. With regard to price, greenhouse tomatoes generally sell at a premium, compared with field grown tomatoes, but at a lower price than organic, grape, and cherry tomatoes. In the case of production facilities, processes, and employees, field and greenhouse tomatoes demonstrate clear distinctions. Therefore, in its deliberations, the ITC considered whether the entire U.S. fresh tomato industry had suffered injury due to imports of greenhouse tomatoes. The ITC ruled that Canadian greenhouse exports had not caused damage to the U.S. fresh tomato industry and dismissed the U.S. case against Canada (ITC, 2002).

Canadian Dumping Case Against All Types of U.S. Fresh Tomatoes

In November 2001, after the DOC issued preliminary dumping margins against Canadian firms, the Canadian Tomato Trade Alliance (CTTA) brought a dumping case against the United States for tomato exports of any type for the fresh market, not just greenhouse tomatoes as in the U.S. case.¹ The Canadian case also covered any tomatoes originating in or exported from the United States (Canadian Customs and Revenue Agency, 2001), thus affecting Mexican tomatoes indirectly as well. During the winter season, almost all Mexican field tomatoes for export are grown in Culiacán, Sinaloa, and then sent by truck to Nogales, AZ, where the tomatoes are marketed to both the United States and Canada.² Mexico claimed that Canada had in effect initiated an investigation against Mexican tomatoes but that since a formal dumping suit was not filed against Mexico, the method denied Mexico’s producers and exporters their rights accorded under the World Trade Organization. Canada stated that tomatoes shipped in bond from Mexico to Canada would not be included in any dumping margins. Otherwise, tomatoes are entering U.S. commerce and being re-exported from the United States and, therefore, fall within the scope of the dumping case (*The Packer*, 2002b). Very few tomatoes are now shipped in bond, perhaps less than 10 percent. Shipping tomatoes from Mexico to Canada in bond would incur additional costs.³

¹The British Columbia and Ontario industries, strong competitors in normal times, joined together to form this organization in early 2001 as U.S. groups began to talk about perceived dumping by Canadian firms.

²Large Mexican growers own many of the marketing firms in Nogales. In 1997, 63 percent of the volume of tomatoes imported through Nogales was sold by Nogales-based Mexican grower-owned marketing firms (Calvin and Barrios, 1998).

³Currently, tomatoes arrive in Nogales, and shippers then select tomatoes to prepare orders for buyers. To meet buyer specifications, a shipper might use tomatoes from several truckloads to fill the order. If some incoming truckloads were off-limits because they were in bond shipments to Canada, shippers would have less marketing flexibility. Shippers might, however, be able to make adjustments to the way they prepare their loads to reduce this problem.

On January 8, 2002, the Canadian International Trade Tribunal (CITT) ruled that the preliminary injury inquiry revealed a reasonable indication that dumping of tomatoes had caused injury to the Canadian industry. As in the U.S. case against Canada, the CITT had to decide what were the like products. In its preliminary assessment, the CITT decided that field and greenhouse tomatoes were like products, since in their view, there are more significant similarities than differences.

On March 25, 2002, the Canada Customs and Revenue Agency (CCRA) issued its preliminary determination on dumping margins, which ranged from an average margin of 0 to 71 percent per individual firm (Canadian Customs and Revenue Agency, 2002). Firms that were required to submit data and complied had an average margin of 22 percent. Those that were not required to submit data were assigned a 22-percent margin. Firms that were required to submit data but did not comply received a rate of 71 percent—the highest average dumping margin for a complying firm.

The U.S. side offered an undertaking proposal (the Canadian term for a suspension agreement) on April 15, 2002. The undertaking involved minimum prices for mature green tomato exports to Canada between June 1 and September 30. The CCRA rejected this proposal in early May as failing to eliminate the injury.

There had been discussions between U.S. and Canadian tomato organizations about resolving the case out of court. On June 19, the CTTA informed the CITT that it did not wish to advance the dumping case and requested that it cancel the upcoming hearing scheduled for June 24 and terminate the case. The CITT cancelled the hearing but informed the CTTA that it would proceed to make a final determination.

On June 24, 2002, the CCRA announced its final determination on dumping margins, which were very similar to the preliminary margins. The average margin for complying and nonmandatory respondents rose from 22 to 26 percent and the margin for noncooperating mandatory respondents fell from 71 to 70 percent. These margins could have had a serious impact on Canadian consumers. In 2000, 51 percent of Canadian tomato consumption consisted of imports from the United States.

Although not scheduled to make a final determination until July 23, the CITT made its final determination on June 26, 2002. The CITT decided that the dumping of tomatoes had not caused injury to the Canadian industry and so ended the case. The CITT had advised the CTTA that it would draw the appropriate inferences from the CTTA's request to terminate the case. In addition, there was not clear information regarding the financial performance of the Canadian greenhouse growers and the allegation that greenhouse prices are determined by the price of U.S. field grown imports. Finally, CITT noted that Canadian production increases may have affected prices, rather than U.S. imports (Canada International Trade Tribunal, 2002). Since 1990, U.S. tomato exports to Canada had moved within a narrow band, ranging from a low of 120,284 metric tons to 148,296 metric tons.

U.S. dumping margins for Canadian greenhouse tomato firms

Firm	Preliminary margins 10/2/2001	Revised preliminary margins 10/19/2001	Final margins 2/19/2002	Amended final margins 3/28/2002
	<i>Percent</i>			
BC Hot House	50.75	33.95	18.21	18.04
Red Zoo	23.17	23.17	1.86	1.85
Mastronardi	5.54	5.54	14.89	0.52
Veg Gro	2.45	2.45	3.85	3.85
J-D Marketing	0	0	1.53	0.83
All others	32.36	24.04	16.22	16.53

Source: U.S. Department of Commerce.