Changing Structure of Global Food Consumption and Trade. Anita Regmi, editor. Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, Agriculture and Trade Report. WRS-01-1.

Abstract

Higher income, urbanization, other demographic shifts, improved transportation, and consumer perceptions regarding quality and safety are changing global food consumption patterns. Shifts in food consumption have led to increased trade and changes in the composition of world agricultural trade. Given different diets, food expenditure and food budget responses to income and price changes vary between developing and developed countries. In developing countries, higher income results in increased demand for meat products, often leading to increased import of livestock feed. Diet diversification and increasing demand for better quality and labor-saving products have increased imports of high-value and processed food products in developed countries. Consumer groups in developed countries have also brought attention to organic production of food and the topic of animal welfare. One way in which the public and private sectors have responded to consumer demand for these quality attributes has been by developing and implementing mandatory and voluntary quality control, management, and assurance schemes.

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Summary

Income, Demographic Shifts, and Consumer Perceptions Are Changing Global Food Consumption Patterns and Trade

Higher income, urbanization, other demographic shifts, improved transportation, and consumer perceptions regarding quality and safety are changing global food consumption patterns. Shifts in food consumption have led to increased trade and changes in the composition of world agricultural trade. Grain trade, which once accounted for most of world agricultural trade, represents less than 30 percent of current agricultural trade.

Among the determinants affecting trade patterns, income growth and its impact on food consumption are one of the most important in explaining changes over time. The effect of income growth in changing trade patterns differs among developed and developing countries. Diet diversification and increasing demand for better quality and labor-saving products have increased imports of high-value and processed food products in developed countries. In developing countries, higher income results in increased demand for meat products, often leading to the expansion of livestock production. This in turn may result in increased imports of intermediate products such as animal feed.

Given different diets, food expenditure and food budget responses to income and price changes vary between developing and developed countries. Low-income countries spend a greater portion of their budget on staple food products such as cereals and are generally more responsive to food price and income changes. The magnitude of a country's response to income and price change also differs across food items. For example, in poorer countries, greater budget adjustments are made to higher value food items such as dairy and meat, and staple food budgets undergo little change. Middle-income countries are the most responsive to staple food price changes.

Urbanization has played a significant role in changing global food consumption patterns. Given different lifestyles of urban and rural residents, greater demand for urban residents' time, increased food availability, and higher purchasing power in urban areas, urban and rural diets tend to differ significantly. Since the urban population in developing countries is expected to double to nearly 4 billion by 2020, urbanization is a phenomenon that will in the future primarily affect developing countries. With increased urbanization and higher disposable income among urban residents, the demand for meat, horticultural, and processed products is expected to increase among developing countries. Increased demand for meat is expected to result in increased demand for feed grains and protein meals as well, resulting in greater trade in these products.

Demand for quality and convenience and increased awareness regarding safety and health have significantly changed food consumption patterns among developed countries. In the United States, the red meat share of total meat consumption declined from 79 percent in 1970 to 62 percent 30 years later, while the poultry share increased from 21 to 38 percent during the same period. Similarly, per capita fruit and vegetable consumption in the United States increased 25 percent between 1977 and 1999. Facilitated by improvements in shipping technology, trade in horticultural and high value processed products has grown to meet the rising global demand, mainly driven by developed countries.

As consumers become wealthier and the basic demand for a well-balanced meal are met, consumers tend to demand other 'quality attributes' in their food. Accordingly, during the last 20 years, mainly in developed countries, consumer groups have increasingly brought attention to organic production of food and the topic of animal welfare. Most studies characterize these consumers as affluent, well-educated, and concerned about health and product quality. Reasons for purchasing organic and humanely raised animal products are similar across countries. The perception that organic foods are healthier is widespread among buyers, even though some countries prohibit advertising that suggests this. Along with food safety, taste, freshness, and overall quality are often indicated as important attributes determining consumer preference for organic products. Another factor influencing consumer choice, although not directly affecting product quality, is consumer concern for environmental protection and animal welfare.

Consumer demand for special quality attributes and safety varies across countries. Countries also vary in how they perceive and handle risks from disease-causing organisms, generally based on access to and use of advances in science, detection technology, and mitigation methods. Accordingly, wealthier countries with more information about food safety risks tend to demand more stringent food safety standards on both domestically produced and imported food. They are also generally willing to pay more for these higher levels of food safety. Major food safety incidents have greatly increased consumer concerns in recent years, leading to changes in consumer perceptions and food purchasing patterns in certain developed countries.

One way in which the public and private sectors have responded to consumer demand for 'quality' has been by developing and implementing mandatory and voluntary quality control, management, and assurance schemes. These schemes are causing changes in the way food products are produced, marketed, and traded in Europe and to some extent in the United States. Quality assurance schemes develop standards for producing, processing, and transporting, and may include standards for environmental management practices.

Differences in what food products countries want and what they will accept in imported food affect patterns of food demand and global trade, and complicate the development of workable trade rules that are acceptable to different trading partners. Adhering to set standards, whether voluntary or nationally mandated, may increase production costs. In general, any policy that imposes costs on a domestic firm that foreign firms do not face can potentially put domestic firms at a disadvantage. Domestic firms understand this consequence of differences in regulation. Thus, when a country passes legislation that increases costs for domestic producers, the producers sometimes apply political pressure to offset these costs or to block imports from countries that do not have similar regulations. Consumer demand for quality attributes can therefore impact trade flows and lead to disputes between trading partners.

Countries are responding to arbitrage pressures and other trade-related tensions by adopting multilateral coordination mechanisms such as mutual recognition, coordination, and harmonization of standards and rules. In general, the greater the coordination of multilateral mechanisms and private approaches among firms and nations, the more they will be able to provide verifiable and valuable information to trading partners and facilitate global agricultural trade.

Changing Structure of Global Food Consumption and Trade: An Introduction

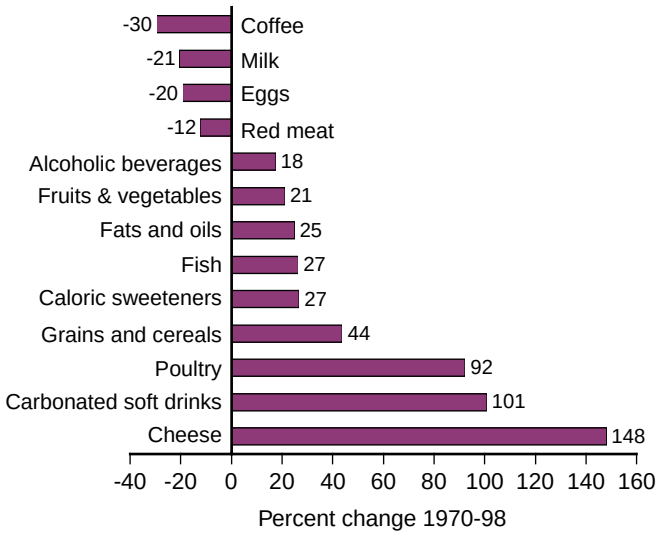
Anita Regmi[1]

Introduction

Global food consumption patterns have changed over time. Our diets on a daily basis are very different from what our parents or grandparents consumed. In winter, instead of living on canned fruits and vegetables, we can now purchase at our neighborhood grocery store fresh grapes from Chile, oranges from Australia, snow peas from Guatemala, and just about any produce all year long. Similarly, the time spent on food preparation has changed dramatically; we can buy pre-cut vegetables, frozen dinners, and sometimes order different ethnic carry-out meals on almost a daily basis. These changes in food consumption patterns have resulted in large changes over time in per capita food consumption in the United States (fig. 1). Per capita consumption of coffee, milk, eggs, and red meat has declined significantly during the past 30 years, while the consumption of cheese, soft drinks, and poultry have increased. Food consumption in the United States can no longer be categorized by food eaten by a few major ethnic groups. It ranges from fast-food burgers and fries to home-cooked meat and potatoes, tacos and fajitas, Chinese noodles and rice, pasta and pizza, Middle Eastern pita sandwiches, and many other types of food. These changes in the American diet have occurred gradually over time, resulting in part from increased ethnic diversity in the population, greater disposable household income, increased trade and improved transportation, greater numbers of women in the labor force, and increased awareness and consumer preference for improved quality and more healthful products.

Just as the American diet is constantly changing, globalization and increased per capita income is changing the eating habits of individuals all around the world. What are the forces driving these changes in global food consumption? How do these forces differ across developed and developing countries? How does this affect global food trade? In the following 10 chapters, this publication attempts to answer the above questions. Trade is one of the important factors that increase the array and the availability of food to consumers. Trade, in turn, is affected by supply side factors such as relative growth in factors of production, and demand-driven factors like growth in disposable income and changing consumer preferences. The first chapter in this publication discusses how these and other factors, including improved transportation, have

Figure 1
Changes in U.S. per capita consumption, 1970-98



Source: Economic Research Service, USDA.

[1] Agricultural economist with the Market and Trade Economics Division, Economic Research Service, USDA.

changed the composition of global food trade. Our discussion of the topic is not exhaustive. For example, the effect of trade liberalization and political changes that have occurred in many countries around the world, which in turn may have affected food availability, is not addressed in this publication.

One of the primary factors affecting food consumption patterns, is of course, the ability to purchase food. The last two decades have witnessed major increases in per capita income levels of households all over the world. The first two chapters of this publication analyze the impact of income changes across countries. Chapter 2 specifically analyzes how income and food price changes affect consumer behavior in low-, middle-, and high-income countries. As illustrated in figure 2, consumers in high-income countries such as the United States spend a large share of their food budget on meat, while cereal is the predominant component of the food budget for consumers in poorer countries such as Kenya and the Philippines. Generally, as the population grows wealthier, the consumption of meat and fresh produce increases[2]. At very high-income levels, such as in the United States, changes in income and food prices may not translate to perceptible changes in food expenditure patterns at a national level. However, changes may occur within the composition of sub-categories of food, such as substituting grocery store brands with 'quality-assured' organic brands, or replacing store brand meat and cheese with imported products perceived to be of better quality. Additionally, as illustrated in figure 1, the composition of U.S. meat consumption changed significantly during the last two decades, with increases in poultry replacing declining red meat consumption. Similarly, at very low-income levels, changes in income and food price may not result in changes in consumption of certain food groups. This is due to consumption shifts within a food sub-category. For example, when the price of rice increases, individuals may consume more wheat or coarse grains, and not change their overall expenditure on cereals. As income levels increase beyond a certain threshold and consumers migrate to the 'middle-income' category, they appear most likely to change their food basket by consuming a more diverse and higher valued diet.

[2] Fruit and vegetable budget shares in figure 2 include expenditures on roots and tubers, which are generally cereal substitutes in poorer countries. This may have contributed to relatively high fruit and vegetable budget shares in Kenya and the Philippines.

While increases in income have enhanced food purchasing power, better trade and transportation have improved its selection and availability. The role of improved transportation and infrastructure facilities in changing the composition of global food trade is discussed in Chapter 4. Besides income and improved transportation, lifestyle changes related to urbanization also determine the composition of the food we eat. Just as our diets are very different from the food our parents and grandparents consumed, diets of an average consumer in New York City or San Francisco may be different from that of an average consumer in rural Georgia or Montana. The effect of urbanization in influencing the composition of food consumed by individuals is examined in Chapter 3. This chapter focuses on a global analysis, examining how the impact differs among low-, middle-, and high-income countries.

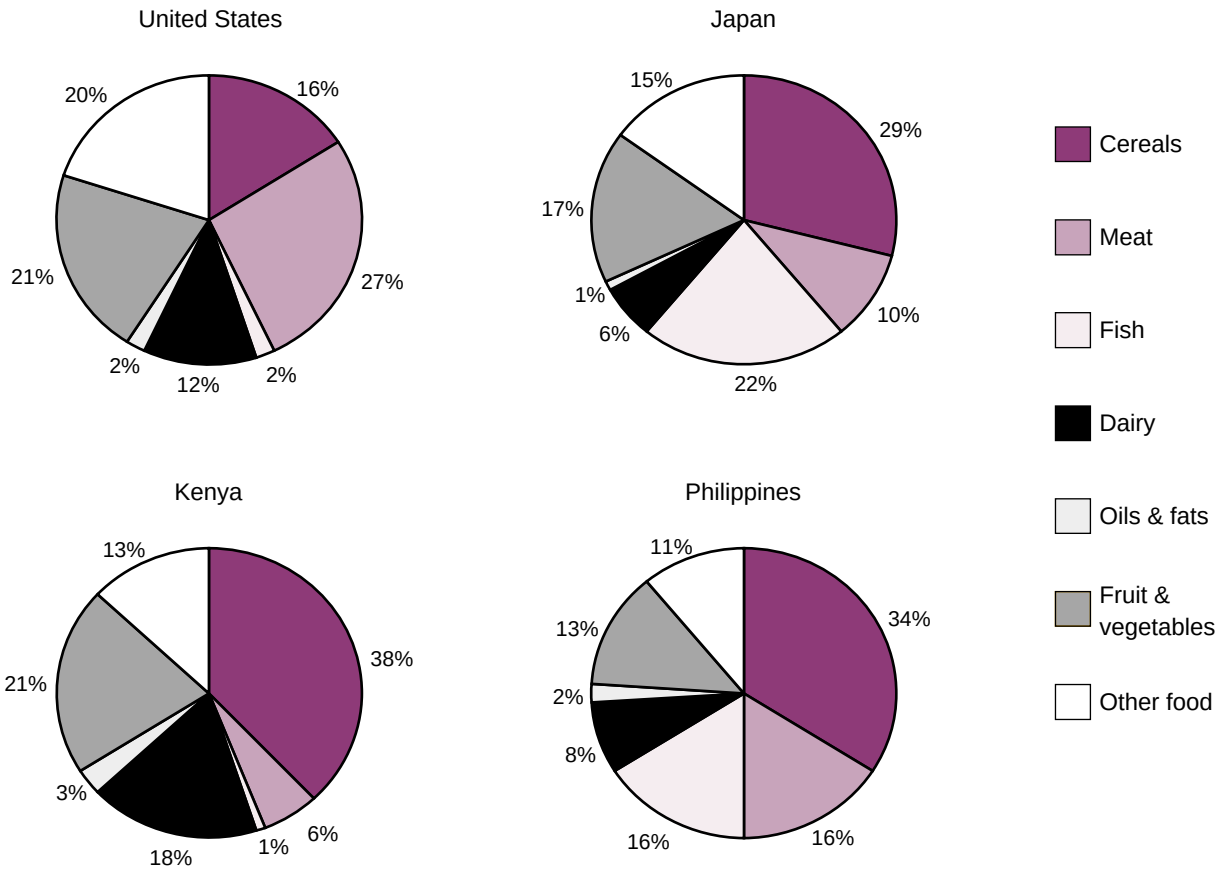
Alternative demands on time in fast-paced, more affluent, dual-income urban households may result in urban consumers preferring higher valued and more processed food that requires less time for preparation. With food-retail and restaurant chains operating nationwide, mass-media advertisements, prevailing popular culture, and instantaneous transfer of information with modern technologies, food consumption is undergoing changes in all areas of the country, as well as beyond its borders. Along with the export of popular American culture, the United States also exports its food and eating habits to various urban centers around the world. Therefore, the United States plays a very important role in shaping the diets of individuals in many countries. Both bulk and prepared U.S. agricultural products are exported worldwide, and U.S. fast food chains dot the urban landscapes in cities all over the world. An examination of current U.S. food consumption patterns can therefore provide some insights to potential changes in future food consumption patterns in developing countries as income levels increase. Given that meat and fresh produce consumption will likely increase with income, Chapters 5 and 6 examine the factors shaping current U.S. demand for these products.

Finally, when the basic demand for a well-balanced meal are met, further increases in income result in demand for other 'quality attributes' in the food we consume. The demand for 'quality attributes' in developed countries has escalated in recent years due to increased media attention and public awareness resulting from various incidences of large-scale food contamination. Consumers in developed countries are

Figure 2

Global food consumption patterns

Food item share of total food budget



Source: 1996 International Comparison Project Data. The World Bank.

increasingly demanding food products perceived to be safer, specifically products that are free from disease-causing organisms, chemical residues, and that are not produced using any chemical inputs or genetic modifications. Some American and a large number of European consumers are additionally demanding food from animals that are raised in a humane environment. These domestic demands have led to policy changes at the national and some at the international level. What implications do such policy changes have for future trade and the supply and demand of food? These issues are presented in Chapters 7 through 9.

In response to consumer demand for quality, food industries in Europe and to a smaller extent the United States have designed quality assurance systems that guarantee quality attributes in food products. Issues concerning such schemes and examples of quality assurance schemes are presented in the final chapter of this publication.

Global Food Consumption and Impacts on Trade Patterns

Mark Gehlhar and William Coyle[1]

Abstract: Driven primarily by per capita income growth, the composition of world agricultural trade has substantially changed in the past two decades. For developing countries, consumption and trade are shifting from basic staples towards higher value livestock products. In high-income countries, demand for foreign brands are expanding intra-industry trade in processed consumer-ready products.

Introduction

Changes in food consumption in one region have implications for production and trade in other countries. In each country, trade acts to balance the difference between production and consumption while at the same time trade links countries in a global economy. With growing interdependency, shifts in consumption can have major impacts on food markets throughout the world. In the last two decades the composition of world agricultural trade has undergone a dramatic shift. Today, grain trade no longer serves as a proxy for agricultural trade as it once did. Bulk commodities (grains, oilseeds, cotton, and tobacco) have become less important in the world trade, representing less than 30 percent of world agricultural trade. Shifts in global food consumption have affected U.S. agricultural trade, which traditionally was comprised largely of bulk commodities. Countries exporting a higher content of non-bulk commodities have generally increased their share in the world market, as bulk commodities become less important in total trade.

What are the major determinants of changes in the structure of global food trade? This question was addressed by Coyle, Gehlhar, Hertel, and Wang (1998) by analyzing historical patterns of world agricultural trade from 1980 to 1995. In that study, different economic factors were identified and used to explain shifts in trade patterns. These included income growth and food expenditures, factors of production, transport costs, and trade policy changes. Of these determinants, income growth and its impact on food consumption was most important in explaining changes in trade patterns over this period. The study employed a global model with a demand system capable of capturing the effect of income on changes in food expenditures over a wide range of income levels. Since the study focused on the composition of world agricultural trade in aggregate, a natural follow-on contained in this chapter is an examination of structural shifts in specific regions. Of interest are differences between developed and developing countries and how they affect the changing structure of global agricultural trade.

It is commonly thought that dietary upgrading, stemming from income growth in developing countries, has contributed to changes in global trade patterns. The linkage between changes in food consumption patterns and changes in world agricultural trade is a complex story involving more than income growth and dietary change. To begin with, a background section on historical trade patterns is provided. This is followed by a discussion of the major determinants of structural change. A final section provides results from a formal modeling exercise focusing on income growth and its effect on consumption and trade.

Background

The composition of world agricultural trade can be described in terms of changes in its major component parts. Total agricultural trade consists of food and non-

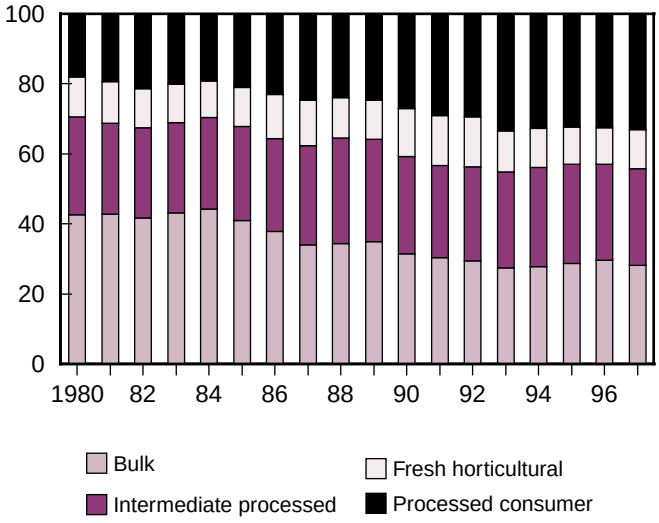
[1] Agricultural economists with the Market and Trade Economics Division, Economic Research Service, USDA.

food commodities in both raw and processed forms. A useful classification of agricultural trade is a breakdown of agricultural trade into four components: bulk commodities, processed intermediate products, fresh horticultural products, and processed consumer goods.[2] From 1980 to 1997 the share of bulk has steadily dropped (fig. A-1) while the shares of non-bulk categories have remained steady or increased. Bulk commodities are no longer a valid indicator for measuring world agricultural trade growth. The share of intermediate processed commodities in total agricultural trade has not decreased as bulk commodities have. Slower trade growth for bulk does not by itself mean global demand for bulk commodities has slowed. Import demand for bulk commodities is partly satisfied with growth in intermediate processed products, which are essentially processed bulk commodities. Oilseeds processed into vegetable oil and meal can be subsequently traded, reducing demand for imported oilseeds. Grains fed to livestock ultimately produce a variety of meat and animal products sold in foreign markets, thereby curbing foreign import demand for grains.

Fresh horticultural trade, consisting of products consumed without further processing, has kept pace with total agricultural trade, leaving its share nearly constant over this time period. Improvements in shipping technology have played a role in expanding trade of fresh produce. The fastest growing category has been processed consumer goods. Factors driving trade growth in this product category are more complex than for other categories.

Only a few commodities account for a large share of total agricultural trade. Among major commodities there are dramatic differences in the rates of growth in trade (shown in table A-1 and ordered by growth rates). One recent phenomenon involves certain products entering international trade which previously were thought of as "non-tradeable." This takes place as consumer preferences for foreign goods evolve and shipping technology improves. Pet food is an example,

Figure A-1
Composition of world agricultural trade
Share of total



Source: U.N. COMTRADE, ERS, classification.

and is now one of the fastest growing products in world trade, reaching $3.5 billion in global trade in 1998.[3] Over the past 15 years many of the faster growing categories in trade are non-bulk packaged products, where consumers differentiate products carrying unique brands and labels. Pastry, prepared foods, and chocolates have grown in world trade by nearly 10 percent per year over the past 15 years. These alone account for more than $15 billion in world trade, a value exceeding the value of world wheat trade. Wine, a highly differentiated product, has grown at a rate of 6 percent a year and is now $7.4 billion and likely will surpass trade in corn in value of trade.[4]

Growth in many of the processed intermediate products such as soybean oil, flour, and soybean meal has also exceeded growth rates for total agricultural trade (3.5 percent per annum). Import demand for these commodities originates (or is derived) from consumer's demand for finished processed food and livestock products. Trade in intermediate processed products depends on exporters having a comparative advantage over importers in performing milling/crushing activity required for bulk commodities. Exporting countries

[2] Bulk commodities consist of raw grains, oilseeds, tobacco, and cotton. Intermediate processed commodities consist of semi-processed goods such as flours, meals, and oils. Fresh horticultural products consist of unprocessed fruits and vegetables such as bananas and tomatoes, and nursery products including cut flowers. Consumer-processed products include processed products at or near where a substantial degree of processing has taken place. Items in this category include beverages, bakery products, ready to eat cereals and snack food, fresh and frozen meat, and preserved fruit and vegetables.

[3] Pet food remained a non-traded product for the United States until 1983. U.S export sales doubled between 1993 and 1998, reaching $830 million in 1998.

[4] World trade used here excludes trade between the 15-member European Union.

Table A-1—Major commodities in world agricultural trade

	1980	1998	Annual growth
	Billions $U.S.		*Percentage*
Pet food	0.01	2.0	23.3
Pastry	0.5	3.0	10.6
Chocolate products	0.6	3.2	10.1
Food prepared	1.7	9.2	9.5
Grapes	0.4	1.9	8.8
Cigarettes	1.8	7.9	8.7
Oil of palm	1.8	6.2	7.5
Wine	2.4	7.4	6.0
Beef and veal	2.7	7.3	5.7
Bananas	2.1	5.2	5.5
Cheese and curd	1.5	3.6	4.9
Oil of soya beans	1.8	4.5	4.6
Cake of soya beans	3.8	7.8	3.9
Tobacco leaves	4.0	6.8	3.1
Rice	5.0	9.3	2.7
Hides and skins	3.3	4.6	2.5
Soybeans	7.8	9.7	1.6
Cotton lint	8.5	8.9	1.5
Flour of wheat	2.0	2.4	1.4
Wheat	16.2	14.8	0.6
Corn	9.8	8.7	0.5
Coffee, green	13.3	12.5	0.3
Cocoa beans	3.0	3.3	0.1
Total agricultural products	187.6	323.5	3.5

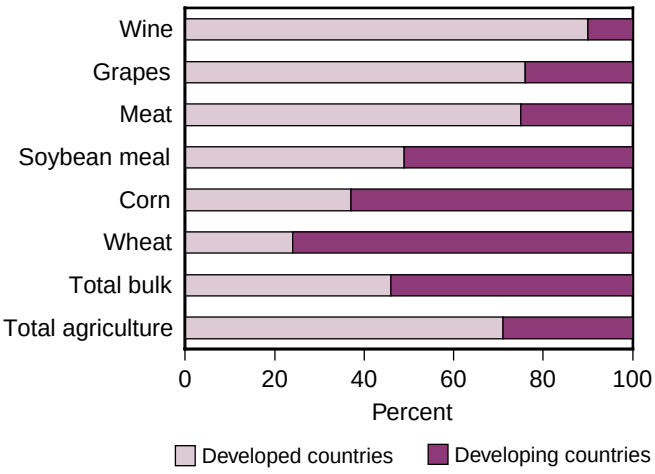
Source: FAOSTAT: excludes intra-EU Trade.

with larger home markets can take greater advantage of economies of scale, if they exist, as well as state-of-the-art processing and shipping technology.

Wheat, corn, coffee, and cocoa beans account for most trade in bulk commodities. Bulk commodities are the slowest growing component of agricultural trade. Growth of these commodities has been less than 1 percent per year.

An important factor in the changing structure of world agricultural trade is the dominant role developed countries have played. Most of the growth in consumer processed trade is attributable to developed country imports. Developed countries import a much greater share of processed consumer goods (consumer-ready goods) than developing countries, while the opposite is true for bulk commodities (fig. A-2). In most cases, the developed countries' share of total imports of consumer goods increased, indicating faster import growth than developing countries. For example, in 1980, developed countries imported 70 percent of global meat trade. Since then the share has increased to 75 percent in 1998 (table A-2).

Figure A-2
Shares of world imports by developed and developing countries



Source: FAOSTAT.

As income grows, meat typically becomes a more important source of calories in the human diet (shown in fig. A-3). While the relationship between income and livestock product consumption is well known, the link between economic growth and meat trade is less clear. Regions with faster growth in meat consumption do not necessarily become larger importers of meat. Expansion of domestic meat production plays an important role in determining import growth. Imports will depend on how competitive domestic producers are in producing for the home market. Input costs, technology, and levels of productivity of livestock sectors vary by region. Some production technologies are easily replicated in different regions while others are less transferable.

World imports of red meats are concentrated in a few developed countries. Japan's meat imports alone account for nearly as much as all developing countries' imports combined (fig. A-4). Despite rapid economic growth in most of Asia, only Japan stands out as a major market for meat exporters. Newly industrialized countries of Korea and Hong Kong have been the fastest growing markets for meat in recent years. While consumption of meat has increased in low- and middle-income countries, there has not been a noticeable shift in exports toward these markets. One reason is that there has been a shift in world meat production, with rapid growth in meat production occurring in developing Asia and the Near East (table

Table A-2—Developed countries' import share of world imports, by leading commodities

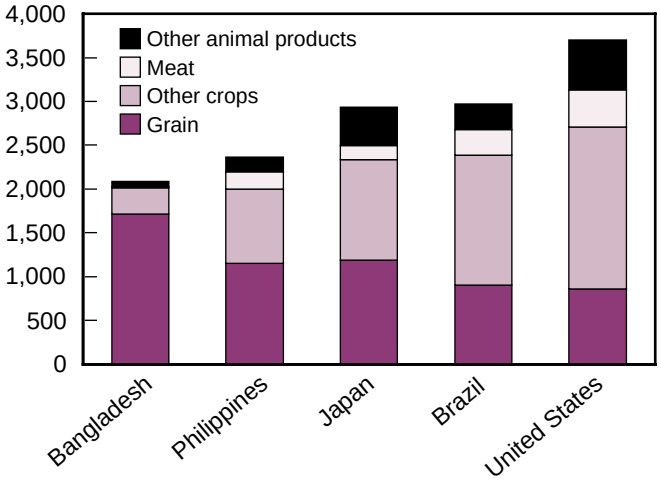
	1980	1985	1990	1995	1998
			Shares of world total		
Consumer Processed					
Chocolate products	0.69	0.75	0.74	0.71	0.73
Meat	0.70	0.68	0.76	0.74	0.75
Pastry	0.47	0.62	0.66	0.69	0.70
Pet food	0.91	0.97	0.93	0.89	0.86
Food prepared nes	0.47	0.52	0.51	0.57	0.57
Wine	0.88	0.92	0.89	0.87	0.90
Horticultural					
Bananas	0.89	0.95	0.95	0.91	0.88
Grapes	0.81	0.82	0.84	0.76	0.76
Tomatoes	0.95	0.92	0.94	0.95	0.95
Intermediate					
Cake of soya beans	0.84	0.77	0.75	0.64	0.49
Hides and skins	0.86	0.74	0.54	0.42	0.42
Oil of palm	0.32	0.27	0.27	0.25	0.29
Oil of soya beans	0.10	0.18	0.11	0.07	0.08
Bulk					
Cotton lint	0.56	0.67	0.48	0.35	0.34
Corn	0.59	0.64	0.56	0.36	0.37
Rice	0.16	0.19	0.22	0.16	0.17
Tobacco	0.82	0.80	0.80	0.76	0.77
Soybeans	0.86	0.79	0.78	0.68	0.59
Wheat	0.37	0.38	0.32	0.22	0.24

Source: FAOSTAT: excludes intra-EU Trade.

Figure A-3

Income level and source of calories

Calories per capita

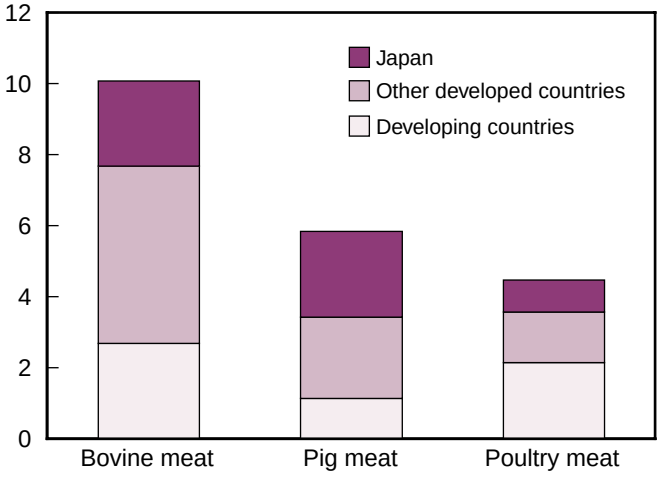


Source: FAOSTAT.

Figure A-4

World meat imports

$ billion



Source: FAOSTAT.

Table A-3—World meat production 1980-1998

	1980	1985	1990	1995	1998	1980-98
			Share of world total			*Growth per annum*
North America	0.20	0.19	0.18	0.18	0.18	2.13
Western Europe	0.22	0.21	0.19	0.17	0.16	1.14
Oceania	0.03	0.03	0.02	0.02	0.02	1.44
Total high income OECD	0.45	0.42	0.39	0.37	0.36	1.61
East and S. East Asia	0.04	0.04	0.04	0.05	0.05	4.97
South Asia	0.03	0.03	0.03	0.03	0.03	4.07
China	0.11	0.13	0.17	0.23	0.26	8.09
Near East	0.02	0.03	0.03	0.03	0.03	3.99
Asia and Near East	0.19	0.23	0.27	0.35	0.38	8.00
South America	0.09	0.08	0.09	0.10	0.10	3.28
Rest of World	0.27	0.27	0.25	0.18	0.16	-0.29
World	1.00	1.00	1.00	1.00	1.00	2.76

Source: FAOSTAT.

A-3). As livestock sectors expand in these regions, import demand for meat lessens. Domestic meat production in Asia has kept pace with economic growth and consumption in the region. In 1980, high-income Organization for Economic Co-operation and Development (OECD) countries produced 45 percent of the world meat while Asia and the Near East produced less than 20 percent. But by 1998, high-income OECD produced just 36 percent of world meat while Asia's share increased to 38 percent. Much of this growth has been in non-ruminant animal production where production takes place without major land requirements.

Imports of animal feeds have shifted away from developed countries to developing countries. For example, the share of soybean meal imported by developed countries was 84 percent in 1980, but fell to less than 50 percent in 1998. An important use of soybean cake is in livestock production, and this has been a major factor driving import growth in developing countries. China's livestock growth has kept pace with its overall economic growth, dampening its import demand for meat. An abundant labor force has facilitated livestock production, with low wages keeping production costs low. Overall, the increase in domestic consumption has been matched by increases in domestic production. Meat provides a good example of why there is not always a direct link between consumption growth and trade growth.

Determinants of Structural Changes in World Food Trade

Determinants affecting trade structure can be basically broken into factor growth on the supply side, income growth on the demand side, and barriers to trade. This section summarizes these factors and their linkage to trade. Together, these economic forces alter the structure of world agricultural trade. Measuring their individual impact requires a method capable of isolating the effects of each.[5]

Growth in Factors of Production

On the supply side, changes in the relative abundance of primary factors (labor, capital, and land) determine changes in production costs. Differences in production costs across countries are influenced by relative differences in wages, cost of capital, and land. The relative abundance of arable land is the most important determinant of agricultural production. Land, however, is a fixed resource for most regions. Long-run changes in agricultural production must be accompanied by changes in other variable factors such as capital, labor, or productivity growth. Factor intensities (relative input use of factors) can vary for different commodities and countries. Some countries rely more heavily on capital inputs, while labor-abundant countries use labor more intensively. In theory, sectors intensively using the more abundant factor expand more than those sectors requiring greater input use of a more scarce resource.[6] Countries with higher rates of capital accumulation but slow population growth become rela-

[5] These factors were taken into account in the modeling framework employed in the study conducted by Coyle *et al*. The Global Trade Analysis Project (GTAP) is employed in this study to simulate the historical changes in world trade.

[6] The Rybczynski theorem in trade theory predicts that when the endowment of one factor increases faster than others, the sectors that use this resource most intensively increase their output faster than other sectors (Bowen 1994).

tively more capital intensive, which in turn favors sectors using capital more intensively.

As growth occurs, the supply of factors used in production changes, with different sectors in the economy competing for resources. This affects production costs differently in each sector. For example, rapid economic growth driven by industrial production in East and Southeast Asia bids up wages for workers in this region. As a greater share of the labor force is employed in manufacturing and service sectors, agricultural labor costs rise. As an example, the cost of producing rice in Thailand increased when wages rose from rapid expansion in light manufacturing and services activity during the mid-1990s.

In each country, growth rates of the labor force and physical capital stock differ. In many developing countries, capital is often relatively more scarce than other inputs. This has implications for production and trade. As an example, the processing of oilseeds for vegetable oils and protein meal is capital-intensive, requiring plant and equipment investments. In regions where capital is scarce it may be more economical to support a livestock sector by importing processed feed ingredients.

Skill, Technology, and Productivity

A higher rate of educational attainment generally results in an expansion in the supply of skilled labor. Skill requirements can vary with technologies employed in the production process. For example, in many developing countries, lower skilled production technology is employed in primary agriculture and processing.

The relative abundance of lower waged labor has helped support growth of poultry and pork sectors in many low-income and middle-income countries. However, modern poultry production and processing requires high capital investments. In higher income countries, meat production and meat processing sectors have had to adopt labor saving technology. This is particularly true for Europe, Japan, Canada, and the United States where it has become imperative to employ more capital-intensive technology to remain profitable.

Productivity growth through technological progress has played an important role in agricultural growth. It is a well-documented source of growth for most developed countries. Measuring the effect of productivity on the composition of trade requires commodity-specific productivity rates by region.[7] This could be an important factor driving production and trade composition change.

Have supply-side effects had an impact on the shift in agricultural trade away from bulk to non-bulk commodities? In the study conducted by Coyle *et al*, supply-side effects did not contribute to major changes in the structure of world agricultural trade. One reason is that there have not been substantial factor price changes or significant differences in factor intensities. The supply-side effects have had more to do with shifts in economy-wide structure rather than compositional changes within agriculture.[8] Rapid capital accumulation has fostered faster growth in industrial production, particularly in the East Asian region.

Income Growth

The specific food sectors that account for the largest changes are largely demand driven. Demand-side effects come about as household income rises. Food in general is a 'normal' good where an increase in income brings about an increase in food expenditures. But the share of a household's budget devoted to food generally falls as incomes rise, while expenditure share for services rises.[9] However, not all shares *within* the food sector fall proportionately due to the household's preference for diet upgrading. This behavior can be empirically measured and represented in a demand system used for formal modeling applications. As income-driven shifts in consumption take place in a country, it can lead to changes in the structure of imports.

Consumption patterns are a function of many factors and not always directly related to income changes. They can coincide with lifestyle changes where greater emphasis is placed on convenience. This can lead towards greater food purchases away from home, reducing preparation costs at the same time the mix of commodities consumed may change. As this occurs some food commodities may experience not only a decrease in the share of food expenditure, but an absolute decline in per capita consumption. In East

[7] This type of detail was not available in the study conducted by Coyle *et al*.
[8] As economic growth occurs, agricultural output generally declines as a share of total GDP.
[9] This is known as the Engel effect.

Asia, for example, per capita rice consumption has actually dropped in Japan, Taiwan, and South Korea as per capita incomes rose. Since these countries were previously not major rice importers due to import controls, the impact on world rice trade from income effects is unnoticeable.[10] The impact on trade comes about as consumption of different types of foods such as dairy, meat, beverages, and prepared food increases.

Another interesting aspect concerning the consumption and trade link is that changes in total food intake may not occur when the composition of food consumption and trade changes. This is important for high-income countries and can account for large changes in global food trade.

As income rises, preferences for foreign brands or varieties may increase as per capita consumption of that item remains relatively flat. A small change in foreign share of total domestic consumption in a country can bring about changes in the composition of total food imports.[11] The demand for foreign varieties of products contributes to simultaneous exporting and importing of similar products between the same trading partners. This results in *intra-industry* trade.

Trade Barriers

Other factors can affect trade structure besides supply and demand-side factors. These are barriers to trade, which exist in the form of policies and transportation costs. There are substantial differences in tariff rates for different commodities. In temperate countries, tropical products such as bananas and coffee beans tend to have very low levels of protection, whereas commodities that compete directly with domestic production in those countries may have much higher barriers such as rice, wheat, meat, and dairy products. In some cases reductions in trade barriers affect trade but may not alter consumption. This occurs as barriers are reduced and consumers directly substitute domestically produced goods for imported goods, leaving consumption unchanged. In other cases, lowering tariff barriers can greatly expand consumption. This is particularly true for developing countries where certain commodities are deemed luxury items and governments can raise revenues with heavy taxes at the border. For many years, fresh apples in Southeast Asia carried very high import tariffs, severely limiting their consumption since domestic production was small or non-existent.

A commodity-specific policy can affect the composition of trade. Subsidization of soybean meal production creates a bias in favor of exporting processed products over soybeans, a bulk commodity. On the other hand, an import policy of tariff escalation over processed products creates a bias in favor of bulk trade. Overall, the combined effect of trade policy has an indeterminate effect on the composition of trade. Reduction in barriers can expand total agricultural trade while leaving the composition (bulk and non-bulk shares) unaffected. This is because trade barriers are applied to both bulk and non-bulk commodities, leaving the change in composition unnoticeable. Under simulated conditions, reductions in trade barriers from 1980 to 1995 showed little change in the composition of agricultural trade. A further complication is that non-tariff barriers (NTB), such as quotas, were replaced by tariffs, creating measurement problems for change in actual rates of protection. As a result, tariff protection in the OECD countries has generally increased while the share of imports covered by NTBs declined over this time period. It was found in the Coyle *et al*. study that policy reform over the 15 years before 1995 were not a significant factor affecting the change in the composition of agricultural trade.

Transport costs can act as a formidable barrier to trade just as tariffs and, like tariffs, these costs vary by commodity. Higher transport costs are generally associated with non-bulk perishable commodities. Thus, it would seem more likely that a reduction in overall transport costs would benefit trade in non-bulk commodities, thereby affecting the composition of trade. Furthermore, technological innovation has been greater for perishable products. A problem in measuring transportation's effect on trade is that technological innovation is not easily captured by changes in shipping costs alone. It was found that even while technological change took place in shipping it does not necessarily lead to lower freight rates but to better and faster service.

[10] Rice imports of these countries represent less than 3 percent of world rice trade.

[11] For example, trade in beer has grown faster because of increased consumption of foreign brands rather than in increased total beer consumption. Canada and the United States concurrently export and import beer and grain-based food products. In high-income countries, import demand for new varieties is an area that deserves greater attention (see Feenstra 1994).

Modeling Income Effects

This study employs a modified version of the GTAP model. For our purpose here it is used to simulate the effects of historical growth on world trade. Specifically we are interested in the changes in the historical trade patterns attributed to income growth.

Income effects in the model are driven principally by income elasticities. The income elasticities used in our modified version of the GTAP model are reported in table A-4. These are based on estimates provided by Cranfield et al. and mapped to the GTAP regions. The 1995 parameters are calibrated to the model's base period whereas the 1980 elasticities are derived in a backcasting exercise where prices are held constant and real expenditure is reduced in each region to the 1980 income level (shown in table A-4). The differences across regions reflect variations in the level of income in each region. The change from 1995 back to 1980 depends on the changes in income growth on a per capita basis. Clearly the most dramatic changes are in those regions where there has been greater changes in per capita income. In the Asian NICs region for example, the expenditure elasticity of demand for grains fell from 0.44 to 0.08. This would suggest that the effect of income growth on the demand for grains would be far greater in 1980 than in 1995. According to these estimates, in 1980 livestock products in China are considered a luxury good given that the income elasticity exceeds 1, however, this parameter is reduced to 0.96 in 1995 as per capita incomes have risen in China. In the high-income regions of Australia, Canada, Japan and the United States, the income elasticity of demand for livestock products was only marginally higher in 1995.

The general approach in performing the demand-side experiment is a form of "backcasting" where observed changes in population and economic growth are the exogenous variables in the model. Prices and quantities are endogenous for all other domestic and trade variables. In this type of experiment the model produces change in trade composition attributable to income effects alone. In most regions of the world economic growth exceeds population growth (table A-5). In China, per capita incomes grew the fastest in the world. In some regions per capita income was negative, including Mexico, the Middle East and North Africa and the Economies in Transition. Of primary interest is how the composition of trade changes as a result of changes arising from per capita income growth in individual regions.

Table A-5—Population and economic growth by region, 1980-1995

Regions	GDP	Population
	Percent	
Australia	2.9	1.3
Japan	3.2	0.5
E.Asian NICs	7.7	1.2
ASEAN	6.2	1.9
China	10.1	1.3
Canada	2.4	1.2
United States	2.5	1.0
Mexico	1.3	2.0
Mercosur	1.8	1.7
Western Europe	2.0	0.3
Economies in Transition	0.0	0.6
Mideast and North Africa	0.7	2.9
Rest of the World	2.5	2.3
World	2.6	1.7

Source: World Development Indicator, The World Bank.

Table A-4—Income elasticities estimated from AIDADS by region, 1980 and 1995

	Grains		Livestock		Horticulture		Other food	
	1980	1995	1980	1995	1980	1995	1980	1995
				Elasticities				
Australia	0.103	0.057	0.696	0.760	0.419	0.478	0.524	0.594
Japan	0.082	0.032	0.652	0.727	0.368	0.428	0.474	0.550
Asian Newly Industrialized Countries	0.439	0.084	0.685	0.663	0.538	0.376	0.589	0.486
ASEAN countries	0.597	0.307	0.769	0.677	0.661	0.468	0.702	0.545
China	0.938	0.757	1.079	0.959	0.985	0.826	1.074	0.925
Canada	0.048	0.025	0.716	0.776	0.425	0.493	0.540	0.613
United States	0.022	0.010	0.754	0.814	0.465	0.547	0.583	0.665
Mexico	0.184	0.142	0.662	0.680	0.409	0.408	0.504	0.513
MERCOSUR	0.190	0.122	0.663	0.651	0.390	0.377	0.478	0.481
Western Europe	0.098	0.065	0.694	0.738	0.419	0.452	0.522	0.568
Economies in Transition	0.337	0.335	0.686	0.685	0.479	0.478	0.561	0.560
Mideast and North Africa	0.439	0.404	0.714	0.704	0.550	0.528	0.613	0.595
Rest of the World	0.812	0.739	0.982	0.936	0.871	0.808	0.958	0.899

Estimated by Cranfield, Hertel, Eales, and Preckel 1998.

Evidence of Income Growth Effects on Agricultural Trade Patterns

This section reports results from a formal modeling exercise (see box "Modeling Income Effects"). Results for the income growth experiment (shown in tables A-6-A-9) are reported for four aggregate commodities, including processed commodities, livestock products, bulk commodities, and horticultural products. Import value shares are calculated for each of the 13 regions and for the world for each of the four time periods.

Overall, the direction of share changes is consistent with historical changes over this period. This confirms that income effects on food consumption have contributed to the changing structure of world trade. However, there are wide differences across individual regions. A large proportion of the shift occurs in higher income countries. Generally, the regions that have experienced the greatest per capita income change generally have the largest change in their trade structure.

High-income countries exhibited the greatest shift toward processed products. For example, Japan's processed share expanded from 0.26 in 1980 to 0.32 in 1995, reflecting the relative importance of expenditure growth for these products. Similarly for Asia's Newly Industrialized Countries (NICs), the processed commodity share increased from 0.23 to .30. While China experienced the fastest growth of all regions, this did not lead to dramatic changes in its trade structure. Much of the adjustment from income effects takes

Table A-6—Simulated import shares for processed commodities

Regions	1980	1985	1990	1995
		Percent		
Australia	0.47	0.49	0.50	0.52
Japan	0.26	0.28	0.31	0.32
E. Asian NICs	0.23	0.24	0.27	0.30
ASEAN	0.25	0.25	0.26	0.28
China	0.14	0.15	0.15	0.16
Canada	0.37	0.39	0.42	0.42
USA	0.31	0.33	0.36	0.37
Mexico	0.20	0.20	0.20	0.19
Mercosur	0.30	0.30	0.30	0.31
Western Europe	0.30	0.31	0.34	0.34
Economies in Transition	0.43	0.44	0.50	0.42
Mideast & North Africa	0.23	0.22	0.20	0.20
Rest of world	0.31	0.31	0.31	0.31
World	0.30	0.31	0.33	0.33

Source: Simulated from Modified GTAP Model.

Table A-7—Simulated import shares for livestock commodities

Regions	1980	1985	1990	1995
		Percent		
Australia	0.10	0.10	0.10	0.10
Japan	0.25	0.26	0.27	0.28
E. Asian NICs	0.23	0.23	0.23	0.23
ASEAN	0.14	0.14	0.14	0.14
China	0.08	0.08	0.08	0.09
Canada	0.12	0.13	0.13	0.14
USA	0.14	0.14	0.15	0.15
Mexico	0.20	0.20	0.20	0.20
Mercosur	0.15	0.15	0.15	0.15
Western Europe	0.22	0.23	0.24	0.24
Economies in Transition	0.19	0.19	0.20	0.19
Mideast & North Africa	0.19	0.18	0.18	0.18
Rest of world	0.13	0.13	0.13	0.13
World	0.20	0.20	0.21	0.21

Source: Simulated from Modified GTAP Model.

Table A-8—Simulated import shares for bulk commodities

Regions	1980	1985	1990	1995
		Percent		
Australia	0.30	0.30	0.30	0.29
Japan	0.35	0.31	0.26	0.24
E. Asian NICs	0.38	0.36	0.32	0.29
ASEAN	0.41	0.40	0.39	0.37
China	0.50	0.50	0.49	0.47
Canada	0.23	0.23	0.22	0.22
USA	0.35	0.34	0.33	0.32
Mexico	0.38	0.38	0.38	0.39
Mercosur	0.27	0.27	0.27	0.27
Western Europe	0.25	0.25	0.24	0.24
Economies in Transition	0.24	0.23	0.17	0.25
Mideast & North Africa	0.33	0.33	0.33	0.33
Rest of world	0.33	0.33	0.33	0.33
World	0.29	0.28	0.27	0.28

Source: Simulated from Modified GTAP Model.

Table A-9—Simulated import shares for horticultural products

Regions	1980	1985	1990	1995
		Percent		
Australia	0.07	0.06	0.06	0.06
Japan	0.06	0.06	0.07	0.07
E. Asian NICs	0.05	0.05	0.06	0.06
ASEAN	0.06	0.06	0.06	0.06
China	0.02	0.02	0.02	0.02
Canada	0.19	0.19	0.19	0.20
USA	0.15	0.15	0.14	0.14
Mexico	0.04	0.04	0.04	0.03
Mercosur	0.08	0.08	0.08	0.08
Western Europe	0.13	0.13	0.13	0.13
Economies in Transition	0.09	0.09	0.09	0.09
Mideast & North Africa	0.06	0.06	0.06	0.06
Rest of world	0.06	0.06	0.06	0.06
World	0.11	0.11	0.10	0.10

Source: Simulated from Modified GTAP Model.

place domestically rather than in China's external trade.[12] Among some of the lower income regions, the share of processed commodities actually fell. This was the case for Economies in Transition, Mexico and the Middle East and North African region.

The growth in imports of livestock products was roughly proportional to agricultural trade growth, keeping the share nearly the same for most countries. Based on our simulation exercise, the largest change in the livestock import shares are found in the high-income countries of Japan, Canada, and Western Europe. For these regions the income elasticity increased marginally from 1980 according to simulated estimates. The opposite occurs for developing countries where the income elasticity has fallen. In those cases, import shares for livestock have remained the same over this period.[13]

In nearly all regions of the world the import share of bulk commodities declined. Much of the shift away from this aggregate category took place in higher income regions, particularly in the higher income Asian regions. For Japan, the share dropped the most, from 0.35 to 0.24. For the Asian NICs, the drop in the bulk share was nearly as large.

Of these aggregate commodities, horticultural products represent the smallest share of agricultural imports. Like livestock products, this category grows roughly proportional to total agricultural trade. The direction of change for the horticultural product share differs by region. This is partly due to the fact that, across this time period, expenditure elasticities also vary by region.

Conclusions

Several factors can contribute to the changing composition of world agricultural trade. An earlier study indicated per capita income levels to be the most important factor affecting food consumption patterns. Developed countries have played a major role in the aggregate shift of world agricultural trade towards imports of non-bulk commodities. Income growth effects on import demand differ between developed and developing countries. The growth in imports of processed food products by developed countries is not necessarily a reflection of increased per capita consumption or diet upgrading but rather diversification of consumption towards foreign varieties.

For an individual commodity there is not always a direct link between consumption and trade growth. In developing countries, diet upgrading and increased consumption of livestock products do not necessarily translate into higher import shares of these products over grains and other bulk commodities. Imports of animal feed help expand domestic livestock production while reducing the need for direct imports of livestock products. The most noteworthy example is China, where rapid economic growth has not yet created a major import demand for meat and livestock products. Rather, domestic livestock production has accelerated in China in the past two decades.

There are likely many complex factors driving changes in world food trade besides the standard economic determinants discussed here. Future research challenges will be to examine other factors besides income such as the role of urbanization in developing countries. It is likely that not only are income effects important, but the stage of development, distribution of income, and the geography and culture of a country are important factors affecting the changing content of a country's food imports.

[12] China has a low import share of total domestic consumption. In the model, substitution between foreign and domestic sources (Armington specification) governs the degree to which imports can compete with domestic production.

[13] Part of the problem is with the use of an aggregate livestock category containing a large non-food component (hides and skins). Industrial uses of livestock products are not directly related to income-induced dietary changes in developing countries. Furthermore, demand for hides and skins imports is a derived demand for footwear. This is complicated by the fact that hides and skins are used for leather in shoe-making where demand in footwear (the final good) is derived from the export demand in developed countries.

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Cross-Country Analysis of Food Consumption Patterns

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Abstract: Low-income countries spend a greater portion of their budget on food and are more responsive to income and food price changes than middle- and high-income countries. Higher value food products undergo greater budget adjustments to price and income shocks, while budgets for staple food products like cereal change the least.

Introduction

The world population is expected to increase by more than 1.2 billion people between 1998 and 2018, almost all of whom will reside in low and middle-income countries (The World Bank, 2000). The expected increase in population, combined with rising income levels in developing countries, is expected to account for most of the anticipated increases in global food demand over the next couple of decades. Cross-country food demand analysis can improve understanding of global food trends by quantifying the relationship between food demand, composition of food, and income levels. This knowledge in turn can provide crucial input in assessing future global food needs.

While the previous chapter described the factors that affect food consumption and trade patterns across time, focusing on region-specific income effects, this chapter will examine how changing incomes and prices affect changes in food expenditure for a cross-section of countries ranging from low, to middle, to high income. The results discussed in Chapter 1 were derived from a simulation study based on demand elasticity estimates from 1985 data. Our paper in turn will estimate demand elasticities using 1996 data, which could potentially be used in future simulation studies. In addition to examining the effect on aggregate food demand, this chapter will also examine the effect of income and price changes on food subgroups such as: bread and cereals, meat, fish, dairy products, oils and fats, fruit and vegetables, and other food products.

Background

As described in the previous chapter, rising income and improved access to a greater variety of food results in changes in food consumption patterns. This chapter further indicated that developed countries exhibit greater preference for high-value processed products as income increases. Other studies indicate that with an expected large growth in population and income levels, developing countries will mainly account for overall future increases in global food demand. For example, a recent publication suggests that about 85 percent of the increase in the global demand for cereals and meat between 1995 and 2020 will occur in developing countries (Andersen, Pandya-Lorch, and Rosegrant 1999). The same study also indicates that the demand for meat in the developing world could potentially double during this 25-year period.

While global food demand, especially in developing countries, is expected to increase with income, the food share of total budget is expected to decline as income increases. An Economic Research Service (ERS) analysis of 51 countries indicated that on average, high-

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income countries spend 16 percent of their expenditures on food, while low-income countries spend 55 percent (ERS 1997). Similarly, the cross-country demand analysis conducted by Theil, Chung, and Seale (1989) using the first four phases (1970-1980) of the International Comparison Project (ICP) further confirms that the proportion of budget spent on food decreases with income, and that wealthier countries are less responsive to changes in income and food prices. Results from the study by Cranfield, *et al*. (1998), using the 1985 ICP data, indicates that poorer countries are expected to experience larger growth in total food demand during the next two decades.

Rising income is also expected to change the composition of food demand, especially in developing countries. This is illustrated both by the ERS study (July 1997), which indicates that rising income levels generally result in a more diverse diet, as well as by Cranfield, *et al*.'s analysis which concludes that the composition of food demand will undergo a greater change in developing countries compared with developed countries. In low per capita income countries, cereal consumption accounts for a large share of the total food budget. As per capita income rises, consumers in these countries will shift some consumption away from lower value cereals to higher value livestock products. In developed countries, where incomes and livestock product consumption are already high, consumers are expected to make relatively small adjustments between food consumption groups with changes in income levels. As indicated in Chapter 1, the substitutions made by consumers in developed countries may lead to greater consumption of processed high-value products, or consumers may upgrade food consumption to newer and foreign varieties that are perceived to be of better quality. These shifts in food consumption may be within the same food subgroups and therefore may not be evident by demand analyses of broad food subgroups.

International Evidence on Food Consumption Patterns

The 1995 International Comparison Project data are used to analyze the demand for food in 99 countries ranging from low- and middle- to high-income (see box). Consumer response to changes in factors affecting demand is measured by elasticities. For example, an income elasticity measures the responsiveness of the quantity demanded to a unit change in income, while price elasticity measures the responsiveness of the quantity demanded to a unit change in price. When an income elasticity for a product is greater than one, the product is considered to be a luxury good and accounts for an increasing proportion of total expenditures with increases in income. When an income elasticity of demand is less than one, the product is considered to be a necessary good and accounts for a smaller proportion of total expenditure as income increases.

To examine the effect of income on consumption, countries are grouped together according to per capita income (as calculated from the expenditure data). Low-income countries represent those with real per capita income less than 15 percent of the U.S. level, middle-income with real per capita income between 15 and 50 percent of the U.S. level, and high-income with per capita income greater than 50 percent of the U.S. level. This criterion for grouping places the majority of Sub-Saharan African countries, poor transition economies such as Mongolia and Turkmenistan, and low-income Middle Eastern countries such as Yemen within the first group. High income countries include most Western European countries, Australia, New Zealand, Canada, Japan, and the United States; while the middle income countries include better-off transition economies such as Estonia, Hungary and the Czech Republic, North African countries, and many Latin American countries.

Poorer Countries Spend a Higher Proportion Of Their Budget on Food

Consistent with past findings, our results indicate that low-income countries spend a greater portion (47 percent) of their total expenditures on food compared with richer countries, which on average spend 13 percent of their total budget on food (table B-1). In general, lower income countries spend a greater proportion of their budget on necessities such as food, while richer countries spend a greater proportion on luxuries. With income elasticity below one, food, beverages and tobacco, and clothing and footwear appear to be necessities in all countries, while education, gross rent, fuel and power, house operations, medical care, recreation, transport and other groups are all luxuries.

Food Demand in Poorer Countries is More Responsive to Income Changes

To compare our estimates with those of Theil, Chung, and Seale from the earlier phases of ICP, we observe

Table B-1—Budget shares and income elasticities of aggregate consumption categories

Consumption categories	Low income <15% of U.S.	Middle income 15-50% of U.S.	High income >50% of U.S.	Low income <15% of U.S.	Middle income 15-50% of U.S.	High income >50% of U.S.
	--- *Budget shares* ---			--- *Income elasticity* ---		
Food	0.47	0.29	0.13	0.73	0.58	0.29
Beverages & tobacco	0.04	0.05	0.04	0.97	0.97	0.97
Clothing & footwear	0.08	0.07	0.05	0.90	0.88	0.86
Education	0.06	0.07	0.08	1.06	1.05	1.05
Gross rent, fuel & power	0.09	0.14	0.18	1.24	1.18	1.16
House operations	0.05	0.07	0.07	1.17	1.14	1.12
Medical care	0.04	0.08	0.11	1.74	1.35	1.26
Other	0.07	0.09	0.15	1.59	1.32	1.24
Recreation	0.02	0.04	0.07	1.76	1.42	1.29
Transport	0.08	0.11	0.13	1.24	1.18	1.15
Number of countries	32	41	26	32	41	26

the income levels and elasticities for the 39 countries present in both datasets. As earlier mentioned, Theil, Chung, and Seale used the first four phases of ICP, which included data collected between 1970 and 1980, to estimate the demand for the same aggregate consumption groups as estimated in this study. The horizontal axes in figures B-1 and B-2 represent countries arranged in ascending order of 1996 per capita income, with Tanzania near the origin and the United States at the extreme end. As shown in figure B-1, between 1980 and 1996, real per capita income grew faster for wealthier countries than for the poorer countries. Figure B-2 compares the income elasticity for food from the two studies, which appear to be relatively similar. These results indicate that poorer countries are more willing to change their expenditures on food in response to changes in income, as measured by the income elasticity. As income level rises, the income elasticity declines.

Between 1980 and 1996, there is very little change in income elasticity among the poorer countries, which experienced slower growth in per capita real income compared with developed countries (fig. B-1). During this time, developing countries experienced rapid urbanization, which increased the availability and the selection of food in these markets. Urbanization, as will be discussed in greater detail in the next chapter, may have contributed to maintaining or even increasing the income elasticity for food in low-income and many middle-income countries in 1996 compared with 1980 (fig. B-2). The large increase in the estimated income elasticity for Brazil (the lone peak in the graph) can be attributed to the prevailing currency crises during this period. Except for several European countries, among the wealthier middle-income and higher income countries, the income elasticity for food in 1996 is lower than in 1980. The adoption of the Common Agricultural Policy (CAP) by several countries between 1980 and 1996 and the subsequent modification of the CAP in 1992 may have influenced income elasticities in European countries. The CAP maintained agricultural prices at artificially high levels in European countries, thereby increasing expenditures for food as per capita incomes rose. In addition, European countries that adopted the CAP were forced to maintain the same trade barriers as the rest of the European Union (EU), thereby diverting trade away from lower cost imports from countries outside the EU.

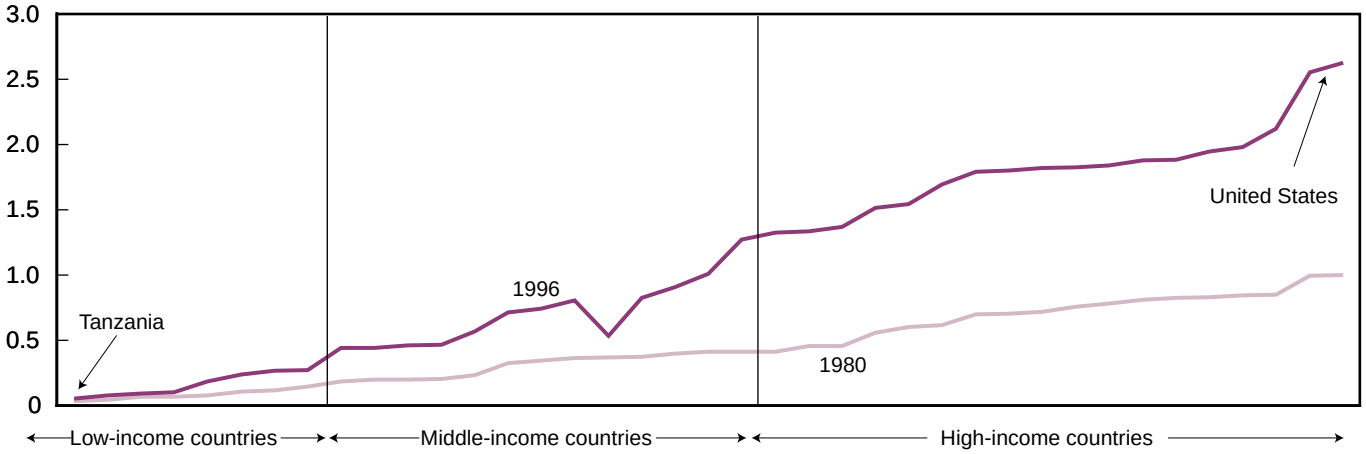
Food Demand in Poorer Countries is More Responsive to Food Price Changes

Figure B-3 compares the price elasticities for aggregate food groups between 1980 and 1996, reflecting the consumer response to price changes with no compensation in income levels. For both years, poorer countries are highly responsive to changes in food prices compared with wealthier countries. As incomes increased between 1980 and 1996, the price elasticity for food for many middle-income and all low-income countries also increased contrary to expectations. This is because income levels did not grow much for most low-income and many middle-income countries during 1980-1996, and real per capita income in 1996, although higher than in 1980, continued to remain at very low levels compared with wealthier countries. Additionally, as discussed earlier, developing countries experienced rapid urbanization, which has increased the availability and choices of food in these countries. This in turn has enhanced consumer ability to select lower value substitutes within a food group as prices increase for certain food items within the same group. Food price elasticities for many higher income coun-

Figure B-1

Per capital real income

Index, 1980 US$=1.0

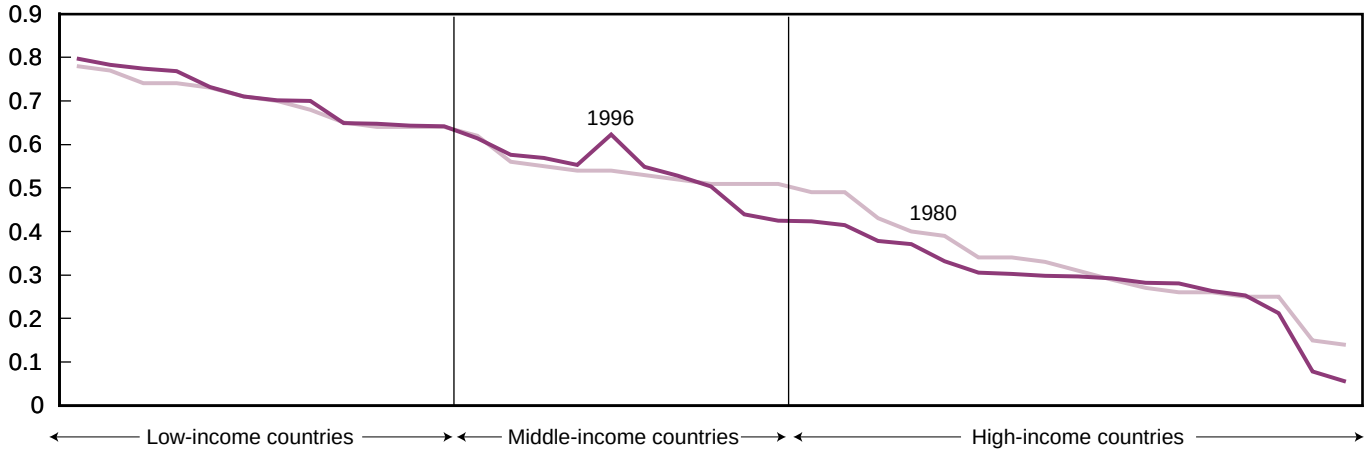


Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

Figure B-2

Income elasticity for food

Elasticity



Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

tries were about the same or less in 1996 than in 1980. The exception to this category is again several European countries, which as already mentioned, may have been affected by the adoption and modification of the Common Agricultural Policy.

Composition of Food Moves from Low-Value To High-Value as Income Increases

As indicated in table B-2, cereals, fats and oils, and fruit and vegetables (including tubers) account for a larger share of the total food budget in low-income countries compared with high-income countries. On the other hand, meat and dairy budget shares are greater for high-income countries compared with both low- and middle-income countries. Excepting dairy products among the extremely poor countries and fish for all low-income and many middle-income countries, all other food groups are necessary goods as indicated by elasticity levels that are less than one.

Analysis of Cross-Country Food Demand Model

Analytical Framework

Our analysis employs a two-stage budgeting process (Deaton Muellbauer, pp. 122, Theil, Chung, and Seale, pp. 129-138) which assumes that consumers first allocate their budget to broad consumption groups. Given the budget for the broad groups, consumers then make budget decisions for items within each group. Accordingly, we first estimate an aggregate demand system across 10 broad consumption categories (food being one of them), followed by a second demand system comprising seven food sub-categories. The first stage assumes preference independence between the 10 broad consumption categories: food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, house furnishings and operations, medical care, transport and communications, recreation, education, and other consumption expenditures. This implies that the preference ordering among items within one broad consumption group is not dependent on the quantities of items consumed in other groups. Using the maximum likelihood estimation process, parameters for the Working's Preference Independence model (Theil, Chung, and Seale 1989) are estimated from the first stage of the analysis, which in turn yield income and price elasticities for the 10 broad consumption groups.

The second stage of the analysis involves the estimation of parameters for the seven food sub-categories, bread and cereals, meat, fish, dairy products, fats and oils, fruit and vegetables, and other food products. In this analysis, preference independence cannot be assumed since the demand for a particular food group may be dependent on consumption of items in other food groups. For example, demand for meat products may be dependent on consumption of fish. Therefore, the more suitable Working Slutsky model (Theil, Chung, and Seale, 1989) is used in this estimation. Based on the parameters estimated from the second model, we can calculate the conditional income and price elasticities for each food group. The unconditional demand elasticities can then be obtained by multiplying the conditional elasticities by the corresponding elasticity for food as an aggregate group obtained from the first step of the analysis.

The analytical framework used in this study follows the methodology developed and described in detail by Theil, Chung, and Seale (1989). They estimated the demand for 10 broad consumption categories, namely, food, beverages and tobacco, clothing and footwear, gross rent, fuel and power, house furnishings and operations, medical care, transport and communications, recreation, education, and other consumption expenditures. All data are normalized with reference to the United States, and all domestic prices are converted into U.S. dollars to facilitate comparison.

Data

The International Comparison Project (ICP), initiated by researchers at the University of Pennsylvania, is currently maintained by the Statistical Advisory Services of the World Bank. Over the years, data collected by the ICP has increased from 10 countries in Phase I (1970) to 115 countries in 1996. The study conducted by Theil *et al*. (1989) used the Phase IV data from 60 countries, while the study by Cranfield *et al*. (1998) used the 1985 data covering 64 countries. The current study uses the 1996 ICP data, which covers expenditure and price data for 115 countries, over 10 broad consumption categories, and 22 sub-categories.

To conduct cross-country analysis, consumption expenditures and prices expressed in different currencies must be expressed in terms of a base country currency comparable across countries. One solution to convert expenditures into a single currency would be to use the exchange rates. However, exchange rates do not account for the fact that services are cheaper in less developed countries. Therefore, exchange rates tend to overstate the poverty of poorer countries. To obtain more accurate estimates for individual countries, ICP uses the Geary-Khamis (The World Bank, 1993) method of aggregation to arrive at prices that are in terms of purchasing power parities (PPPs) relative to a base country. Similarly, expenditures are aggregated using the Geary Khamis method to arrive at total per capita real expenditures relative to a base country, which is used as a proxy for per capita real income. Our analysis uses the United States as the base country for calculating PPP and per capita real income.[1]

[1] The program ICP ToolPak developed by Yuri Dikhanov, Statistical Advisory Service, the World Bank, was used.

Continued on page 19

Continued from page 18

The 1996 ICP data was collected between 1993 and 1996 by six different agencies contracted by the United Nations for countries in Asia, Africa, the Middle East, the Caribbean, Latin America, OECD, and the Commonwealth of Independent States (CIS). Each of the agencies was responsible for collecting data for a particular region for which the data was collected at a very disaggregate level and then aggregated upward using the PPP methodology to express it in terms of base country currency, which in most cases was 1996 U.S. dollars. However, not all PPPs were expressed relative to the United States. Data for Asia were expressed relative to Hong Kong and data for Latin America were expressed relative to Mexico. Since Mexico was also represented in the OECD data, merging Latin America with the rest of the data was relatively easy. Merging Asia has proven to be more challenging. Japan is represented in both the Asian and OECD data, but matching the two datasets indicated scaling problems within the Asian data. Therefore, the current analysis is conducted for 99 countries, excluding 13 countries from Asia, two from the Caribbean, and Herzegovina, for which population data were unavailable. Food expenditure data for the two Caribbean countries, Bermuda and Belize, appeared to include a large amount of expenditures by tourists and were therefore unrepresentative of the indigenous population.

Results

The results from the estimation of our demand systems confirm Engel's Law and appear to be consistent with previous studies closely matching those obtained by Deepak, Shapouri, and Seale for Brazil (June 2000). Similarly, the estimated elasticities for cereal and horticultural products presented in table A-4 are similar to those obtained in our study. The elasticity of demand for meat estimated from our study cannot be compared with the elasticity of demand for livestock in Chapter 1, since Gehlhar and Coyle include dairy in their estimation of demand for livestock products, while our study separates dairy and meat into two food categories. Furthermore, in comparing the elasticity from the two studies, one has to bear in mind that the elasticities presented by Gehlhar and Coyle are computed based on parameters estimated using the 1985 data (Cranfield et al. 1998) and are not derived from direct estimation of 1980 or 1995 data. A detailed list of the estimated elasticities together with the respective countries will be presented in a forthcoming ERS technical bulletin.

Most of the parameters estimated for food sub-categories, except for fish and fruit and vegetables, were statistically significant at the 1-percent level, but all parameters were significant at the 5-percent level. These results could be explained by the data. Fish consumed in poor developing countries may not enter the retail market, while fish consumption in developing land-locked countries may be very low. Similarly, this fruit and vegetables group also includes data on roots and tubers and may explain why the parameters estimated for this sub-group are not very robust. As income increases in poor countries, consumers tend to move away from consuming cassava, sweet potatoes and other tubers, to consuming staples such as rice and wheat. On the contrary, as income increases, consumption of fresh fruits and vegetables is expected to increase.

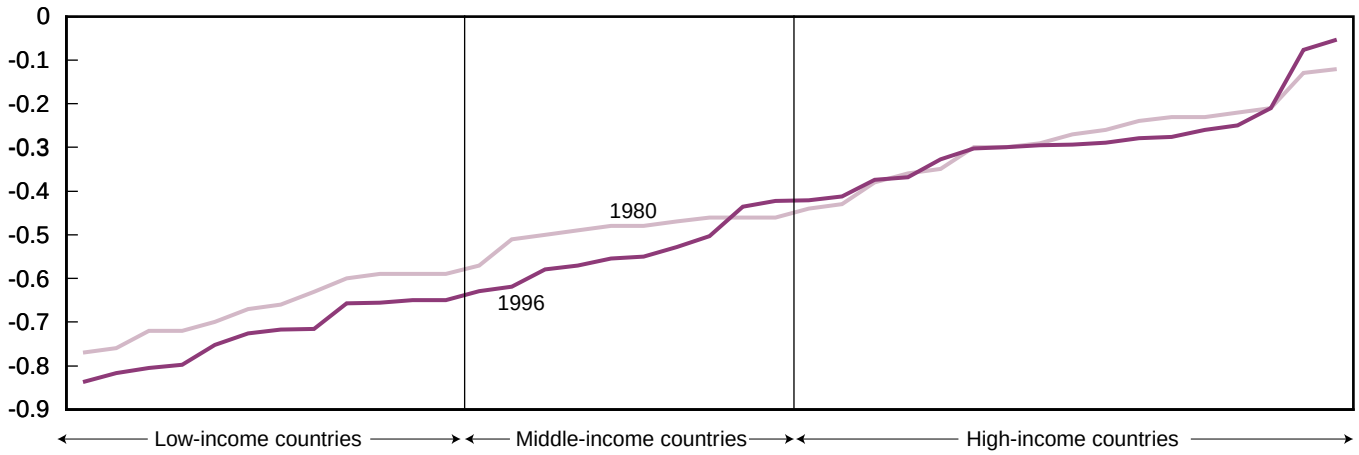
Food Sub-Group Demand in Poorer Countries Is More Responsive to Income Changes

For all food subgroups, poorer countries exhibit a greater responsiveness, as given by the income elasticity (table B-2), to changes in income levels compared with wealthier countries. For example, when income falls, poorer countries make bigger cutbacks in consumption expenditure of different food groups than wealthier countries do. However, these cutbacks are not implemented evenly across the different food groups. Larger cuts are made on higher value items such as fish, dairy, and meat, while the consumption of cereal, the main staple, is cut the least. Conversely, when income increases, poorer countries increase their expenditure on different food items to a greater extent than wealthier countries, with the greatest increase in expenditure on higher value food items such as dairy and meat.

Staple Food Demand is Less Responsive to Income Changes

For all income levels, countries indicate comparatively lower income elasticities for staple products such as cereals, fats and oils, and fruits and vegetables (includes tubers), than for meat and dairy products. However, the difference between the elasticities for the

Figure B-3
Own-price elasticity for food



Source: 1996 data are ERS/USDA estimates based on International Comparison Project data. 1980 data are from Theil, Henri, Ching-Fan Chung, and James L. Seale, Jr., International Evidence on Consumption Patterns (1989).

Table B-2—Budget shares and income elasticities of food sub-categories

Consumption categories	Low income <15% of U.S.	Middle income 15-50% of U.S.	High income >50% of U.S.	Low income <15% of U.S.	Middle income 15-50% of U.S.	High income >50% of U.S.
		--- Budget shares ---			*--- Income elasticity ---*	
Cereals	0.28	0.20	0.16	0.56	0.41	0.19
Meat	0.18	0.22	0.25	0.82	0.65	0.33
Fish	0.05	0.05	0.06	2.77	0.92	0.43
Dairy	0.09	0.13	0.14	0.93	0.71	0.35
Oils & fats	0.07	0.05	0.04	0.58	0.43	0.21
Fruit & vegetables	0.23	0.21	0.20	0.66	0.53	0.27
Other food	0.11	0.13	0.15	0.80	0.63	0.32
Number of countries	32	41	26	32	41	26

lower value staples and the higher valued items are dramatically larger for poorer countries than for the wealthier countries. For example, the difference between the estimated elasticity for cereal and dairy ranged from a low of .03 for the United States to .42 for Tanzania, while the difference between the elasticity for cereal and fish for the two countries are .042 and 4.04, respectively. This again illustrates that consumers in poorer countries are more willing to change their consumption patterns as income changes.

Food Subgroup Price Change Responsiveness Is Dependent on Income Level

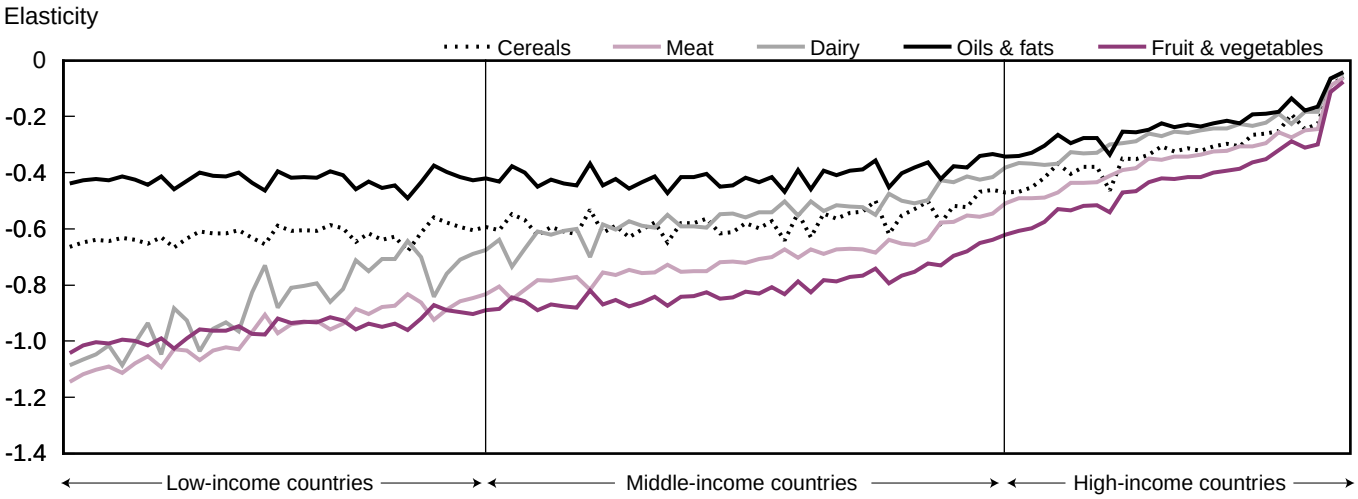
Figure B-4 presents own-price elasticities for the five food subgroups. As shown in the figures, poorer countries are more responsive to food-price changes than wealthier countries. Low- and middle-income countries exhibit similar responses to price changes for staples such as cereals and fats and oils. It is possible that for the lowest income group of countries, price changes may result in substitutions among food within a particular group. For example, when the price of rice increases, poorer consumers may choose to consume corn or sorghum rather than move to a different group such as meat and dairy. Consumers with greater disposable income, on the other hand, may choose to substitute products outside the cereal group. However, for higher value food sub-categories such as meat, dairy, and fruit and vegetables, price change responsiveness directly increases as countries get poorer.

Cereal Price Changes Inversely Affect the Demand for Fruit and Vegetables

Cross-price effects within food consumption subgroups are explored considering the case of cereal price changes. Figure B-5 provides the changes in

Figure B-4

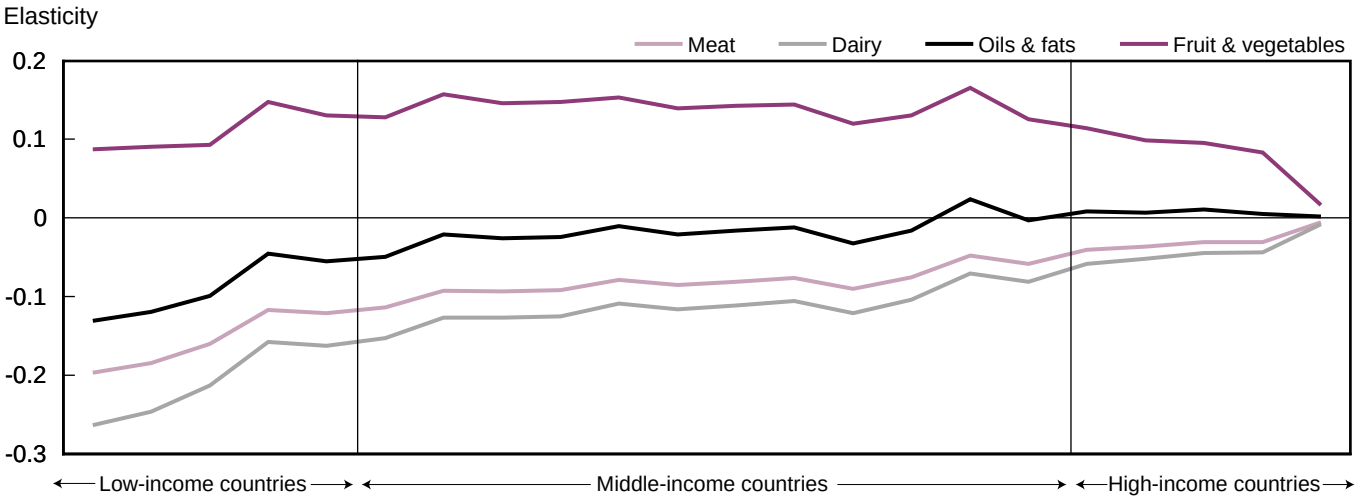
Own-price elasticity for food groups



Source: ERS/USDA estimates based on 1996 International Comparison Project data.

Figure B-5

Cross-price elasticities for cereal



Source: ERS/USDA estimates based on 1996 International Comparison Project data.

demand for meat, dairy, fats and oils, and fruit and vegetables for changes in cereal prices. Fruit and vegetables are substitutes for cereals in all countries, while meat, dairy, and fats and oils are generally complements. As with other elasticities, poorer countries are more price-responsive than wealthier countries, and the dispersion of cross-price elasticities between the food sub-groups greatly increases as the per capita income of a country declines. Cereal cross-price elasticities for the United States range from .0017 for fruit and vegetables to -.008 for meat, while for Tanzania, the range is from .087 for fruit and vegetables to -.26 for dairy.

Conclusion

This paper provides further evidence that both the budget share allocated to food, as well as the income elasticity of food decline as income increases. Low-income countries spend a greater portion of their budget on necessities such as food, while richer countries spend a greater proportion of their income on luxuries, such as recreation. Low-value staples, such as cereals, account for a larger share of the food budget in poorer countries, while high-value food items such as dairy and meat are a larger share of the food budget in richer countries.

Low-income countries are also more responsive to income and food price changes, and therefore, make larger adjustments to their food consumption pattern with changes in incomes and prices. However, our study illustrates that adjustments to price and income changes are not made uniformly across all food categories. Staple food consumption changes the least, while greater changes are made to higher value food items such as dairy and meat. In fact, our results indicate that price changes of staple food such as cereals lead to similar responses in low- and middle-income countries, indicating that consumers in poorer countries may resort to greater substitutions within a food sub-category.

This paper also suggests that per capita income changes in developing countries are often correlated with urbanization, which in turn affects food consumption patterns. The effect of urbanization on food consumption will be discussed in more detail in the following chapter.

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Effects of Urbanization on Global Food Demand

Anita Regmi and John Dyck[1]

Abstract: Urbanization, by affecting caloric requirements, food availability, and female labor status, impacts the structure of food consumption. Urbanization, associated with economic development and income growth, has already largely occurred in developed countries, while continuing strongly in developing countries. Food demand projections may differ if they account for urbanization.

Introduction

The four decades since 1960 have witnessed rapid growth of the global economy and a doubling of the world population. At the same time, global food consumption has kept pace with income and population growth, leading to increased demand for most food commodities. Will this food consumption growth continue? Studies of the world's population have consistently shown that the rate of growth in population is slowing, and that global population may even cease growth sometime in the 21st century. Projections of global food demand have already taken into consideration this slowing of the rate of population growth. In most projections, the other main determinants of food consumption have been income and prices.

Recent research has suggested that other demographic variables also determine the rate and composition of changes in food consumption. Among the most important is the shift of much of the world's population from a rural existence, centered around farming, to urban life centered around non-agricultural occupations. Urbanization, defined as the proportion of urban residents in the total population, has been closely related to economic growth. While economic growth can continue indefinitely and go in cycles, urbanization has so far been a one-way process, and, as in developed countries, eventually the rural share of the population becomes so low that urbanization is no longer an important factor in projecting food balances. In considering what food consumption will be like in the first half of the 21st century, the extent of urbanization and its interaction with income changes are important.

Reasons Why Rural and Urban Food Consumption May Differ

Urbanization can lead to structural changes in food consumption patterns for several reasons. First, given different lifestyles, calorie requirements of urban and rural residents differ, with sedentary urban lifestyles requiring fewer calories to maintain a given body weight. The decrease in calorie consumption per person related to urbanization has been well illustrated by Clark, Huberman, and Lindert (1995), who examined Britain's food consumption pattern between 1770 and 1850, a period of rapid urbanization. Given a dramatic 65 percent increase in income per person during this period, food demand should have significantly increased, assuming even a modest income elasticity of demand for food. However, data indicate that food consumption per person may have stagnated or even declined in Great Britain during this period. The authors point out that different calorie requirements for urban and rural residents may be one of the factors leading to lower calorie consumption in urban areas which is reflected in the overall lower average per capita consumption.

In modern times, urbanization appears to have a greater impact on composition rather than the overall

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level of per capita food consumption. For example, an empirical study using 1960-1988 data illustrates that urbanization leads to significantly reduced urban demand for cereals in higher income Asian countries (Huang & David, 1993). Other data, that will be discussed later, indicate greater meat, fruit, and vegetable consumption in urban areas.

Second, food availability and an individual's ability to purchase food differ in urban and rural areas. Given the subsistence nature of agriculture in many developing countries, the composition of food consumption in rural areas is generally constrained by residents' ability to sell their produce as well as purchase other food. For example, Wu (1999) indicates that on average, rural households in China still produce 50 percent of their own food. Urban residents on the other hand, generally do not grow their own food and are exposed to a wider array of food from which to choose.

Finally, urban areas are centers of economic opportunity and have a greater percentage of women working outside the home. Studies have indicated that increased opportunity cost of women's time increases the demand for non-traditional 'fast food' in many countries. For example, the demand for rice, a non-traditional imported product, has increased significantly in the urban areas in West Africa (Reardon, 1993; Kennedy & Reardon, 1994). The processing and cooking costs of rice in West African cities are lower than for the traditional coarse grain cereals. Rice, particularly "fast-food" or street-vendor rice has become very attractive, even to poor urban consumers. Similarly, the increased value of women's time appears to be an important factor raising demand for bread in quasi-urban households in Kenya (Kennedy and Reardon, 1994) and urban households in Sri Lanka (Senauer, Sahn, and Alderman 1986).

The Interaction of Urbanization and The Level of Economic Development

The influence of urbanization in determining future food demand is dependent on the degree to which urbanization has occurred. If urbanization is largely over, and the country has reached a stable level of economic development, the effect of further urbanization on future dietary patterns will be small. If the rural population is still a large share of the total, urbanization's effects on consumption differ depending on economic conditions. For poorer countries, urbanization may initially lead to the substitution of marketed staple cereals and processed foods for basic rural staples such as rice and cassava. With further increases in income levels, food consumption expenditures may increase as more and more expensive sources of nutrients such as meat, fruit, and vegetables are increasingly consumed, while the consumption of staples, such as cereals prepared at home, may decrease. Specific impacts of urbanization, however, may still differ from one region to the other based on inherent socio-economic factors present in the region. For example, increased urbanization may lead to reduced rice consumption in Asia, while it may actually increase rice consumption in Sub-Saharan Africa.

Urban areas typically offer residents a wider choice of dietary patterns from foreign cultures than do rural areas. Some argue that as countries become more developed, given the current trend towards globalization, there is a tendency for dietary structure to become increasingly similar across similarly developed countries. This is facilitated by multinational food processing and distribution industries that operate globally as well as changing demographics within the countries. The presence of U.S.-style fast food restaurants in other countries has greatly affected food consumption in these countries.

Blandford (1984) points out that the dietary patterns across the majority of the Organization for Economic Co-operation and Development (OECD) countries had become increasingly similar by 1984. As income levels increase in developing countries, exposure to the global 'urban' eating pattern increases, resulting in the consumption of many Western-style foods.

In addition to urbanization, the relative size of different age cohorts in the world population may also affect future food consumption (see box). At present, this factor appears to be somewhat correlated with urbanization since a large proportion of the population in the less-urbanized developing world is young, while that in the more-urbanized developed world is aging. As the younger and rapidly urbanizing population in developing countries increasingly embraces Western food habits, the growth and composition of global food consumption and trade will continue to undergo changes.

Urbanization and changes in dietary pattern do not necessarily indicate improved nutritional patterns. Clark, Huberman, and Lindert (1995) note that poor eating habits of urban dwellers were evident in Great Britain 150 years ago. Despite corrections for income

and family composition, rural workers were found to consume more calories and proteins from grains and dairy products and vitamins from green vegetables, while urban residents consumed more tea, coffee, sugar, and treacle[2]. According to the authors, the diet differences were reflected in the general health of the population, with data indicating the rural population to be consistently taller than the urban dwellers. In modern times, urbanization and the associated greater component of animal protein in the diet of urban residents may actually lead to a taller urban population. However, research indicates that the sedentary lifestyle and high consumption of fats and sugar associated with modern urban society are damaging to human health (Grundy 1998).

Trends in Urbanization and Food Consumption

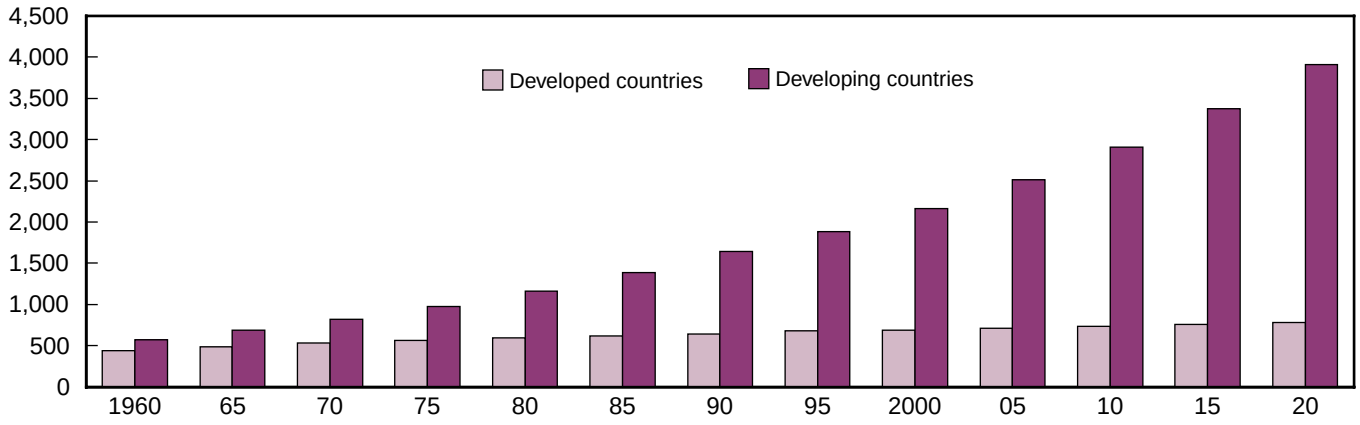
During the past three decades, the urban population increased from 34 percent of total world population in 1960 to 46 percent in 1998 (World Bank, 2000). In 1960, developed countries accounted for about a third of all urban population in the world (fig. C-1). However, in 1998, developed countries accounted for only about one fifth of the 3.4 billion global urban population. Urban population growth in low- and middle-income developing countries has outpaced both the urban population growth in high-income developed countries, as well as the rate of growth of the rural population in developing countries. While the urban population in developing countries totaled about 574 million in 1960, it exceeded 2 billion in 1998, growing at the annual rate of about 3 percent in the 1990s. By contrast, the rural population in these countries grew less than 1 percent per year during the 1990s. Assuming the 1990's rates of growth for urban and rural areas continue, the urban population in developing countries can be expected to double to nearly 4 billion by 2020.

Urbanization in developing countries has generally been associated with increasing per capita income and changing lifestyles and consumption patterns. As illustrated in Figure C-2, during 1961-1998, when the urban population in developing countries quadrupled, the average income in the region measured by per capita gross national product (GNP) in constant U.S. dollars doubled. Although per capita income levels greatly increased for countries at all income levels, major differences in per capita income exist between the low- and middle-income countries. The average per capita income level (in 1995 US$) for low-income countries grew from about $145 in 1961 to $530 in 1998, while that for middle-income countries ranged from about $1,400 in 1961 to over $3,000 in 1998 (World Bank, 2000).

Urbanization in many developing countries accompanied rapid industrialization and economic development. For example, based on the World Bank's development indicators, between 1985 and 1998, productivity, foreign direct investment, and transport and infrastructure services increased considerably in

[2] A sweet syrup often made from a blend of molasses, invert sugar, and corn syrup.

Figure C-1
Projected urban population



Source: The World Development Indicators, The World Bank, 2000.

Food Consumption in an Aging World

by Hiroshi Mori and John Dyck

In studies of food consumption over time, it is important to include age-related variables, or at least to control for age-related effects. If this is not done, estimates of price and income effects may be biased. In the coming decades, demographic studies project an older age profile for most regions of the world. Data indicate (World Bank, 2000) that during the last four decades, the number of individuals below 14 years of age declined in countries across all income levels. Nevertheless, on an average, this age group still accounts for over 30 percent of the population in developing countries compared with 19 percent in developed countries. Both to properly explain past changes in food habits and to project future levels of food consumption, economists need to think through and empirically test linkages from the demographic shifts to the observed changes in food consumption.

This is particularly important in countries in which the population is not evenly distributed by age and where the age distribution may have changed rapidly over a given period. Japan, in particular during the period 1960-1998, is a major example of such a shift in the age structure of the population. Because of a very low birth rate, Japan has moved from a relatively youthful population distribution in 1960, with 30 percent below 14 years and less than 6 percent above 65 years, to a population with over 16 percent 65 years or older and 15 percent 14 years old or younger in 1998 (World Bank, 2000). Factors related to age and age distribution could have affected food consumption patterns in the country.

Age-related variables include the chronological age of an individual. Food consumption by an individual can change as he or she ages over a lifetime. Blisard and Blaylock found important differences in food consumption according to ages in the United States (1988-89 data), with older people consuming higher levels of fruits, vegetables, and other foods at home. As the U.S. population ages, this suggests higher at-home consumption of such foods in the future.

Another age-related variable to consider is the birth cohort, or generation, to which individuals belong. A cohort of people of the same age may adopt a dietary pattern that differs from the cohorts above and below them, and they may keep this eating pattern through their lives. For instance, U.S. consumption of coffee may be greater in some older cohorts, and now again in the new cohorts, with cohorts in the middle more attached to soft drinks. A cohort born in 1940 may show above-average coffee consumption throughout the life span of its members.

Recent research by Mori and others (1997 and 1999) found large age-related differences in food consumption among consumers in Japan. Using a time series of cross-section data on household food consumption, they examined the differences in at-home consumption of particular foods among consumers according to the 5-year birth cohort to which they belonged. In addition, variables for the age of the individuals and for the year of the annual survey were included. The study found that consumption of rice, sake, fresh fish, and fresh fruit varied according to cohort: the older cohorts consumed greater amounts of these foods, and newer cohorts less. For beef and beer, the opposite case was true: newer cohorts consumed more. Much of the overall change in at-home food consumption could be explained by the replacement of older cohorts by newer ones. Further research is needed to investigate the role of economic variables (income and price) in models that include age-related variables.

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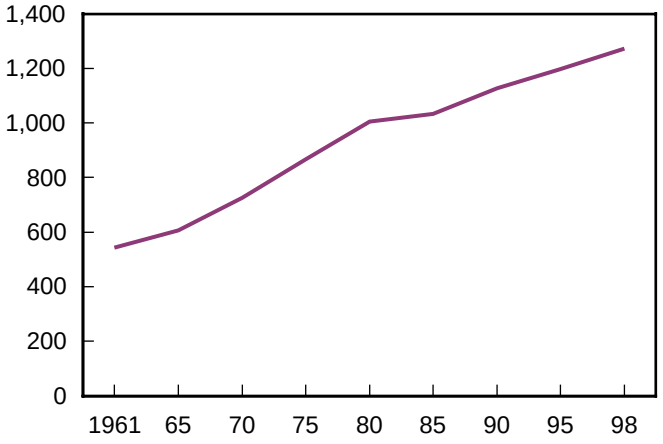
low- and middle-income countries. In developing countries, this period witnessed a growth of 50 percent in passenger air travel, telephone mainlines per 1,000 people grew by almost 70 percent and, on an average, the use of international telecommunications services grew by about 40 percent. As in the case of per capita income growth, although low-income countries witnessed tremendous growth in various economic indicators, they lag far behind developed and middle-income countries when comparing actual indicators.

Figure C-2

Developing country GNP per capita

1995US$



Source: The World Development Indicators, The World Bank, 2000.

Increased urban economic activity and income during the last two decades have led to changes in global food consumption patterns. Often the best available measure of food consumption is the supply or availability of food in a market. Global food availability has undergone structural changes as evident from changes in the composition of food availability between 1961 and 1998 (table C-1). At the highest income levels, per capita consumption (as indicated by food availability) of cereals and roots and tubers decreased, while that of meat and fruit and vegetables increased substantially. In low-income countries, where food security remains a concern despite recent economic gains, decreases in root and tuber availability were more than offset by dramatic increases in per capita supply of all other food types. Despite these gains, per capita availability of meat and fruit and vegetables in low-income countries continues to remain far below that of middle- and high-income countries. With the exception of roots and tubers, food supply also substantially increased in middle-income countries.

Structural changes in food consumption associated with urbanization are visible in developing countries. Individual country food consumption data illustrate the fact that the trends observed in food consumption at the national level can be attributed in part to urbanization and associated changes in lifestyles and incomes. Urban dwellers consume more meat compared with the rural population in China, Indonesia, and Pakistan,

Table C-1—Global food availability

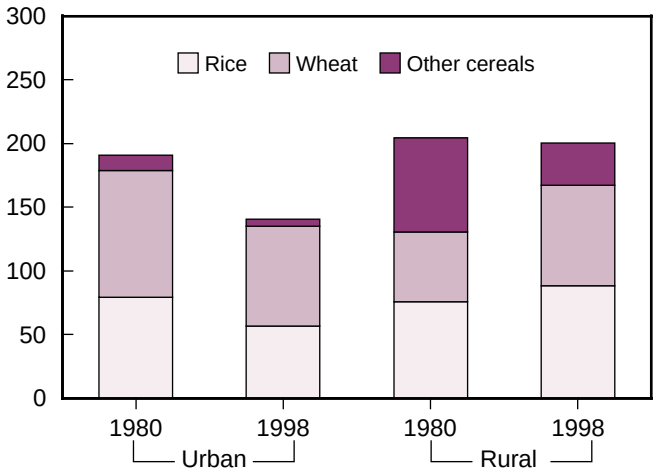
	1961	1965	1970	1975	1980	1985	1990	1995	1998	1961-98
					Kgs/capita/year					*% change*
Cereals										
Low-income countries	138.7	141.2	145.7	136.4	136.2	141.5	148.7	153.9	156.2	12.6
Middle-income countries	125.0	129.4	131.0	136.0	139.9	142.0	142.2	140.4	139.8	11.8
High-income countries	122.3	118.1	111.7	109.0	107.3	107.4	108.1	109.9	112.9	-7.7
Roots & tubers										
Low-income countries	46.6	48.8	53.3	54.1	51.1	51.7	54.6	58.8	59.3	27.3
Middle-income countries	14.6	14.5	14.1	13.0	12.4	12.3	11.7	13.0	13.1	-10.3
High-income countries	17.4	16.0	15.4	14.4	14.6	14.6	14.6	14.7	14.8	-14.9
Fruit & vegetables										
Low-income countries	101.8	106.9	112.5	114.4	121.4	121.0	127.8	121.9	124.2	22.0
Middle-income countries	117.5	124.8	128.3	137.0	150.8	152.2	156.9	156.2	161.9	37.8
High-income countries	152.7	160.9	176.9	184.8	186.8	194.6	216.2	221.7	223.7	46.5
Meat										
Low-income countries	7.6	7.6	7.7	7.4	8.1	8.4	8.7	9.3	9.6	26.3
Middle-income countries	22.7	24.0	26.9	30.0	33.6	35.3	37.7	40.3	39.8	75.3
High-income countries	54.2	58.2	64.8	71.1	76.1	77.9	80.7	83.7	85.8	58.3

Source: FAO Food Suppy data. Note countries are grouped according to the World Bank definition.

and more fresh fruits and vegetables in China and Indonesia (table C-2). Additionally, consumption per person of meat and fruits and vegetables has grown at a faster rate in most urban centers of the developing world than in rural areas.

As mentioned earlier, individuals in rural areas tend to consume more energy-rich carbohydrates, such as cereals, starchy roots, and tubers than individuals in urban areas. However, data indicate that within the rural sector, increased availability and greater purchasing power have led to definite shifts in consumption among these energy-rich staple foods. For example, root consumption declined significantly in rural Indonesia between 1978 and 1987 (table C-2). Similarly, with changes in availability and greater disposable income, individuals tend to shift cereal consumption away from less expensive coarse grains and other less preferred grains to increased consumption of rice and wheat. Although between 1980 and 1998 per capita cereal consumption in urban China declined, cereal consumption in rural China remained fairly stable (fig. C-3). Rice consumption per person remained somewhat stable, while per capita consumption of wheat increased and use of other cereals such as corn, sorghum, barley, and millet declined. Data from India indicate similar results (fig. C-4). Rice consumption was fairly stable in both urban and rural areas between 1972/73 and 1986/87, while wheat consumption per person increased in India, replacing consumption of coarse grains and millets.

Figure C-3
Per capita cereal consumption in China



Source: Economic Research Service, USDA, unpublished data.

Food Demand Forecasts and The Impact of Urbanization

Food demand analysis conducted without taking into consideration the underlying structural shifts resulting from urbanization can sometimes lead to misleading results and erroneous food demand forecasts. The analysis of food expenditure data from 14 Asian countries between 1961 and 1985 indicated that rice consumption in Asia declined with increases in income (Ito, Peterson, and Grant, 1989). This may be a plau-

Table C-2—Food consumption patterns in selected countries

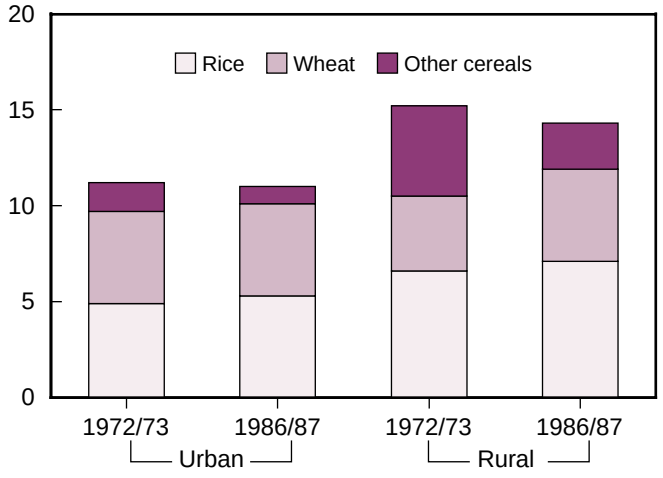
	Urban				Rural			
	Cereals	Roots & tubers	Fruits & vegetables	Meats & offals	Cereals	Roots & tubers	Fruits & vegetables	Meats & offals
				Kg/capita/year				
China 1/								
1988	199	NA	195	29	208	NA	135	12
1998	140	NA	166	30	200	NA	128	16
				Grams/capita/week				
Indonesia 2/								
1978	2,165	275	1,005	64	2,560	810	975	36
1987	2,182	279	1,275	108	2,579	612	1,364	16
				Kg/capita/month				
Pakistan 2/								
1979	10.59	0.73	NA	0.85	13.66	0.72	NA	0.46
1987/88	9.75	0.68	NA	0.76	12.69	0.68	NA	0.51

1/ Economic Research Service, USDA.
2/ FAO 1993.

Figure C-4

Per capita cereal consumption in India

Kgs/capita/month



Source: FAO, 1993.

sible finding for a high-income country such as Japan, but seems improbable for a poor country like Bangladesh where Ito *et al*. also estimated a negative response to rice consumption with income increases. When urbanization was included in the analysis (Huang and David, 1993), rice consumption in Bangladesh was shown to increase with income increases, and rice consumption in Japan was expected to decline by a smaller proportion than indicated in the first study. Thus the factor associated with declining consumption in Bangladesh was the shift to urban living; income increases, either in rural or urban settings, were associated with rising rice use. Huang and David found urbanization to have a negative effect on rice, but a positive effect on wheat consumption in Asia.

The above studies illustrate how as developing countries become increasingly urbanized, the effects of urbanization may need to be taken into consideration in forecasting future food demand. Generally, incomes and urbanization tend to rise together, and the exclusion of urbanization in the estimation process may not be problematic as long as the two variables continue to move together. When analyzing aggregate demand systems that include broad food categories at national levels (as described in Chapter 2), the inclusion of urbanization in the estimation process may not significantly improve the projecting ability of the estimated parameters. However, when food demand is analyzed at a more local level and includes fairly disaggregated commodities, it may be critical to account for urbanization and other demographic variables. Also, once most of a population is urban, further changes in food consumption associated with urbanization become less important, while income changes continue to affect consumption. If urbanization is not included as a variable, food consumption response to income changes may appear to decrease as urbanization becomes complete. In this case, a declining shift in consumption patterns may actually reflect the declining impact of an omitted variable, the rural-urban shift, while the effect of income by itself may not change much.

Conclusions

Urbanization over the next century will chiefly be a phenomenon in the developing countries. In these countries, rural and urban consumption patterns tend to differ. Among basic food groups, rural residents eat more cereals and tubers and roots, and urban residents eat more meat, and fruits and vegetables. As urbanization progresses, it will tend to increase overall meat, fruit, and vegetable consumption/person, and to reduce overall cereal, root, and tuber consumption. The level and rate of urbanization will have important commodity impacts. Since diets rich in meats require feedgrains and meals, they actually demand more cereal than diets based on direct cereal consumption. This and other changes in consumption patterns brought about by urbanization can significantly affect global food supply, markets, and trade.

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Transportation Technology and The Rising Share of U.S. Perishable Food Trade

William Coyle, William Hall, and Nicole Ballenger[1]

Abstract: By reducing delivery times, maintaining product quality, and reducing shipping costs, advances in transportation technology have greatly facilitated trade of perishable food products. Advances in transportation technology are partly responsible for shifts in the composition of U.S. agricultural trade from bulk commodities to non-bulk items, including perishable products.

Introduction

The more-than-decade-long shift in the composition of U.S. agricultural exports from bulk commodities (*e.g.*, wheat and soybeans) to nonbulk items, including perishable products (*e.g.*, meats and fruit) (fig. D-1) is primarily explained by income growth and trade liberalizing measures in the high- and middle-income markets of East Asia, North America, and the European Union (EU). Advances in transportation technology also help to explain this shift, particularly in the rise of perishable product exports. Perishable products now account for about 20 percent of total U.S. food and agricultural exports, and an even larger share of imports.

Advances in transportation technology have made it possible for shippers to deliver perishable products to purchasers thousands of miles away with no substantial loss in freshness and quality and at lower and lower costs. These lower transportation costs have a similar effect on trade as a tariff cut: reducing transaction costs or the wedge between the product price in the exporting and importing countries, thus stimulating trade (see box "Adoption of Transportation Technologies Has Similar Impact on Trade as a Tariff Cut").

For many producers, marketing perishable products abroad was largely infeasible or prohibitively expensive until new technologies were developed in the past 30 years. Packaging innovations, fruit and vegetable coatings, bioengineering[2], and other techniques that reduce deterioration of food products have helped shippers extend the marketing reach of U.S. perishable products. In addition, new technologies in transport are gradually opening the ocean and overland trades to a host of perishable products. As a result, U.S. exports of horticultural and livestock products now can travel greater distances than before (fig. D-2).

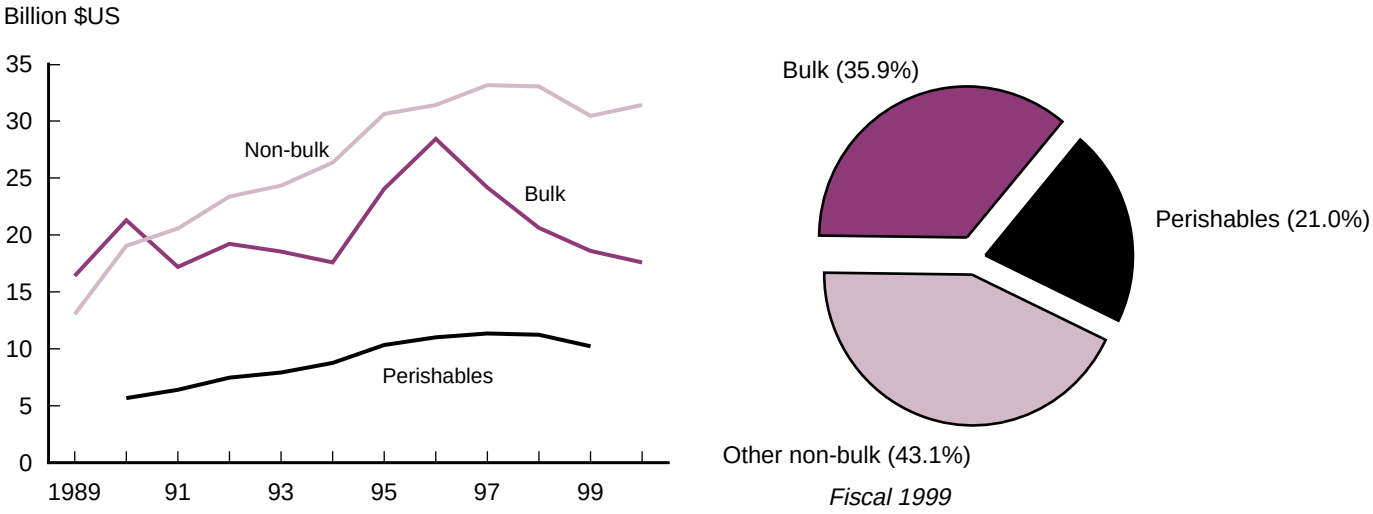
Markets for U.S. perishable products are concentrated in high- and middle-income East Asian countries, North America, and to a lesser extent in Europe. Today, beef and pork produced in the U.S. Midwest are chilled or frozen in regional packinghouses, moved overland to Mexico or to West Coast ports, and shipped by sea to Japan and South Korea. Fresh broccoli goes by ship from California to Japan, and fresh cherries travel the ocean from Washington State. Perishable products, as fragile as avocados, lettuce, mangoes, and nectarines, are increasingly transported by sea to Asia and Europe from the United States and to the United States from suppliers like Mexico and Chile.

[1] William Coyle is an agricultural economist in the Market and Trade Economics Division and Nicole Ballenger is the Assistant Administrator, Economic Research Service, USDA. William Hall is a partner in the Seaport Group, a consulting firm specializing in port planning and logistics analysis.

[2] Some products are engineered to have a longer shelf life such as the 10 to 14 day shelf life of the FreshWorld Farms Endless Summer tomato.

Figure D-1

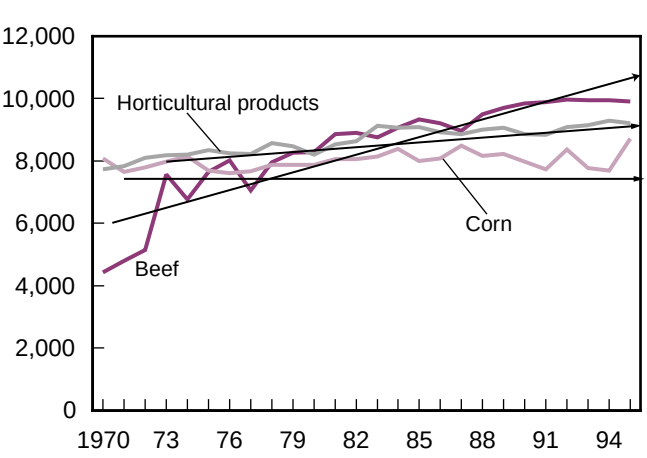
U.S. non-bulks surpass bulk exports since 1991



Source: FATUS, fiscal years.

Figure D-2

Weighted mean distance for U.S. beef, horticultural products, and corn exports



Note: Data excludes the nearby markets of Canada and Mexico.

Source: Wang, Zhi, Bill Coyle, Mark Gehlhar, and Tom Vollrath. "The Impact of Distance on U.S. Agricultural Exports: An Econometric Analysis," in Technological Changes in the Transportation Sector--Effect on U.S. Food and Agricultural Trade, A Proceedings. Economic Research Service, USDA. Misc. Pub. 1566, Sep. 2000.

Trans-ocean transportation costs are still higher for many perishable products than for raw agricultural products like cotton or nonperishable products like nuts and raisins (fig.D- 3). However, new developments in ocean shipping have made it possible to preserve the quality of perishables during transport and still bring down transportation costs.

In addition, satellite technologies, particularly global positioning systems (GPS), which are becoming increasingly available and less expensive, enable shippers to track their cargo around the world electronically. Other electronic technologies enable shippers and carriers to monitor quality, reduce risk (and costs) of liability claims, and shorten cargo delivery time. Profitability in perishable product trade will likely increase further as ocean shipping technologies continue to adapt to the special requirements of different horticultural and livestock products.

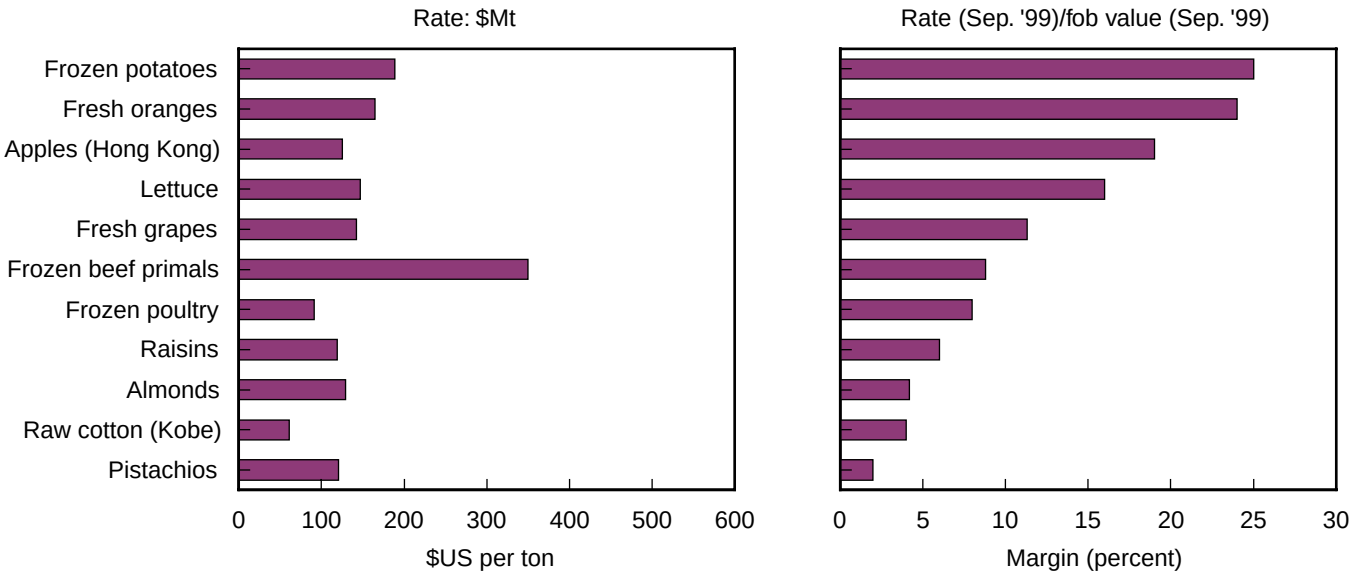
U.S. exports of perishable products increased from $3.5 billion in FY 1989 to $10.3 billion in FY 1999. Meats accounted for about half of these exports in FY 1999 and fresh fruit and vegetables about one-fourth. Consumers in the United States and U.S. trading partners have benefited from improving transportation technology, as the United States imported $13.1 billion of perishable products in FY 1999, with horticultural products (including fresh vegetables, fruit and juice, bananas, cut flowers, and nursery stock) accounting for about 60 percent (fig. D-4).

Reducing Shipping Costs

Loading and unloading have always accounted for a relatively large share of total transportation costs (fig. D-5); thus the longer the journey, the lower the per-mileage transportation costs, other variables remaining constant (fig. D-6). The use of containers has radically reduced these front and back end costs. Port workers

Figure D-3

Shipping margins higher for horticultural products

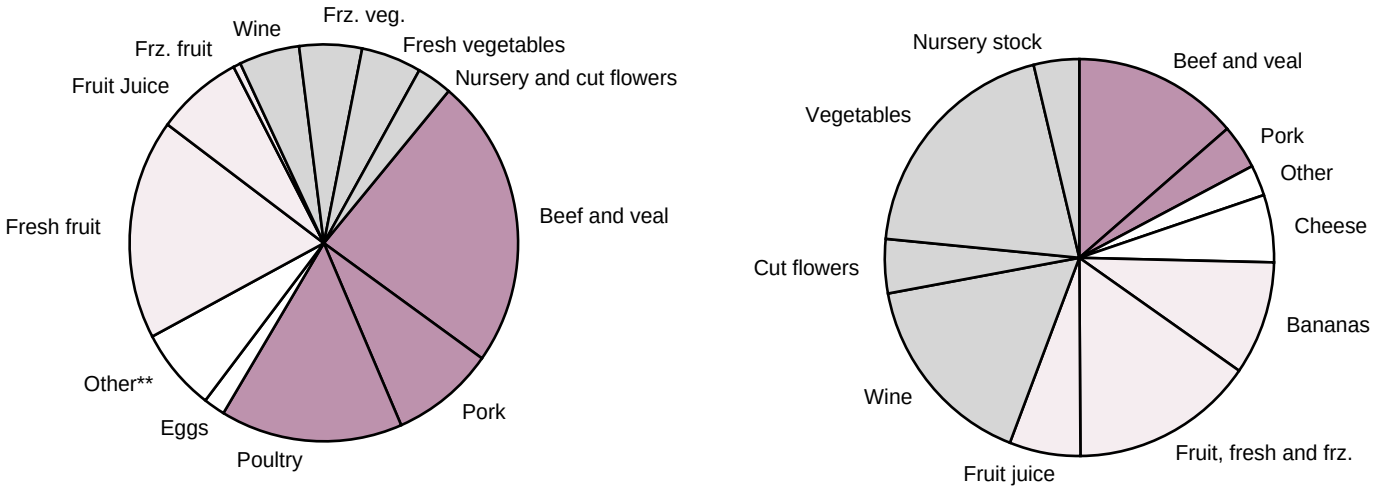


Source: Shipping rates for selected commodities from L.A./L.B./Oakland to Tokyo, Japan; Agricultural Marketing Service, Ocean Rate Bulletins, Sep. 1999.

Note: Apples are for Hong Kong; container and per ton shipping rates are for June 1999; shipping as a share of the commodity's fob value is based on export unit values for Sep. 1999.

Figure D-4

U.S. trade of perishable products



**--dairy products and bull semen.

Source: FATUS.

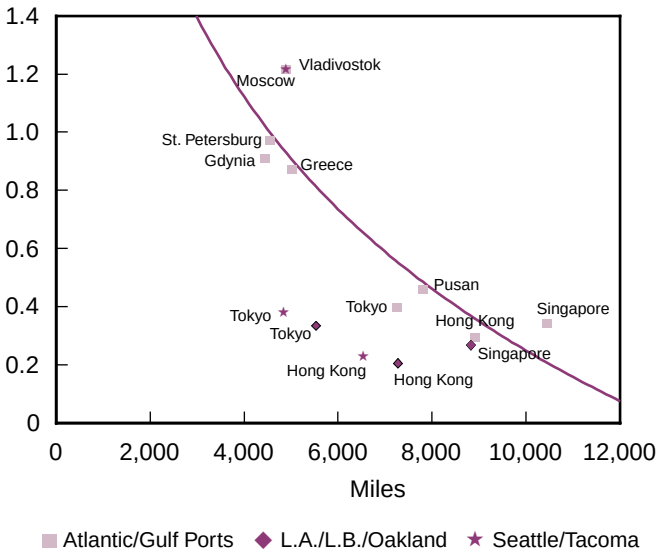
Figure D-5
Shipping costs and times

Sequence	Time (Hrs)	Cost (US$)
Moving container from loading ramp to storage	1	80
Container waiting for pick up after stuffing	48	12
Loading container on road trailer	1	62
Road transport to port terminal	33	360
Waiting for admission to port terminal	2	
Transfer from road trailer to stack		80
Waiting in stack	146	40
Unstacking and transfer to terminal trailer		88
Transfer/loading onto ship		240
Containership travel time (New York-Rotterdam)	154	1,840
Transfer/unloading off ship	1	192
Transfer to stack		60
Waiting in stack	106	30
Transfer from stack to road trailer		60
Clearance and inspection	2	10
Road transport, port terminal to inland depot	14	220
Unloading container at inland depot		40
Storage in inland depot	30	
Moving container to consignee	2	40
Total	540	3,454

Loading and unloading costs are relatively large and fixed regardless of the length of the journey

Source: Cost of operations and time for shipping a 40' container; in APEC's *Congestion Points Study, Phase III, Best Practices Manual and Technical Report, Volume 2 Sea Transport,* Feb. 1997, p 105.

Figure D-6
Shipping rates for container loads of frozen poultry



Source: Agricultural Marketing Service, Ocean Rate Bulletin for Frozen Poultry, October 30, 1998.

now handle standardized containers filled with cargo, rather than handling the cargo itself (see box "Inventing the Container"). Containerization has also led to a significant change in global shipping practices known as intermodalism, moving goods by linking together two or more modes of transportation (*e.g.* rail, truck, air, and ocean).

Containerization is recognized as a major contributor to the steady reduction in world transportation costs since the 1950s. For perishable products, however, the increased speed of handling and reduced transport costs with containerization were not sufficient. Ocean transport of cooled and frozen cargo received a substantial boost with the development of mobile refrigerated containers called "reefers" in the 1960s.

Reefers, like regular containers, are 20-foot or 40-foot boxes with their own refrigeration units. Reefer containers use ship-generated power for climate control and can be carried alongside standard containers on general-purpose containerships. This allows for perishables to be integrated into larger flows

of general cargo and to benefit from the scale economies inherent in container transport. It is an advantage that has challenged the competitiveness of conventional, dedicated refrigerated cargo ships that lack this flexibility.

The reefer share of refrigerated cargo is about 44 percent and accounts for about 22 million tons of cargo annually. Deep-freeze and dedicated refrigerated vessels—accounting for 28 million tons, or 56 percent—are important for palletized chilled fruit, particularly bananas, apples, peaches, pears, grapes, kiwifruit, and citrus, but the reefer container trade is growing more rapidly and is considered better suited for carrying these fruit as well as produce needing more careful handling, like asparagus.

Increasingly efficient and accurate cooling systems for some time have allowed refrigerated carriers to maintain temperatures with great accuracy (plus or minus a quarter degree Celsius). More recently, however, controlled atmosphere (CA) technologies added refinements that have extended the shelf life of perishable products and thus expanded the types of perishables that can be shipped in reefers without spoilage.

CA technologies allow operators to lower the respiration rate of produce by monitoring and adjusting oxygen, carbon dioxide, and nitrogen levels within a refrigerated container. In this way, CA can slow ripening, retard discoloration, and maintain freshness of perishables like lettuce, asparagus, peaches, mangoes, and avocados that would not have survived well during ordinary refrigerated ocean transport. Not all CA systems are the same: some especially sophisticated ones are combined with systems to maintain relative humidity, a crucial factor for some produce such as grapes, stone fruit, and broccoli; and controlling levels of ethylene, a naturally occurring gas that accelerates the ripening process in fresh fruits and vegetables.

In addition, remote reefer monitoring systems can transmit and collect performance information electronically so that physical checks are not required while the reefer is stacked in the hold or by the dock. The remote system may also activate an alarm, helping minimize losses when problems arise at sea or in the container yard.

Developments in Vessel Technology

Accompanying advances in containerization have been changes in container ship technology and in the abilities of world ports to serve those ships. Container vessels are being built larger and larger, making them more competitive with traditional refrigerated vessels.

In the 1970s, container ships on the world's major trade routes were built to carry an average of about 2,500 TEU's (twenty-foot equivalent unit—standard containers with exterior dimensions measuring 20 feet by 8 feet by 8 feet). New vessels deployed on major routes are often 5,000-6,000 TEU's, too wide to fit through the Panama Canal (about 4,800 TEU's maximum). Per-container vessel operating costs are about 50 percent lower for a 5,000-TEU ship when compared with a 2,500-TEU-vessel (Bill Hall, Seaport Consultants; input into Ballenger/Coyle article in AO, 1999).

The largest container ships now in service, such as the Sovereign Maersk, are estimated by industry analysts to have a capacity upwards of 6,600 TEU's, which includes space for over 800 refrigerated TEU's. The refrigerated capacity alone makes the gigantic Sovereign Maersk equivalent to a medium-sized conventional refrigerated carrier. A number of vessels of this size are on order and are expected to become more common. Ships with capacities of 15,000 TEU's or more are said to be technically feasible (JOC, 6-5-00).

The challenge of facing radically larger ships, however, is to increase capacity while maintaining stability and safety, particularly important for ships carrying tall stacks of containers. New hull shapes and ballasting systems promise to improve stability at sea, while bow thrusters will make these large vessels more maneuverable in port than their smaller predecessors. Very large containerships may also require advances in propulsion and propeller technology that remain to be fully developed and tested.

These larger and larger ships, while lowering the cost of transportation, would be limited by the capacity of ports that service them. They would be constrained by harbor depths and the capacity of loading and unloading equipment. They—like the largest container ships of today—would be too large to pass through the Panama Canal. A new service pattern could emerge with these giant ships traveling along an east-west route between large transhipment ports, which would be fed by smaller north-south feeder lines.

Container ships are dominating the perishable trade between North America, East Asia, and Europe, though conventional refrigerated vessels can serve

Adoption of Transportation Technologies Has Similar Impact on Trade as a Tariff Cut

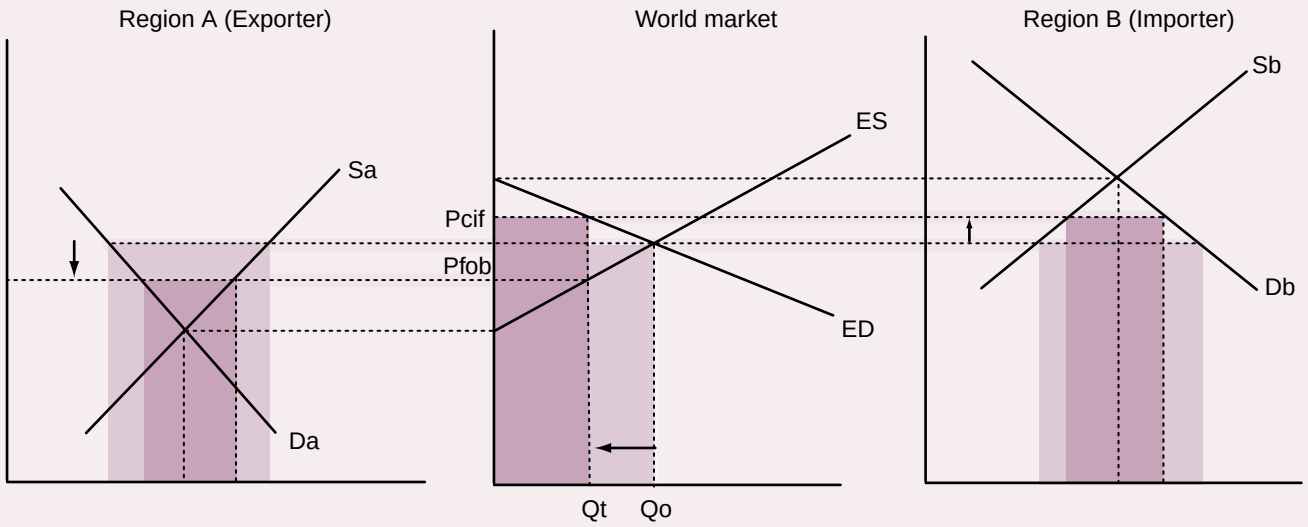
Overcoming distance has always been an important issue in marketing agricultural products, but agricultural economists have examined the role of distance only occasionally (Thompson, 1981). International trade economists have long ignored distance until recently as described by Paul Krugman:

> The analysis of international trade makes virtually no use of insights from economic geography or location theory. We normally model countries as dimensionless points within which factors of production can be instantly and costlessly moved from one activity to another, and even trade among countries is usually given a sort of spaceless representation in which transport costs are zero for all goods that can be traded. (Paul Krugman, *Geography of Trade, 1996*)

Transportation costs represent a wedge between the exporter's fob price and the importer's cif price and act as a tariff; when taken into account, it lowers the exporter's price, raises the importer's price, and reduces the quantity traded (fig. D-7). The darkened areas represent the new equilibrium with the inclusion of transportation costs. When transportation costs are included, one can see how the quantity traded on world markets contracts from Qo to Qt. Alternatively,

Figure D-7

Spatial equilibrium model with and without transport costs



Qt = traded quantity with transport costs
Qo = traded quantity without transport costs
Pfob = exporter's fob price
Pcif = importer's cif price

Source: Gehlhar, Mark. "Incorporating Transportation Costs into International Trade Models: Theory and Application" in Technological Changes in the Transportation Sector--Effect on U.S. Food and Agricultural Trade, A Proceedings. Misc. Pub. No. 1566. Economic Research Service, USDA. Sep. 2000.

Continued on page 37

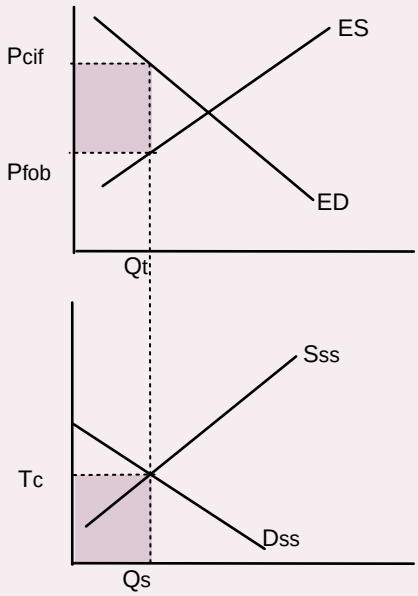
smaller ports, especially in the developing world, that are still unable to handle large container vessels and lack the specialized cranes and storage yards needed to support them. Conventional refrigerated ships may have a brighter future in these smaller trades, especially where competition from container vessels has not increased. Ports in some producing areas throughout the developing world have been developing perishable-oriented container terminals. Fruit exporting companies have been among the leaders in

Continued from page 36

one can also see how the reduction of the transportation margin, the difference between Pcif and Pfob, would expand the quantity traded. The top graph in figure D-8 is the same as the middle graph in figure D-7. The level of transportation services (Qs) is derived from the level of trade (Qt) (fig. D-8). Technological change as well as other factors shift out the supply of transport services, reducing transportation costs, and thus expanding trade (fig. D-9).

Figure D-8

Link between world trade and market for shipping services



$Tc = Pcif - Pfob$

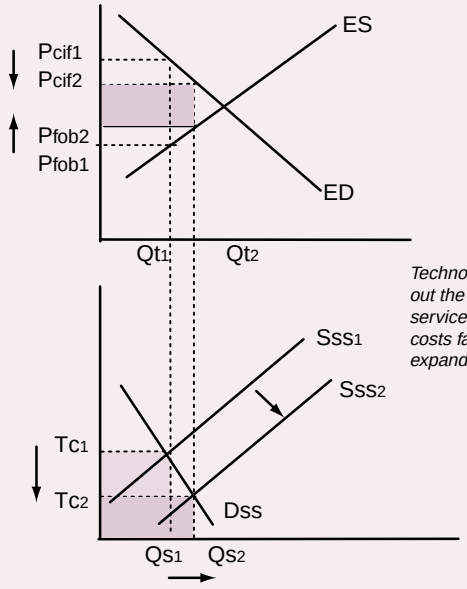
Source: Gehlhar, Mark. "Incorporating Transportation Costs into International Trade Models: Theory and Application" in Technological Changes in the Transportation Sector--Effect on U.S. Food and Agricultural Trade, A Proceedings. Misc. Pub. No. 1566. Economic Research Service, USDA. Sep. 2000.

A key distinguishing characteristic of many food and agricultural products is perishability, which requires refrigeration and prompt delivery to consumers to assure quality. The adoption of modern technologies has facilitated trade of many high-value agricultural products in recent years by shifting out the supply of transport services and lowering costs.

There are also constraints, such as environmental restrictions on refrigerants and inadequate infrastructure that can lead to an inward shift in the supply, or a rise in the cost of transport services.

Figure D-9

Impact of technological change on shipping rates and trade



Technological change shifts out the supply of transport services (Sss2), transport costs fall (Tc2), world trade expands (Qt2).

Source: Gehlhar, Mark. "Incorporating Transportation Costs into International Trade Models: Theory and Application" in Technological Changes in the Transportation Sector--Effect on U.S. Food and Agricultural Trade, A Proceedings. Misc. Pub. No. 1566. Economic Research Service, USDA. Sep. 2000.

this process. For example, in late 1999 Dole took delivery of two 2,000 TEU refrigerated containerships for operations between Chile, the Caribbean and the eastern United States. These vessels are as large as the containerships active in the trans-Atlantic and trans-Pacific trades of two decades ago.

At the same time, the conventional refrigerated shipping industry is not standing still. New ship designs allow more rapid loading and discharge, with forklifts moving throughout the holds. Onboard cooling plants have become highly efficient. The industry is concentrating into fewer and larger firms to increase efficiency, and vessel pooling arrangements help companies utilize capacity more effectively. Some refrigerated carriers can now carry loads of containers on deck, and operators are increasingly using their refrigerated vessels to carry other cargoes, such as autos and palletized machinery, on a seasonal basis, which helps even out earnings for carriers. Conventional refrigerated ships can still be effective, especially at smaller ports, although competition from container ships is increasing.

Inventing the Container

Malcolm McLean, founder of Sea-Land, the largest U.S.-based ocean carrier, made a major contribution to the technology of perishable product shipping (Allen 1994). In 1937, he waited on a dock in Hoboken, New Jersey with a ship-bound truckload of North Carolina cotton. For hours he observed the complicated, labor-intensive process of goods being unloaded from trucks, moved onto the ship, and juggled into their proper places in the hold. As the story goes, he wondered why his truck trailer could not simply be lifted up and placed on the deck of the ship without its contents being touched.

McLean made his idea a reality in 1956 when he purchased a small tanker company, adapted the ships to carry trailers, and launched the Ideal X from Port Newark in the New York harbor. When he later converted from conventional truck trailers to specially engineered steel boxes that could be stacked several layers deep inside the hold, he had launched the era of the cargo container. In 1966, one of his new container ships crossed the Atlantic to Rotterdam, launching the first trans-Atlantic and later trans-Pacific containerized shipping service.

Significantly faster ships may also be on the horizon. Ships are being developed that will travel as fast as 40 knots, about twice the speed of standard vessels. There are significant problems to be overcome, but if solved these ships would perform a North Atlantic transit in about 3-and-a-half days and door-to-door delivery from the U.S. Midwest to Central Europe in 7 days, compared with the typical 14-28 days (Journal of Commerce, 6-29-00). They would occupy a market niche between ocean and air shipping for long-distance movements. These "fast ships", once perfected, would probably target perishables as an ideal market segment.

In summary, it now appears that container ships will continue to take market share from conventional refrigerated ships, although these will likely persist in certain trades and niche markets. We can expect containerships to continue to grow in size, which should decrease unit costs further. More distantly, a new type of fast ship may appear that could significantly impact shipment of high unit-value commodities—such as perishables.

How many ports worldwide have the necessary infrastructure and links to international markets to handle large volumes of reefer container trade? Although there are many "containerports," container traffic and traffic growth are clearly concentrated around the largest few. Of the top 100 containerports in 1999, 15 accounted for about 50 percent of all container throughput (*www.cargosystems.net*).

By far the largest throughput is handled at ports in Singapore and Hong Kong (each with 10 percent of 1999 container throughput), followed by Kaoshiung in Taiwan and Rotterdam in the Netherlands, each with less than half the volume of the largest two ports. In the United States, the five leading container ports (Long Beach, Los Angles, New York/New Jersey, San Juan, and Oakland) together accounted for about 9 percent of world container throughput (*www.cargosystems.net*). Although these figures mean little in terms of the ability of other ports to respond to growing consumer demand for perishable products, they do suggest a challenge to the diversification of perishable product trade beyond major, high-income markets.

Environmental Challenges

Despite tremendous progress in adapting shipping technology to the marketing of perishables, there remain significant constraints to the expansion of perishable product trade. Some constraints derive from economic and environmental issues associated with the technologies.

First, controlled atmosphere (CA) technologies, particularly some of the more complex systems, are expensive for carriers to adopt and install. Although continued technological refinements and developments and increasing competition among manufacturers of CA systems are bringing investment costs down, much of the CA reefer trade is seasonal (timed, for example, to the fruit harvest) and therefore particularly vulnerable to income swings. The reefer business can be very profitable because of the high value of the cargo, but some industry analysts believe that the CA reefer trade, while continuing to grow, will remain a niche market.

Some questions also remain as to how international environmental agreements and national environmental regulations will affect the availability of economical

and environmentally friendly refrigerants for reefer systems. Chlorofluorocarbon compounds (CFC's), the predominant refrigerants used in reefer containers, are being phased out under the terms of the 1990 Montreal Protocol international treaty because of their damaging effect on the ozone layer.

The most popular replacements for CFC's are hydrochlorofluorocarbon compounds (HCFC's) which have limited ozone depletion potential. However, HCFC's are expected to be phased out in favor of hydrofluorocarbons (HFC's) which have zero ozone depletion potential but some global warming potential. The Kyoto Agreement on climate change, while not presently ratified, suggests the possibility of bans or caps on these "greenhouse" gases. If the proposed restrictions on HFC's become a reality, refrigerated shipping will face serious challenges in finding acceptable substitutes.

Hydrocarbons, such as propane or butane, are a possibility, but have come under scrutiny due to their flammability; they have been banned by the Environmental Protection Agency (EPA) for nearly all refrigeration uses. Ammonia systems using cooled brine, which were common before the adoption of Freon (a CFC) in the late 1970s, may be adapted to address environmental concerns. Although new ammonia-brine systems are attractive, ammonia is hazardous and brine is quite corrosive and difficult to pump. Liquid nitrogen systems have also been developed. These new systems are still in the development stages and it is agreed that more work is needed in order completely to replace existing refrigeration systems.

Future Challenges

Perhaps most critical to expansion of perishable trade are infrastructure, institutional and information linkages to make ocean shipping of perishable products not only technologically feasible but also efficient and profitable for all players along the supply chain. Reefer container trade requires that ports on both ends provide sufficient crane capacity, adequate storage space, and ready access to highway and rail systems designed for container traffic. Efficient inspection and customs services by government agencies, as well as port-to-market distribution systems, are critical since most fresh produce must arrive on store shelves within 24 hours of unloading.

Advances in information technologies have been critical in spurring the growth of perishable traffic. This ranges from on-ship remote container monitoring to precise inventory management systems linking producers, shipping companies, and the major supermarket chains and other large customers. Many industry observers maintain that since container shipping is now a mature technology, the greatest future challenges are in the areas of alternative refrigeration systems and in discovering ways to more efficiently manage the supply and inventory chain from production sources to supermarket.

What lies behind the rapid growth in U.S. exports of perishable products over the past 10 years? The general decline in trade barriers, such as tariffs and import quotas, and worldwide income growth play major roles. But the contribution made by advances in transportation technology, particularly in ocean shipping, tends to be ignored. These advances have extended the marketing reach of U.S. perishable high-value products to distant markets by reducing delivery times, maintaining product quality, and reducing costs.

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Changing Consumer Demand for Meat: The U.S Example, 1970 - 2000

Mildred M. Haley[1]

Abstract: U.S. beef consumption has declined, while poultry consumption has increased significantly over the past three decades. Preference changes, relative prices, and available leisure time are important determinants shaping U.S. consumer demand for meat products.

Introduction

The positive correspondence between income levels and meat consumption is an accepted theoretical result that appears to hold empirically, both within and between countries. Between-country comparisons of food budget shares allocated to meat consumption using the World Bank consumption data indicate that consumers in high-income countries tend to allocate larger shares of their food budget to meat expenditures compared with consumers in low-income countries (Chapter 2). The intuition underlying this observation is straightforward: consumers in high-income countries face less restrictive budget constraints, and (typically) lower relative meat prices than consumers in low-income countries. Figure 2 in the introduction section of this report shows a comparison of 1996 budget share allocations between food items made by consumers in the United States and Kenya. American consumers spent 27 percent of their food budgets on meat products, while Kenyan consumers allocated just 6 percent of food expenditures to meats.

The income level/meat consumption correspondence appears to hold within countries as well. Recent U.S. Consumer Expenditure Studies suggest that in the United States, high-income consumers allocate greater proportions of their food budgets to meat products than lower income consumers (USDA, 2001). At the next level of disaggregation, however—consumers allocating budget shares between meat varieties—income levels don't tell the whole story. Such factors as preference changes, relative prices, and available leisure time may drive consumers' allocation of their meat budgets between beef, chicken, and pork.

What follows is a brief presentation of how U.S. meat consumption patterns have changed over the past 30 years. Clearly, the substitution of poultry meat in place of beef by U.S. consumers is the most significant change that has occurred since 1970. While the changed dynamics of U.S. meat demand are not themselves at issue, identification of factors that cause American consumers to eat less beef now than in the past continues to be a source of controversy among economists.

The ongoing analysis of U.S. consumer demand for meat products is a constructive exercise, for several reasons. Foremost among them are the important implications that changed U.S. meat consumption patterns hold for the dynamics of international meat trade. Moreover, the economic and cultural changes that drive meat consumption in the United States are likely to be more or less duplicated by what are now, low- and middle-income countries. Study of U.S. meat consumption patterns therefore, may provide useful insight into how consumer choices are likely to change as economies expand, consumer incomes grow, and meat budgets increase.

Background

American meals have traditionally centered around the consumption of meat. Today it is common to observe

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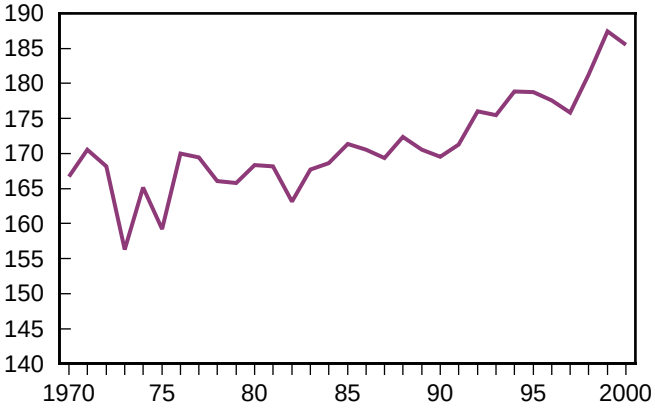
meat and meat products being served at each daily meal: ham, bacon, and sausage at breakfast, a meat sandwich at lunch, and a cut of red meat or poultry at dinner. Fortuitously, American consumers' revealed tastes and preferences for meat are well accommodated by the ample resource base of the United States. The extensive U.S. landbase supports production of feedgrains and protein crops necessary for the manufacture of livestock/poultry feed, as well as pastures and rangelands to graze cattle and sheep.

At the beginning of the 21st century, Americans are consuming greater quantities of meat products than in the past. United States Department of Agriculture statistics indicate that U.S. per capita meat consumption increased more than 11 percent from 1970-2000 (fig. E-1). However, data also show that significant within-category changes have occurred since the mid-1970s (fig. E-2). U.S. per capita consumption of poultry products has increased dramatically, while per capita beef and veal consumption have declined.

Economists have proposed numerous hypotheses to explain changes in U.S. consumer substitution of poultry in place of beef. Applied analysis has focused on such factors as lower relative poultry prices and consumer preference structures altered by health concerns. But, binding time constraints of increased numbers of women in the workforce may also direct meat consumption toward categories in which poultry products predominate—those that favor quick preparation and fast food choices.

Figure E-1
Total U.S. per capita consumption of red meat and poultry

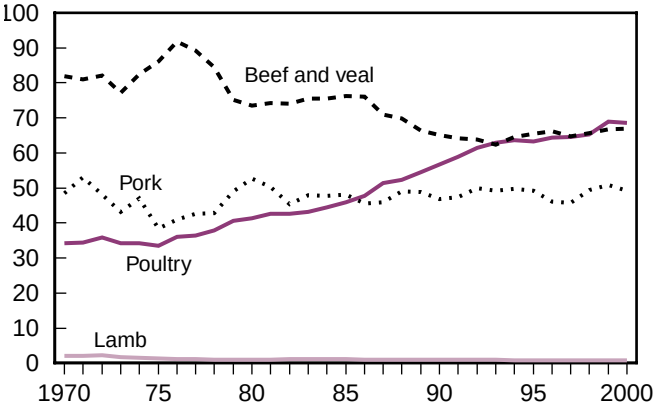
Mil. lb, boneless retail equivalent



Source: Economic Research Service, USDA.

Figure E-2
U.S. per capita consumption of red meats and poultry

Mil. lb, boneless retail equivalent



Source: Economic Research Service, USDA.

Per Capita U.S. Meat Consumption, 1970 - 2000

On a per capita basis, Americans consumed 19 more pounds (lb) of red meat (beef, veal, pork, lamb and mutton) and poultry (chicken and turkey) in 2000, than in 1970. Poultry consumption accounts for almost all of the increase (+34 lb), while beef and veal consumption declined by 15 lb. Slight increases in pork consumption (+1 lb) balanced small declines in lamb and mutton (-1 lb). Figure E-3 shows how Americans re-allocated their meat consumption-set over the 30-year period. Comparison of the consumption percentages in the graph indicates an unambiguous shift from red meats to poultry. In 1970, red meat constituted 79 percent of total meat consumption and poultry 21 percent. Thirty years later, red meat accounts for 64 percent of meat consumption and poultry 37 percent, on a pound per capita basis.[2]

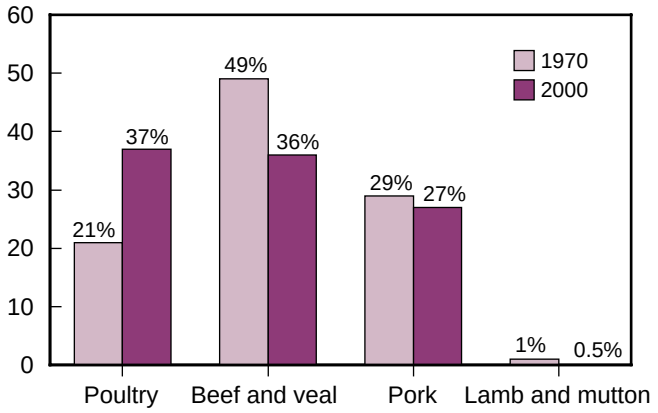
Less Beef, More Chicken: Why?

Numerous hypotheses exist to explain why Americans are currently eating more poultry and less beef than 30 years ago. Most explanations approach the problem from either a demand or a supply perspective. Demand-side arguments fall into one of two categories: (1) American consumers' preference structures have changed, or (2) relative price changes explain substitution between beef and poultry. Supply-side

[2] The shares of red meat and poultry do not add up to 100 due to rounding.

Figure E-3
U.S. per capita meat consumption

Mil. lb, boneless retail equivalent



Source: Economic Research Service, USDA.

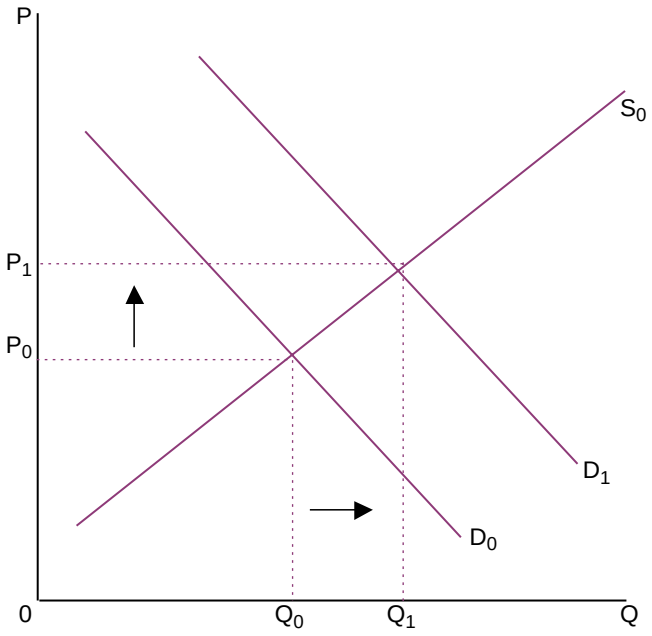
arguments are less direct, focusing on either (1) the supply factors that may have caused relative poultry prices to fall; or (2) explicit inclusion of supply factors in demand analysis models. It has been shown that models excluding supply factors can yield results falsely indicating changed consumer preferences.

One demand-side explanation of changing U.S. meat consumption patterns focuses on consumer preference structures.[3] Many economists argue that the long-term secular decline in beef consumption reflects a fundamental change in American consumers' preference structures. That is, preferences today reflect a different set of likes and dislikes than in the past. Increased consumption of poultry in place of beef is an expression of consumers' (new) preference for meat products possessing desirable health characteristics, such as low(er) saturated animal fats, and low(er) cholesterol levels (Moschini and Meilke, 1989).

Greater poultry consumption caused by changed consumer preferences can be illustrated with simple demand and supply analysis. In figure E-4, aggregate U.S. demand and supply for poultry are depicted in price-quantity space, with linear functions labeled D_0 and S_0, respectively. Changed consumer preference structures for meat, in favor of poultry, causes the aggregate demand curve to shift outward to D_1, where

[3] Economists hypothesize that consumers possess unique preference structures, which are sets of prioritized "likes" and "dislikes". Consumers base consumption/expenditure decisions on their preference structures.

Figure E-4
Greater poultry consumption caused by changed consumer preferences



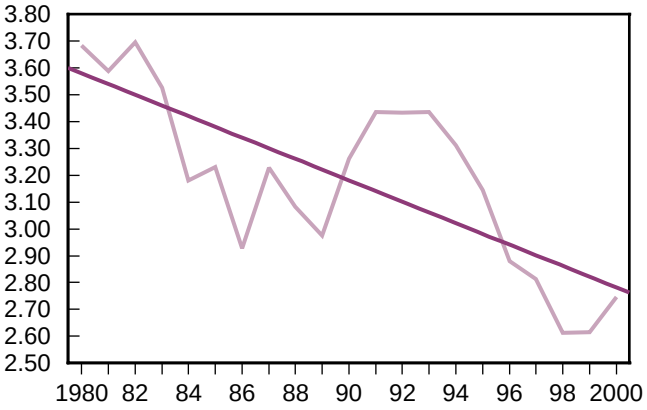
Source: Economic Research Service, USDA.

consumers consume a greater quantity, $0Q_1$, than previously, when $0Q_0$ was consumed.

Another demand-side argument favored by some economists assumes that consumer preferences exhibit stable properties over time, and that in fact, changes in relative meat prices explain consumption substitution dynamics (Chalfant and Alston, 1993). This argument essentially claims for example, that Americans consume more poultry than in the past because its price in terms of beef has declined. Figure E-5 illustrates this view, in part. The graph depicts the relationship between the price of whole chickens in terms of round roast beef. In 2000, fewer units of beef were necessary to exchange for a unit of whole chicken, than in 1970. In this context, increased consumption of poultry and lower beef consumption is simply an application of the microeconomic axiom, which states that when (poultry) prices decrease, quantity demanded increases. Consumer response to lower poultry prices is depicted in figure E-6, as a movement along a curve, D_0, that represents aggregate U.S. consumer demand for poultry. At the lower poultry price P_1, consumers are willing and able to consume $0Q_1$. This quantity is greater than $0Q_0$, the quantity demanded at the higher poultry price P_0.

Figure E-5

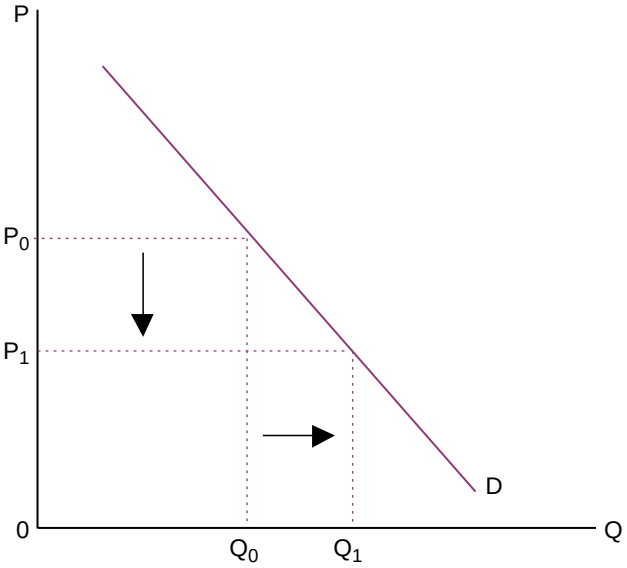
Relative U.S. retail price of whole chicken in terms of round roast beef



Source: Bureau of Labor Statistics, USDC.

Figure E-6

Change in quantity of poultry demanded by U.S. consumers in response to lower poultry prices



Source: Economic Research Service, USDA.

Related to the relative price argument, is an extension of Becker's (1976) time value model to explain American's increased consumption of poultry. The substance of this view focuses on the movement of women into the U.S. workforce, which reduces the typical family's supply of leisure time (typically, by more than 40 hours per week), thus increasing its value. With almost 60 percent of American women working outside the home—up from 40 percent in 1970—the value of reduced family leisure time increases (U.S. Department of Commerce, 2001). Consequently many families allocate their (more) valuable leisure time by substituting away from time-intensive meal ingredients, and toward consumption of products that require less time to prepare. Because many traditional American beef dishes require significant preparation time, it is reasonable to conclude that families are substituting away from beef, whose relative price has increased when the value of preparation time is factored in, toward the many recently developed poultry products, which require less time to prepare.

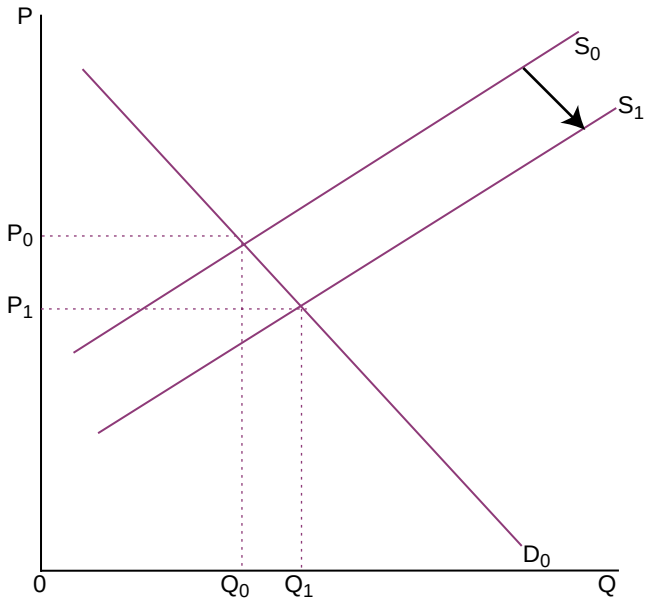
Indeed, the U.S. poultry industry has been highly proactive in development of products requiring less preparation time. Examples include skinless, boneless chicken breasts, pre-marinated cuts, and micro-waveable chicken dishes. Another related innovation is the chicken nugget, which was first available in fast-food restaurants. Nuggets, together with chicken-based sandwiches, are an acknowledgment by the poultry industry of the importance of away-from-home meal consumption.

Supply-side Factors May Also Be Important in Understanding Changing Meat Consumption Patterns

The results of some research that focuses on supply variables as explanatory factors of increased U.S. poultry consumption provides support for the relative price argument, over the changed preference structure hypothesis. Fulginiti (1976) identifies higher adoption rates of new technology by the U.S. poultry industry, relative to the U.S. red meat industry, as the cause of lower poultry prices. In figure E-7, new poultry production technology shifts the aggregate U.S. poultry supply curve outward to S_1. She thus argues that greater poultry consumption ($0Q_1$) is the outcome of lower equilibrium prices (P_1) generated by greater supplies of poultry, rather than changed consumer preferences as depicted in figure E-4.

Unlike many demand studies, Eales and Unnevehr (1993) take explicit account of supply-side variables in their model of U.S. meat demand. They found that inclusion of factors such as livestock production costs and technical change indicators eliminate evidence of preference structure changes in U.S. beef demand. At the same time they note that evidence of changed consumer attitudes toward meat consumption exists, and that the "answer" to the problem of changing U.S. patterns of meat consumption likely lies in the dynamics of simultaneous shifts of aggregate supply and demand curves for meat.

Figure E-7
New poultry production technology shifts aggregate U.S. poultry supply outward



Source: Economic Research Service, USDA.

Beef Industry Response to Lower Consumption Levels

Lower beef consumption levels in the early 1970s induced the cattle industry to accede to consumer advocate group claims that heavy marbling in U.S. beef cuts (i.e., relatively high levels of intra-muscular fat, and/or large amounts of external carcass fat trim) was causing health-conscious consumers to reduce beef consumption. The cattle industry supported changes to U.S. beef grade standards, whose purpose was to better meet perceived consumer demands, at prices acceptable to beef producers. The new set of U.S. grade standards for beef essentially made it easier for carcasses with less marbling to qualify for higher grade categories. That is, some carcasses that would grade "Select" (at that time, termed "Good") on the basis of marbling (or, fat content) under the old grade standard, would grade "Choice" or above, under the new set of grade standards instituted in 1976.

Research suggests that the availability of leaner beef, in general, had no effect on consumer demand. Nelson (1977) found that, "overall demand for beef has not been affected" by the revised set of U.S. grade standards. In fact, 24 years later, industry perceptions of consumer preferences appear to have rotated 180 degrees. The industry, together with beef retailers, now perceive that U.S. consumers want consistently flavorful, tender, and juicy beef—characteristics associated with a relatively high degree of marbling. To meet consumer demands for a specific set of beef characteristics, an increasing number of U.S. beef producers and retailers have instituted their own "branded products" line of beef. Branded product lines of beef involve some degree of identity preservation of animals bearing specified attributes, from the producer level of the marketing chain, through to the retailer. Branded beef product lines are rapidly supplanting U.S. grade standards.

In a further effort to lure consumers back to beef, processors are attempting to duplicate the success of the poultry industry by developing and marketing beef products that economize on preparation time. Marinated, spiced, partially cooked cuts of beef are becoming more readily available at retail outlets. The beef industry has also recently engaged in generic advertising campaigns ("Beef: It's What's For Dinner"), in parallel with the pork industry's "Pork: The Other White Meat" campaign. The returns to generic advertising are difficult to assess, however.[4]

Trade Implications of Increased U.S. Poultry Consumption

The pronounced preference of American consumers for poultry parts that yield white meat—as expressed by the ongoing popularity of the skinless, boneless chicken breast—is a key component in the development of the U.S. poultry export industry. In 2000, the United States exported poultry parts valued at almost $2 billion. In 1975, the value of poultry exports was less than $50 million.

Prior to the 1970s, poultry was largely retailed on a "whole bird" basis. Chicken meat sold as parts was a small component of the domestic U.S. market. Chicken meat retailed as parts came about largely as a consequence of the inspection process at the slaughterhouse level; that is, the carcass of a whole chicken that failed inspection, would undergo a cutting process for removal of the part of the whole bird that caused inspection failure. The remainder of the bird was then further broken down and marketed as chicken parts.

Price signals and disappearance rates began to indicate to processors that consumers preferred particular

[4] Special Symposium on Commodity Promotion Research, 1999.

chicken parts rather than whole birds. To satisfy consumers, processors began to break whole chickens into parts for retail sales. Trays of whole birds broken into constituent parts evolved into packages/bags of drumsticks, wings, breasts, etc. Technology and consumer research yielded the skinless, boneless breast product in the early 1990s (Fulginiti, 1996). The popularity of this particular cut represents a clear industry success in developing and marketing a product bearing a set of desirable characteristics—fast cooking white meat with perceived health benefits—at a price that consumers are willing and able to pay.

The popularity of skinless, boneless chicken breast meat in the United States gave rise to enormous quantities of poultry parts less desirable to U.S. consumers-dark meat, primarily leg-quarters. Large supplies of low-cost, dark U.S. chicken meat coincided however, with the relaxation of selected policy constraints to international meat trade, and, to growing incomes in a part of the world where consumers prefer dark poultry meat: Asia and Russia. The preference of Asian consumers for dark poultry meat is captured in figure E-8, which contrasts the relative price of (dark) leg meat in terms of (white) breast meat, in Japan and in the United States. In the Russian case, import demand for U.S. leg-quarters is the result of the breakdown of trade restrictions previously imposed by the Communist government, and of the ability of the highly efficient U.S. poultry industry to significantly under-price other animal protein produced in Russia.

U.S. trade statistics graphed over time in figure E-9 indicate that Asia and Russia together provide an important outlet for U.S. dark meat parts, which might otherwise be rendered or used as an ingredient in lower valued food products. Breast-meat driven poultry production, and limited U.S. consumer demand for dark meat parts imply that Asian and Russian buyers effectively face an elastic (excess) supply of U.S. dark meat poultry parts.[5] Domestic prices for dark meat parts would likely be lower in the absence of Asian and Russian excess demand.

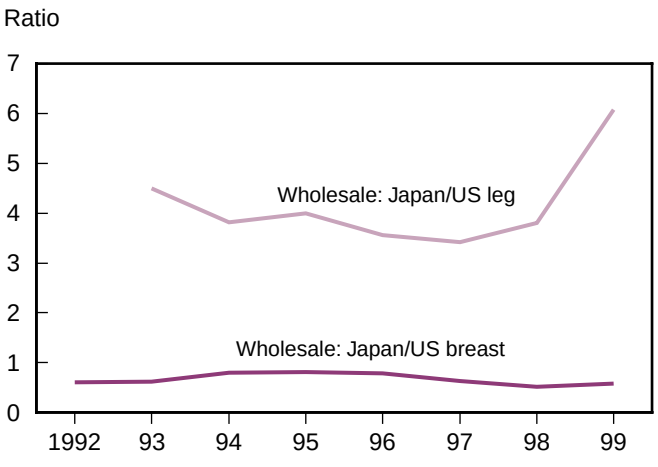
White Meat and Dark Meat Prices: What Comes First, the Chicken Or the Egg?[6]

Identifying the relationship between dark and white meat prices is difficult because leg-quarters and breasts are joint products. That is, white and dark meats are produced in relatively fixed proportions from the whole bird: for every chicken slaughtered there are always two leg-quarters and two breasts. As demand expands in one market, the meat price in that market rises and more birds are slaughtered. Thus, outputs of both white and dark meat are higher, implying that the

[5] 1994-1995 price series for domestic leg-quarters indicate that strong U.S. exports of dark meat products to Russia increased the leg-quarter prices, and induced higher U.S. poultry production. Increased production in turn increased the quantity of breast-meat products supplied to the domestic U.S. market, and lowered equilibrium prices of U.S. breast-meat products. Lower priced breast-meat products likely intensified competition between poultry and beef for U.S. consumers' food dollar during this period.

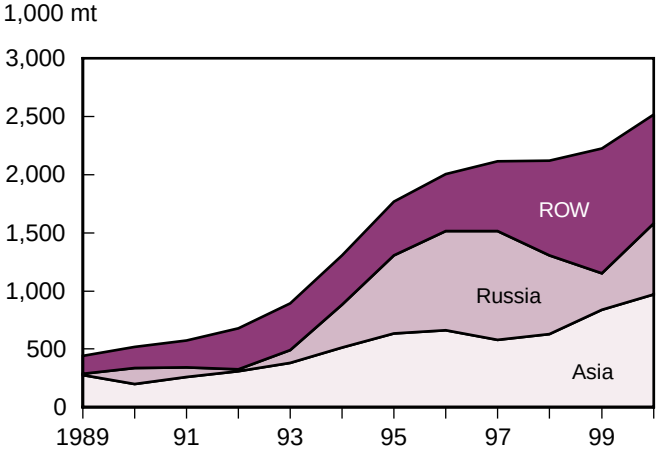
[6] This section based on extensive comments from Philip L. Paarlberg, Professor of Agricultural Economics, Purdue University, West Lafayette, Indiana 47907.

Figure E-8
Ratio of Japan / U.S. broiler part prices



Source: Dyck and Nelson, 2000.

Figure E-9
Country shares of U.S. chicken exports



Source: Economic Research Service, USDA.

price of the meat not experiencing a demand expansion would decline.

In the case of poultry meat, demand for both white and dark meat have expanded at roughly the same time. As discussed above, the demand for white meat in the United States expanded rapidly in the late 1980s and throughout the 1990s. Over the same period, export demand expanded due to income growth overseas and reduced import barriers in key Asian nations and in Russia. The U.S. demand expansion for white meat increases breast prices, and exerts downward pressure on the dark meat price. Lower dark meat prices help to boost U.S. leg-quarter exports. In domestic U.S. markets, the export demand expansion raises the dark meat price and puts downward pressure on the price of breast meat. Lower white meat prices benefit U.S. consumers.

Conclusions

Most Americans continue to center meals around meat consumption. U.S. consumption data indicate that per capita consumption of red meat and poultry has increased since 1970. Most of the increase is accounted for by poultry consumption, while consumption of beef has decreased. Economists have posited a number of hypotheses to explain the substitution of poultry in place of beef consumption. Changes in consumers' preference structure based on health concerns could explain part of the substitution. Moreover, increased numbers of women in the U.S. workforce may cause many families to switch to more timesaving poultry dishes in place of more time/labor intensive preparation often necessary with beef. Another explanation for increased poultry consumption focuses on higher beef prices relative to poultry, and the simple tendency for consumers to choose greater quantities of lower priced goods.

The beef industry has responded to lower consumer demand by attempting to re-align beef more closely with the characteristics desired by consumers. Changes supported by the industry in 1976 U.S. grade standards made leaner beef more available. More recently, the industry has reversed its course, turning back toward more highly marbled products marketed under private labels. The U.S. beef industry has also taken steps recently to emulate the poultry industry in its efforts to develop more timesaving products to accommodate changed U.S. lifestyles.

Given the complexity of the dynamic changes that currently characterize the U.S. meat industry, it is very difficult to attach a single explanation for recent changes in U.S. consumers' demand for meat. It is more likely that some combination of such changing factors as tastes, time preferences, and relative prices together explain why U.S. consumers will likely consume 97 lb of poultry meat and 67 lb of beef in 2001, rather than 34 and 80 lb, as they did in 1970.

The evolved preference of U.S. consumers to consume chicken as white meat yielding parts, instead of as whole birds, has had dramatic implications for U.S. poultry exports to regions of the world where consumers prefer dark chicken meat. U.S. consumer demand for larger quantities of white chicken meat generates huge quantities of chicken parts yielding dark meat. Changes in trade policies, and growing incomes—particularly in Asia and Russia, have created excess demand for dark chicken meat. The United States is expected to export nearly 3 million metric tons of poultry products—mostly dark meat parts—in 2001, thus remaining the world's largest exporter of poultry products.

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Consumer Demand for Fruit and Vegetables: The U.S. Example

Susan L. Pollack[1]

Abstract: Fruit and vegetable consumption has been shown to be an important part of any diet leading towards good health. Factors such as income, aging of a population, market promotion, and consumer awareness of the importance of produce, contribute to increased fruit and vegetable consumption.

Introduction

Fruit and vegetables consumption increases and the composition of products consumed changes as nations become wealthier. For example, fruit and vegetables consumption in the United States has increased over the past two decades along with the Nation's prosperity. Higher incomes provide consumers with freedom to make purchasing decisions based on factors other than meeting basic caloric needs. Increased consumption in the United States has been influenced by several factors, including increased domestic production, product convenience, technological improvements that maintain the quality of fruit for greater periods of time and modify produce to meet consumers preferences, and greater availability and diversity of products through trade. Americans have also increased their consumption of fruit and vegetables as they try to maintain healthier lifestyles.

Background

Fruit and vegetables consumption has been shown to be an important part of any diet leading towards good health. In low-income countries, where meeting caloric requirements is the priority, vegetables, especially starches such as tubers, roots, and legumes make up the bulk of the diet. Consumption is based on locally and seasonally available foods, since people cannot afford expensive imports or the necessary storage facilities for perishable products. Food consumption patterns change, however, as incomes rise. As discussed in earlier chapters, with higher incomes, it is common for people to include more meats and animal products in their diets, and change the types of produce they consume to include more perishable fruit and vegetables. As illustrated in table F-1, between 1961 and 1998, per capita fruit and vegetables availability increased in countries across all income levels. However, per capita availability for low-income countries is about half the amount of middle-income countries, and less than half of high-income countries.

Fruit and vegetables consumption is positively correlated with income levels, with per capita supply (which can be considered as a measure of consumption) being the highest in high-income countries (table F-1). In high-income countries, a wider selection of products is available as a result of increased variety produced domestically and through trade. In this report, U.S. demand for fruits and vegetables is used to illustrate the impact of income and other factors on produce demand.

In the United States, fruit and vegetables consumption has grown over the past two decades as Americans respond to diverse factors. New fruit and vegetable items are available in the markets today that many Americans did not even know existed 20 years ago. Some fruit and vegetables, such as peaches, grapes, asparagus, and melons, have become available in the market during seasons that they are not domestically produced, thanks to improvements in transportation and imports from other countries. Americans have also

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Table F-1—Global fruit and vegetable supply

	1961	1965	1970	1975	1980	1985	1990	1995	1998
					Kg/Capita/Year				
Low-income countries	78	78	79	81	80	81	81	86	86
Middle-income countries	120	127	132	140	154	155	161	164	170
High-income countries	147	156	178	184	193	204	214	222	223

Source: FAO.

increased their demand for fruit and vegetables as they have become interested in healthier lifestyles. When purchasing fruit and vegetables, many consumers are looking for convenience in the products they choose.

Trends in Fruit and Vegetable Consumption

Fruit and vegetables (including melon) consumption in the United States averaged 741 pounds per person annually during 1997-99, 25 percent above 1977-79. Much of the increase is a result of higher vegetable and melon consumption, mostly fresh vegetables and processed potatoes in the form of french fries (fig. F-1). Vegetable consumption increased more rapidly than fruit, rising 24 percent over this period, compared with 8 percent for fruit. Per capita consumption is calculated as the residual of domestic production adjusted for trade and stocks.

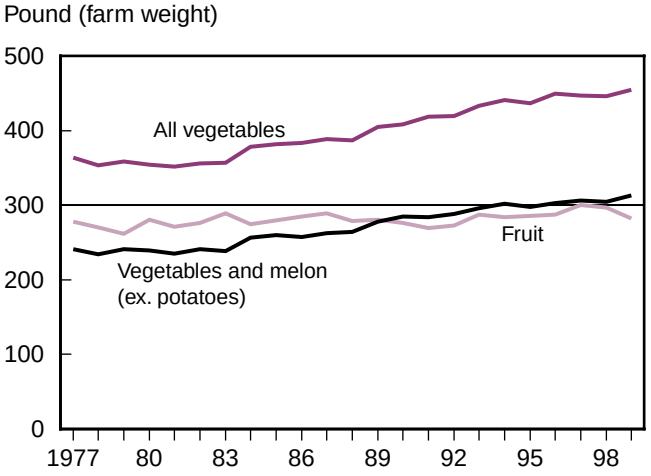
Since the mid-seventies, Americans have changed their consumption preferences. Consumers are eating more fresh and frozen vegetables and fruit and less canned produce (figs. F-2 and F-3). Since the seventies, fresh selections and quality in produce aisles of grocery stores have increased, improving consumers' choices. As a result, fresh vegetable and melon consumption increased 33 percent and fresh fruit consumption increased 26 percent.

Fresh potatoes accounted for the largest share of fresh vegetable consumption. While the consumption of fresh potatoes has remained stable between 1977-79 and 1997-99, their share of total fresh vegetable consumption has declined as other vegetables' share of the total rose. Consumers are varying their diet of fresh vegetables, increasing their demand for asparagus, broccoli, cauliflower, carrots, onions, and lettuces other than iceberg, among others.

Bananas were the number one fresh fruit consumed in 1997-99, with consumption increasing over the 20 years since 1977-79. Unlike most other fresh produce that is popularly consumed in the United States, bananas are not grown domestically, and Americans (excluding Hawaiians) must rely exclusively on imports. The other leading fresh fruits, apples and oranges, are domestically produced. While fresh apple consumption has been on the rise, fresh orange consumption has declined. Americans are turning to other fresh fruit, such as grapes, pears, and strawber-

Figure F-1

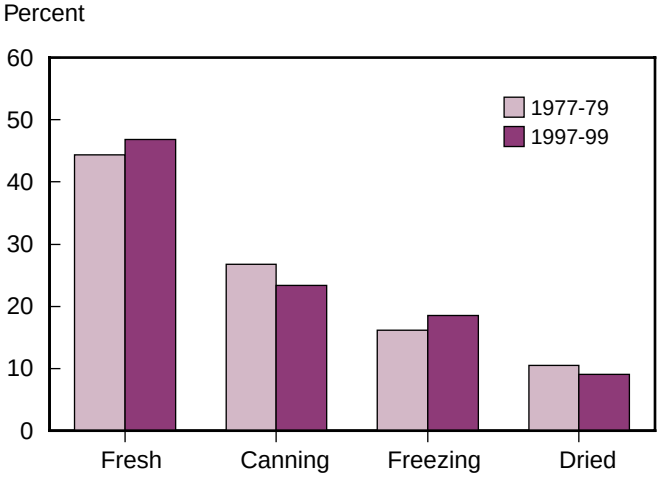
Per capita U.S. fruit and vegetable consumption



Source: Economic Research Service, USDA.

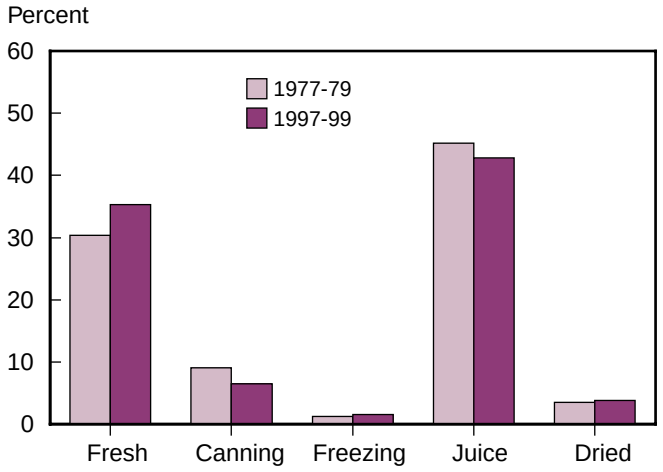
Figure F-2

U.S. vegetable and melon consumption



Source: Economic Research Service, USDA.

Figure F-3
U.S. fruit consumption



Source: Economic Research Service, USDA.

ries, partially because they are now available in the market for longer periods of time than in the past.

Although fruit and vegetables consumption has been growing over the past two decades, the average American is still not consuming the recommended daily servings, as suggested by USDA's food pyramid or the '5 A Day for Better Health[2]' program. The USDA food pyramid, designed as a guideline for healthy eating, suggests individuals should consume at least 2 servings of fruit and 3 servings of vegetables every day. (A serving of fruit is equivalent to 1 medium size fresh fruit, one-half cup of chopped, cooked, or canned fruit, or three-quarter cup juice; a serving of vegetables is equivalent to 1 cup raw leafy vegetables, one-half cup other vegetables cooked or raw, or three-quarter cup juice. These serving guidelines vary, depending on recommended caloric intake based on sex and age, USDA/ARS.)

According to the 1994-96 Continuing Survey of Food Intake of Individuals, conducted by USDA's Agricultural Research Service (ARS), only 23 percent of Americans consumed the recommended servings[3] of fruit and 41 percent the recommended servings of vegetables. The survey also showed that higher income people were more likely to meet the recommended servings of fruit and vegetables, with the proportion of those meeting the recommended requirements declining as income declines. Interestingly, a greater percentage of men than women, 20 years old and over, met the guidelines set for vegetables; the reverse was observed for fruit.

Factors Affecting the Demand for Fruit And Vegetables in the United States

Much of the yearly fluctuation in consumption data can be attributed to yearly changes in the level of production due to weather or the quantity of acres planted to a crop. International trade has been successful in leveling out consumption fluctuations. During serious domestic production shortages, however, higher prices as a result of reduced domestic supply can drive down consumer demand for a product despite the availability of comparable or substitutable imported produce. An example of the effect of production on consumption data is shown in figure F-1. The decline in fruit consumption in 1998 and 1999 reflects reduced production and higher prices due to poor growing conditions in major production regions of the United States.

Consumers Increasingly Demanding Convenient Fruit and Vegetables

Convenience is an increasingly important factor for consumers when selecting fruit and vegetables. As a result, most Americans consume produce in processed forms. In 1997-99, 52 percent of vegetable consumption was canned, frozen, or dried products; 43 percent of fruit was consumed as juice. While there are many vegetables processed, tomatoes accounted for about 70 percent of canned consumption, and potatoes accounted for about 70 percent of frozen consumption. Orange juice accounted for 63 percent of juice consumption. Processed forms of consumption often utilize a greater quantity of a commodity to get an equal serving size to fresh. Since more of a product is needed to produce a processed product, it results in higher per capita utilization of a good. This is not necessarily equivalent to higher servings of the commodity.

Because convenience is such an important factor to Americans, the most popular fresh fruit are often the most convenient to eat. Americans consume more bananas than any other fresh fruit. Bananas are popular because they are inexpensive and they are easy to eat. Apples are also easy to eat fresh, and grapes are

[2] The 5 A Day program is sponsored by The Produce for Better Health Foundation and the National Cancer Institute to promote increased consumption of fruit and vegetables by educating consumers about their health benefits.

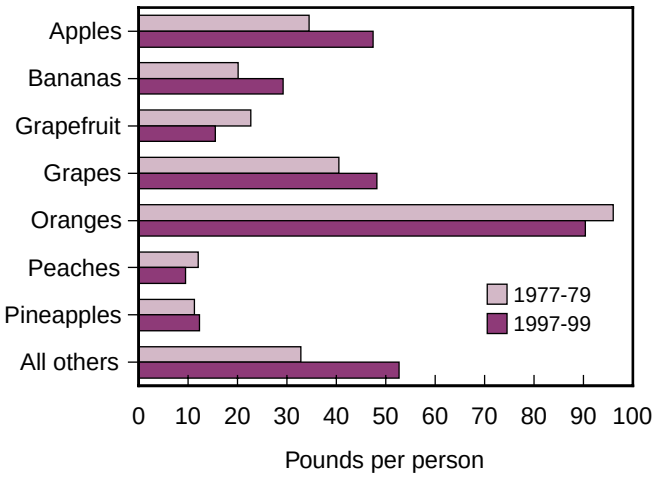
[3] Recommended servings are based on the food pyramid. Dry beans and peas are classified as vegetables in the survey, while in the food pyramid they are also classified under the meat group as are nuts, because they provide a source of protein. Melons are grouped with fruit.

easy to eat fresh or as raisins. Some fruit are consumed more in processed form than as fresh. Oranges are the number one fruit consumed by Americans, and the most convenient way of consuming oranges is as juice, accounting for 86 percent of orange consumption in 1997-99 (fig. F-4). Other fruit are also increasingly being consumed in the juice form. The fastest growing variety is apple juice, with juice consumption exceeding fresh as the number one use of apples in the late nineties.

The most popular vegetables are also consumed in their most convenient forms, which often includes some processing. Potatoes are consumed mostly as french fries and tomatoes are consumed in their canned form (fig. F-5). The introduction of fresh-cut vegetables has increased consumption of several different products. The consumption of two major fresh-cut products, baby-cut carrots and bagged salads, has grown tremendously. These products were new to the markets in the late eighties and have since become a mainstay on the produce shelves in the grocery stores. They provide a more convenient way for consumers to eat fresh produce than the traditional way lettuce and carrots are marketed.

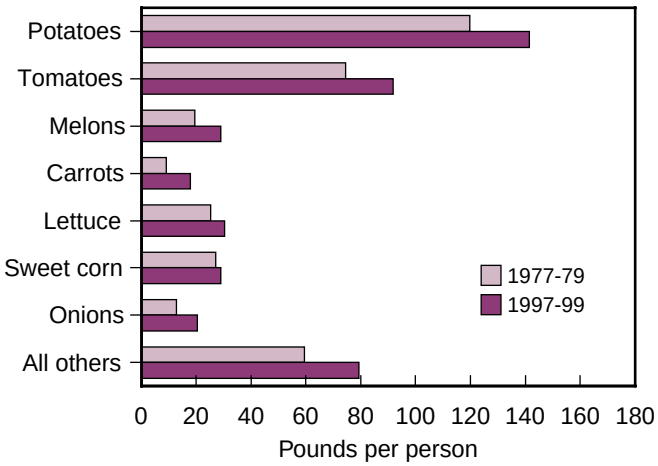
Consumption of frozen produce has also increased over the past two decades, mostly because they appeal to consumers since they are easy to cook and the frozen form of a commodity is available out of season. Frozen product consumption has risen rapidly, increasing 44 percent for vegetables and 36 percent for fruit. Fruit and vegetables are pre-cut and peeled and ready for cooking, reducing the time needed to prepare a meal. Frozen vegetables are a much larger market than frozen fruit because they are used as side dishes to meals or increasingly as the main course. Frozen vegetables, packaged with seasonings and sometimes meat, offer attractive and quick meal alternatives to busy consumers. Frozen fruit items consist mostly of berries, apples, peaches, and cherries, and mostly are used for making desserts. Frozen fruit still comprise the smallest portion of fruit consumption.

Figure F-4
Major fruits consumed in the United States



Source: Economic Research Service, USDA.

Figure F-5
Major vegetables and melon consumed in the United States



Source: Economic Research Service, USDA.

Technology Makes Fresh Products More Appealing

The demand for fresh products has increased as packing and shipping technology has improved. With improvements in shipping, handling, and plant breeding, fruit and vegetables can now be shipped long distances and over greater lengths of time and still maintain appearance and quality. Plant breeding has also produced new varieties of traditional fruit, such as seedless grape and tangerine varieties favored by consumers, increasing demand for these products.

Improved storage facilities provide for year round availability of various commodities. For example, controlled atmosphere storage for apples has resulted in maintaining the fruit crisp until the next crop is harvested. As a result, high quality fresh apples are available year round, increasing fresh apple consumption beyond the fall and early winter seasons.

Concern for Health Increases Consumption

Health issues have also become an increasingly important factor in consumer preferences for produce in recent years. Publicity surrounding scientific studies showing the beneficial values of various fruit and vegetables has been a boom to certain commodities. The growth in broccoli, grape, and berry consumption demonstrates the effect of such publicity on an industry. Health issues alone, however, may not be sufficient to increase consumer demand, especially as the number of studies covering more produce increases. For example, while the grapefruit industry succeeded in receiving endorsements from the American Heart Association, the American Cancer Society, and the March of Dimes to include in their promotions, demand for grapefruit, both fresh and as juice, has declined since 1976-78. Similarly, the cranberry industry grew rapidly after the fruit was found to reduce urinary tract infections. Consumption of cranberry juice, the major use of cranberries, appears to have leveled off in the past 2 years. It appears that while health claims can initially increase demand for a product, they alone may not be sufficient to further expand consumer demand.

The aging of the baby boom population and the increase in the life expectancy of Americans has boosted demand for fresh produce. Studies have demonstrated that spending on fresh fruit and vegetables is higher for households with middle-age and older members (Cook, 1990; Nayga, 1995; Reynolds 1990). Individuals in these age groups tend to increase their consumption of fresh fruit and vegetables because of the reported health benefits of these commodities, and because they have more income to spend on the often more expensive fresh products.

Imported Produce Expands Consumers' Selection

International trade has played a major role in changing consumer demand for fruit and vegetables. Fresh fruit consumption has grown partly as a result of the greater availability of out of season imports. Traditionally, during the winter months, only citrus, bananas, and apples were available in the supermarkets. Since the mid-eighties, however, improved transportation and increased production in Southern Hemisphere countries has made certain fruit, previously unavailable in the United States, now common. Summer fruit such as grapes, peaches, and plums, mostly from Chile, are being sold in U.S. markets, providing alternatives for consumers. As a result, consumers have substituted imports, especially grapes and pears, for traditional winter fruit such as oranges and grapefruit.

Also through trade, new varieties of tropical produce not grown in the United States have become popular. With an increasingly diverse population in the United States, many people desire the fruit and vegetables they consumed in their native countries. As a result, tropical fruit imports, such as mangoes and papayas, have increased, especially in the nineties. As the general population becomes familiar with these products, demand continues to grow and the product becomes a regular item in the market. A recent example of this is mangoes. The increased popularity of mangoes over the last decade has resulted in imports increasing 184 percent between 1990-91 and 1998-99. Although there are some places in the United States that can produce tropical fruit, imports will be necessary to meet the growing demand.

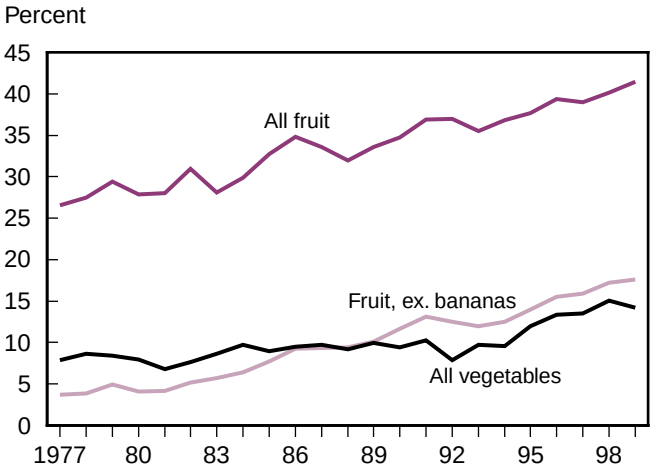
Imports have also increased for commodities already produced in the United States, creating a more stable supply for consumers. For example, Mexican tomato imports have become an important source of winter tomatoes in the domestic market. In recent years, the fresh tomato market has received a new source of competition, this time from Canada. Canadian greenhouse tomatoes are in the market largely during the spring and fall and compete with Florida and Mexican tomatoes.

A similar situation has occurred in the citrus market with the import of the tangerine variety, clementines. The increase in clementine imports, mostly from Spain, takes place at the same time that the U.S. citrus market is at its peak. Even though clementines are often higher priced than domestic tangerines and oranges, the popularity of the clementine continues to rise. U.S. consumers like clementines because they are easy to peel and especially because they are seedless.

Imported fruit and vegetables are becoming an increasingly important component of the U.S. diet. Vegetable imports as a share of domestic consumption averaged 14 percent in 1997-99 (fig. F-6). Fruit imports averaged 40 percent of consumption. Fruit consumption, however, is heavily dependent on banana imports. Excluding bananas, the import share of domestic fruit consumption dropped to 14 percent. Fresh fruit

Figure F-6

Imports as a share of fresh fruit and vegetable consumption



Source: Economic Research Service, USDA.

imports (excluding bananas) as a share of domestic production grew about 8 percent a year between 1977 and 1999. The rising importance of nonseasonal and tropical fruit in the American diet is largely responsible for the growth.

Conclusion

U.S. demand for fruits and vegetables has been influenced by income growth, and other supply-side and demand-driven factors. Not only has the domestic supply benefited from advances in production technology, but also from access to a wider range of sources around the world. Consumers can expect a wider array of produce on the grocery store shelves and lower to stable prices for traditionally consumed commodities as shipping and handling techniques improve, reducing loss. The continued research findings about the health benefits of fruit and vegetables have kept produce consumption in the limelight, encouraging more consumption. The aging of the affluent baby boomers, with their desire to maintain health, has also resulted in higher consumption of fruit and vegetables.

As incomes continue to grow in developing countries, demand for fruit and vegetables are expected to increase. With increased globalization and the associated changes in lifestyles, demand for produce in developing countries will likely be shaped by the same factors that have affected U.S. demand for these products. As in the United States, availability, affordability, convenience, and health concerns will probably influence future consumption of fruit and vegetables across the world.

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Effects of Food-Safety Perceptions on Food Demand and Global Trade

Jean C. Buzby[1]

Abstract: Food safety has emerged as an important global issue with international trade and public health implications. How countries perceive and handle food safety risks is complicated and partly based on their access to and use of science, detection technology, and mitigation methods. Highly publicized food safety incidents affect consumer perceptions, leading to changes in food purchasing patterns.

Introduction

Global food trade will likely increase due to expected increases in global income levels, improved transportation networks, and growing populations requiring greater quantities of nutritious and safe food. Although, for the United States at least, there is no evidence that imported food, as a whole, poses higher food safety risks than domestically produced food (Zepp, Kuchler, and Lucier, 1998), globalization of food supply means that new food safety risks can be introduced into countries (*e.g.*, emerging bacteria), previously controlled risks can be re-introduced into countries (*e.g.*, cholera), and contaminated food can be spread across greater geographical areas and cause illness worldwide.

Food safety risks include risks from veterinary drug and pesticide residues, food additives, pathogens (*i.e.*, illness-causing bacteria, viruses, parasites, fungi, and their toxins), environmental toxins such as heavy metals (*e.g.*, lead and mercury) and persistent organic pollutants (*e.g.*, dioxin), and unconventional agents such as prions associated with bovine spongiform encephalopathy (BSE) in cattle. Scientists generally agree that food safety risks are low, though highest for foodborne pathogens such as *E. coli* O157:H7.

The U.S. Surgeon General states that food safety has emerged in the last decade as a significant global issue with international trade and public health implications (Satcher, 2000). Worldwide, foodborne pathogens have been estimated to cause 70 percent of the roughly 1.5 billion annual episodes of diarrhea and 3 million deaths of children under the age of 5 (WHO, 2000).[2] Countries are not equally at risk from foodborne disease—persons in developing countries with inadequate supplies of safe water and poor waste disposal are particularly susceptible. Food safety risk levels also vary greatly among countries because of differences in available technology (*e.g.*, refrigeration), plant and livestock host factors (*e.g.*, herds exhibit varying infection rates), food production practices (*e.g.*, access to and use of veterinary drugs), cultural differences (*e.g.*, routine consumption of raw seafood) and geographic or climatic differences (*e.g.*, colder climates may kill some pathogens) (Buzby and Roberts, 1999).

Currently in the United States, the bulk of all sporadic and outbreak cases of microbial foodborne illnesses are likely from domestically produced foods because food imports tend to make up only a small proportion of all foods consumed. For example, the average import share of U.S. food consumption was 9.2 percent for 1995-98, though import shares are higher for particular food categories that are often linked to

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[2] Waterborne pathogens also play a large role in causing diarrheal illness and death.

foodborne illness such as fish and shellfish (58.6 percent), fruit (fruits, juices, and nuts, 14.6 percent), and vegetables (10.3 percent). The potential for increased food-related illnesses from continued increases in internationally traded food will challenge government food safety systems and private firms to develop and implement improvements in prevention, inspection, and control systems.

As we shall see, consumer concerns about food safety risks vary across countries and change over time. Food Marketing Institute 1989-97 data indicate that over time, U.S. consumers have become increasingly concerned that foodborne bacteria pose a "serious health risk" while they have become less concerned about other food safety risks such as those from chemical residues, irradiation, and food additives (Food Marketing Institute, 1997).

Countries Vary in Their Perceptions and Acceptance of Food Safety Risks

Each country has its own unique set of health concerns and priorities (Patterson, 1990), though data measuring these concerns are limited. Consumer concerns may include foodborne bacteria, hormones, and irradiated foods for example. The level of consumer food safety concerns, and perhaps consumers' relative ranking of the different concerns and priorities, vary among countries and stem largely from country-wide differences in consumer perceptions about food safety. Figure G-1 presents a schematic to help clarify the relationships between consumer perceptions, concerns, and acceptance.

Consumer perceptions are the result of a complex function of factors such as differences in each country's: baseline food safety risks levels; food safety risks from internationally imported food; access to and extent and nature of information about food safety, risk levels, and related topics; trust in the different sources of information; and experience with major food safety incidents. There may even be basic differences in how people view symptoms of foodborne diseases. Some societies consider diarrheal diseases as a natural/normal occurrence due to factors such as teething, eating hot/spicy foods, indigestion, and even superstition, instead of perceiving diarrhea as a symptom of disease that can be transmitted through food and food handling (Motarjemi and Käferstein, 1997).

Even if the food safety risks are the same across countries, countries may perceive and handle these risks differently. Assessments of similar risks may vary due to differences in access to and use of advances in basic science, detection technology, and mitigation methods (Buzby and Roberts, 1999). For example, countries vary in how they perceive and handle the risks from *Listeria monocytogenes* in foods that are not intended for further heat treatment (i.e., ready-to-eat foods such as luncheon meats). The United States has a zero-tolerance policy for this organism in all ready-to-eat foods, a tolerance so strict, that some countries have raised questions about this policy and claim it is a trade barrier that the United States is using to keep their perfectly safe products out of U.S. markets (Madden, 1994).[3]

Worldwide, consumers' knowledge and perceptions about risk-reducing technologies vary, and as a result not all countries are equally accepting of the different technologies. Consumer acceptance about innovative food technologies such as irradiation is the result of a complex decision-making process involving their assessments of the perceived benefits and risks of the new technology and its alternatives (Henson, 1995). Even within a country, acceptance of and willingness to pay for a new technology that reduces food safety risks varies. For example, only about half of U.S. adults are willing to buy irradiated meat and poultry, according to 1998-99 FoodNet survey data (Frenzen *et al*., 2000).

Reading up from the bottom of figure G-1, what countries accept, in terms of food safety risks in food imports, depends on what countries want—which in turn depends on both their tastes and preferences for foods with different bundles of attributes, and on what they are willing and able to pay to avoid food safety risks. Accordingly, wealthier countries with more information about food safety risks (even if it may be sensationalized) not only demand increased year-round access to a wider variety of internationally traded foods but they also tend to demand more stringent food safety standards on both domestically produced and imported food and are generally willing to pay more for these higher levels of food safety. For example, Denmark has gone to extraordinary efforts to minimize *Salmonella* contamination in pork and, as a

[3] The U.S. Department of Agriculture is in the process of issuing a new rule on *Listeria*.

Figure G-1—Food safety risks: Countries vary in perceptions, concerns, and acceptance

Each Country's Food Safety Risk Perceptions are a Function of:

- Baseline food safety risks from domestically produced food
- Food safety risks from internationally imported food
- Access to and extent and nature of information about food safety, risk levels, and related topics
- Trust in the different sources of information
- National experience with major food safety incidents (*e.g., Cyclospora* outbreaks, BSE, dioxin)
- Perception of science and risk assessments
- Current ability to avoid/control different food safety risks (*e.g.,* access to available remedies)
- Knowledge and acceptance of food technologies (*e.g.,* irradiation and organic methods)

⇩

Each Country's Food Safety Concerns and Priorities

⇩ ⇩

Each Country's Tastes and Preferences for Different Foods with Different Bundles of Attributes:

- Price
- Sensory qualities (*e.g.,* flavor, color, etc.)
- Foods produced with or without certain food technologies (*e.g.,* irradiated versus non-irradiated foods)
- Perceived food safety risk level
- Other perceived risks and concerns (*e.g.,* environmental and animal welfare issues)

Willingness To Pay To Avoid Food Safety Risks which is also a function of factors such as income and ability to control particular food safety risks

⇩ ⇩

What Countries Want in Food

e.g., pathogen-free raspberries
e.g., beef with no risk of BSE/vCJD
e.g., poultry uncontaminated by dioxin

⇩

What Countries Accept in Imports

e.g., raspberries from countries where raspberries are not contaminated with *Cyclospora*
e.g., beef imports from countries that have never isolated BSE in cattle
e.g., poultry from countries where feed was not contaminated by dioxins

society, is willing to pay for strong control measures. Trade patterns with neighboring countries have been affected because Denmark does not want to import pork from countries whose pork poses higher levels of risk from *Salmonella*.

Differences in tastes and preferences among countries have an effect on which foods are imported. Tastes and preferences for different foods are based on how consumers view the bundle of attributes that each food possesses when consumers are making their food purchase decisions (fig. G-1). For example, consumers clearly consider price, quality, and sensory-based attributes such as flavor and color, but may also consider if the food was produced using certain food technologies such as irradiation. This attribute bundle may also include food safety risk levels, as perceived by consumers, or by government oversight in the case of some internationally traded food. For example, some consumers in some countries such as France prefer cheese made from unpasteurized milk and are willing to accept the associated higher health risks from *Listeria* contamination. Other countries, such as the United States, ban the sale of most unpasteurized cheese, even though it constrains consumer choice.

Tastes and preferences for certain foods are influenced by issues other than food safety concerns and sensory-based attributes. One example is consumer reluctance, particularly in European countries, to buy food produced using biotechnology such as genetic engineering. For example, some biotech foods or crops have been genetically engineered to resist pests. In addition to food safety concerns, some consumers have expressed concerns about the uncertain long-term impact of biotech foods on the environment, particularly the consequences of cross pollination, the impact on ecosystems, and the development of pesticide resistance by certain pests from using some of the bio-engineered plant pesticides (Vogt and Parish, 1999). A second example is that in addition to food safety concerns, some consumers consider farm worker safety concerns and environmental concerns (*e.g.*, pesticide use) when deciding whether to buy organic or conventionally grown products.

Differences in what food products countries want and what they will accept in imported food ultimately affect patterns of food demand and global trade, and complicate the development of workable trade rules that are acceptable to different trading partners. Countries also vary in how consumer behavior, firm behavior, and policies/regulations change with new information on food safety risks (such as from outbreaks) and the development and acceptance of new risk management technologies.[4]

Food Safety Incidents and Publicity Affect Food Demand and Trade

Highly publicized international food safety incidents may lead to lasting changes in consumer perceptions about food safety and their food purchasing patterns. In some instances where the public outcry has been particularly strong, there have been changes in government regulations affecting domestic and/or imported food products. Here, the hypothesis is that following the resolution of the problem that caused a major international food safety incident, consumer perceptions about the implicated food product and about the exporting country's ability to produce safe food may be slow to change, and these perceptions have a lasting influence on food demand and global trade.

To explore this hypothesis, three international food safety incidents are presented: (1) the 1996 outbreaks from the pathogen, *Cyclospora*, on Guatemalan raspberries in the United States and Canada, (2) the ongoing bovine spongiform encephalopathy (BSE) crisis in the United Kingdom (UK), and (3) the 1999 contamination of feed in Belgium by cancer-causing dioxin. Each case study begins with a brief description of the incident and with supporting economic impact data. Each case study concludes with a discussion of consumer perceptions and reactions, and how they relate to the hypothesis that these changes in consumer behavior affect trade. The economic impact data illustrate how severe international food safety incidents can be on the exporting country and the implicated industry, particularly during periods where the implicated exports were reduced, suspended, or denied entry. And as we shall see, it can often be difficult for the exporting market to recover from an outbreak or illness linked by fact or by rumor to an exported food (Satcher, 2000).

Cyclospora in Guatemalan Raspberry Exports to The United States and Canada

In 1996, *Cyclospora* outbreaks in the United States and Canada caused 1,465 illnesses (Herwaldt and

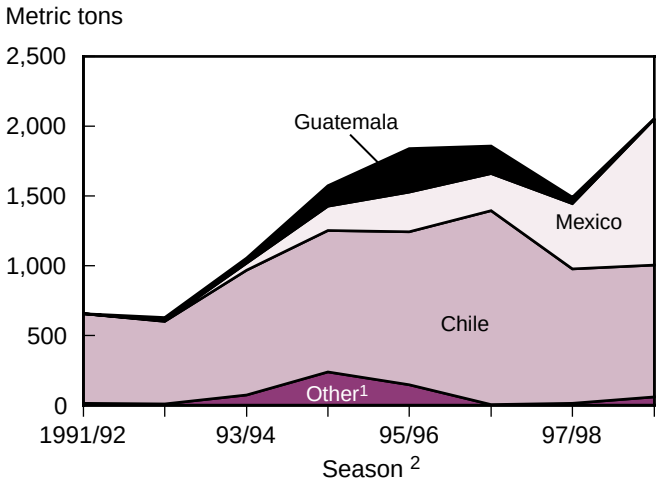
[4] Food industry's response to consumer food safety concerns is discussed in Chapter 10.

Ackers, 1997). At first, California strawberries were erroneously implicated, and this caused $20 to $40 million in lost strawberry sales (Powell, 1998). By July 1996, the U.S. Centers for Disease Control and Prevention declared Guatemalan raspberries as the likely source of these illnesses. After additional outbreaks in 1997, Guatemalan raspberry exporters temporarily suspended exports to the United States, resulting in an estimated income loss of $10 million to Guatemalan producers and workers (Powell, 1998). In response to the outbreaks, the U.S. Government issued an import alert for Guatemalan raspberries for the spring 1998 season. Although Canada faced similar risks, it did not institute a similar ban at this time. Canada later banned Guatemalan raspberry imports after another outbreak in Toronto caused 305 illnesses in 1998—a ban that remains in place today. In contrast, the U.S. opened its doors in 1999 to Guatemalan raspberries from approved farms using a new food safety program.

Prior to these outbreaks, in 1995/96, Guatemala was a major player in raspberry exports to the United States. Although the problem appears to have been resolved to the satisfaction of the U.S. Food and Drug Administration (FDA), the demand for Guatemalan raspberries has only been restored to about one-third of the pre-outbreak levels (Calvin *et al*., 2000). The trade restrictions coupled with the time needed to implement the complex system of production controls gave other countries, particularly Mexico, the opportunity to take over much of Guatemala's role as a raspberry supplier (fig. G-2). Only six Guatemalan raspberry farms remain in business, down from the 1996 estimate of 85 farms before the first outbreak (Calvin *et al*., 2000).

During the early days of this incident, there was a temporary reduction in demand for all berries from all sources, with strawberries particularly hard hit (Calvin *et al*., 2000). Retail and commercial buyers eager to protect their business and the health of their customers, and consumers knowledgeable about the outbreak, switched to other types of produce. Later when Guatemalan raspberries were identified as the source of the outbreak, consumer demand dropped for Guatemalan blackberries as well, and the demand for raspberries as a whole declined regardless of the country of origin (Calvin *et al*., 2000). Although this problem has been resolved, lingering changes in consumer demand and trade continue to persist today. Consumer confidence about Guatemalan raspberries

Figure G-2
U.S. fresh raspberry imports



1 Not including Canadian imports of fresh berries which are often technically still fresh berries but destined immediately for processing facilities.
2 Season defined from September through August of the following year.

Source: U.S. Department of Commerce data published in Calvin *et al*., 2000.

(and other Guatemalan products) is changing slowly though it has not yet been completely restored (Calvin *et al*., 2000), and some buyers continue to avoid it.

The highly publicized Guatemalan raspberry crisis raised consumer awareness about the potential for imported produce to bear foodborne pathogens (Zepp, Kuchler, and Lucier, 1998).[5] This resulted in the interests and concerns of consumers being intertwined with the marketing actions of retail and other commercial buyers. At the top of figure G-1, this experience with *Cycolospora* in imported raspberries can be considered as a shock to the food safety risk perceptions in the United States. This in turn alters the tastes and preferences for raspberries if buyers and consumers now see the bundle of attributes possessed by raspberries, and perhaps by other berries, as containing higher food safety risk levels. These updated tastes and preferences are reflected in what the United States wants in these products (*Cyclospora*-free raspberries), and in what the United States will accept in imports (*e.g*., raspberry imports from countries where *Cyclospora* is not a problem).

[5] In October 1997, following media attention on these outbreaks, the President announced a food safety initiative on the safety of imported and domestic fruits and vegetables to upgrade standards for fresh produce and to ensure that imported produce is as safe as domestic produce (Vogt, 1998).

This incident illustrates that consumer perceptions about the implicated food product and about the exporting country's ability to produce safe food are slow to recover after an international food safety incident, and that these perceptions have a lasting influence on food demand and global trade. This case study also illustrates that after a food safety incident, industries implicated by rumor, fact, or association can be economically vulnerable, countries can respond to similar risks differently, and consumption and trade patterns can adapt and change, potentially involving substitution away from the implicated product or away from a country's exports of that product.

Bovine Spongiform Encephalopathy (BSE) In The United Kingdom

In 1996, Britain announced that there was a possible link between bovine spongiform encephalopathy (BSE), known as "mad cow disease" in cattle and a new strain of Creutzfeldt Jakob Disease (vCJD) in humans. This rare but invariably fatal human strain causes progressive deterioration of brain tissue and has caused 87 deaths as of December 2000 in the United Kingdom (U.K. Dept. of Health, 2000), two in France (and one probable), and one in the Republic of Ireland. Science has not provided a definitive understanding of how BSE is linked to this human strain. However, many scientists now believe that humans become ill by eating bovine products contaminated with some kind of causative agent of BSE.

Immediately after the 1996 announcement, domestic sales of beef products in the United Kingdom fell by 40 percent and within a month, household consumption of beef fell 26 percent from the previous year's level (Atkinson, 1999).[6] Table G-1 shows that the significant export trade in live cattle and beef developed by the United Kingdom during the early 1990s was hard hit by the European Union's (EU) March 1996 ban of U.K. live cattle and bovine products (Atkinson, 2000). Other export markets followed the EU's ban on British live cattle and products, lowering real producer cattle prices in the United Kingdom.

In the first year of the crisis (1996), the total economic loss from BSE to the United Kingdom was estimated to range between £740 million and £980 million (Atkinson, 1999) (US$1.2 to US$1.6 billion).[7] Although this figure has not been updated, the cumulative gross budgetary cost of BSE to the United Kingdom between March 1996 and March 31, 2000, was roughly £3.5 billion (US$5.6 billion) and is expected to total £4 billion (US$6.4 billion) by March 31, 2001 (Watson, 2000). The number of newly confirmed BSE cases in animals peaked in 1992 and has since been decreasing due to prevention and control efforts.[8] As of August 1, 1999, exports of U.K. beef to the EU are permitted. However, sales are expected to be slow, and any short-run benefits will probably come from increased consumer confidence about beef in the United Kingdom (Atkinson, 1999).

In addition to the financial toll, the emotional toll of this crisis was particularly high. Incidences of human illness caused enormous concern worldwide and left a lasting impact on food safety risk perceptions. The media emphasized the unusually high severity of the human illness that is relentlessly progressive, untreatable, and invariably leads to a traumatic decline and death. Consumer concerns were fueled higher when the media told human stories where families of victims essentially saw loved ones waste away and when the media emphasized that because of a lack of scientific knowledge about the incubation period and how to prevent and control the disease, no one knew for certain how high the human health toll would reach. Recently discovered cases of BSE in other EU countries have continued to fuel consumer concerns worldwide and have caused economic disruptions in these countries. For example, between November 2000-February 2001, 29 BSE cases were discovered in Germany, and beef consumption in Germany fell by more than 75 percent during the same period (Reuters, 2001).

However, until the recent foot and mouth disease outbreak in Europe, in the United Kingdom at least, there were several signs that consumer confidence in the safety of beef was beginning to return. During the four-week period ending May 28, 2000, total beef consumption in Great Britain increased 4 percent, compared with consumption a year earlier (though still 9 percent below the 1995 level) and the percent of homes that purchased beef increased 1 percent

[6] A detailed chronology of events can be found on <*http://www.maff.gov.uk/animalh/bse/default.htm*> as accessed on June 5, 2000.

[7] Assuming an exchange rate of 1 pound sterling is equal to US$1.60.

[8] Although BSE cases in animals existed during the 1980s, the 'BSE crisis' followed the British Government's announcement of a possible link to vCJD in humans in 1996.

Table G-1—United Kingdom exports of beef and veal and cattle, 1990-1999 [1]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Beef and Veal:										
Quantity (*metric tons*)	81,837	80,252	74,419	117,771	141,706	148,304	31,893	269	995	322
Value (*1,000$*)	298,232	270,043	288,535	353,597	486,241	531,066	105,084	832	2,799	1,400
Cattle:										
Quantity (*head*)	351,501	399,990	429,129	424,589	468,715	392,157	57,067	36	126	17
Value (*1,000$*)	77,861	88,748	110,444	126,217	133,119	103,027	13,276	5	36	4

[1] In 1996, the European Union banned imports of U.K. bovine products and live cattle.

Source: FAOSTAT Agricultural Data, *http://apps.fao.org/page/collections?subset=agriculture*, accessed Feb. 26, 2001.

compared with purchases a year earlier (though still 4 percent below the 1995 level) (MAFF, 2000). Beef's share of total meats consumed recovered in 1997 and was stable in 1998 (Atkinson, 1999). Part of the increase in beef consumption is due to lower real beef prices (Atkinson, 1999) and part is likely to be explained by increased confidence by some U.K. consumers in the safety of beef. Following the BSE crisis, the U.K. Government undertook policy changes aimed at eradicating BSE, preventing its transmission to other animal species, and protecting consumers of beef products in the United Kingdom and worldwide (Atkinson, 1999). For example, all cattle over 30 months of age were banned from entering the animal or human food chain by the U.K. Government. Other measures were undertaken to cushion U.K. beef producers and the rendering industry from the full economic impacts of the crisis and to restore public confidence.

Figure G-1 can also be used to understand how food safety risk perceptions by U.K. consumers are changing following improvement in government control over the BSE crisis. Confidence in the beef supply by U.K. consumers is beginning to return due to changes in food safety risk perceptions which are in turn influenced by improvements in access to and extent of information about the disease, greater trust in the different sources of information, and belief that the current ability to avoid this risk has been improved by the U.K. Government's control and prevention actions.

1999 Contamination of Feed in Belgium

Another significant food safety issue that quickly spread across national borders and caused serious trade impacts occurred when fat used in animal feed in Belgium was inadvertently contaminated with polychlorinated biphenyls (PCBs) and/or cancer-causing dioxin in January 1999. The feed was later fed to chicken, swine, and other food animals, potentially resulting in contaminated food products. To date, human illnesses have not been linked to this incident though long-term surveillance may find otherwise.

Although dioxin can be found throughout the natural world (soil, water, and air for example), 90 percent of human exposure is through the food supply (WHO, 1999). Dioxins are persistent organic pollutants that accumulate in body tissue and pose cancer and other human health risks—in general, the higher up the food chain, the greater the accumulation (WHO, 1999). Consumers have only a limited ability to restrict their exposure to foodborne dioxins (*e.g.*, consuming low-fat dairy products and trimming fat from meat) and therefore national governments have essential roles in monitoring food safety and acting to protect public health (WHO, 1999).

The European Commission (EC), the executive body of the EU, and the rest of the world were not notified of the dioxin crisis until late May 1999. On June 11, the U.S. Food and Drug Administration (FDA) issued a precautionary import alert that recommended detention of products at ports of entry until importers provided lab test results showing that shipments were free of detectable levels of PCBs and/or dioxins (FDA, 1999). Products in this initial import alert included eggs, products containing eggs, game meats from Belgium, France, and the Netherlands, all animal feeds and feed ingredients, and pet foods from all European countries (FDA, 1999). This list was later expanded to include milk-containing products such as soups and cheese.[9] Countries around the world also issued different combinations of temporary consumer advisories, import bans, and import alerts of potentially contaminated foods and animals from Belgium, select

[9] The import alerts from this crisis were later canceled in early 2000 (personal communication with FDA on September 21, 2000).

EU countries, or the EU as a whole.[10] Many foreign buyers demanded price concessions or refused to buy select Belgian products. Belgium also banned domestic sales of many products.

According to a report from the Belgium Ministry of Economic Affairs on the impact of the dioxin crisis on meat production, there was a sharp decline in Belgian meat production in June 1999, some recovery in July-August, and a September production level at 5-15 percent below normally expected levels (FAS, 2000).[11] Production of other food products such as milk and eggs also faced a more subtle but marked decline in June, though these dioxin effects had largely disappeared by September (FAS, 2000). Overall, when considering the relative importance of the different subsectors, the dioxin crisis caused an estimated food industry production decrease of 10 percent in June 1999, 2.5 percent in July and August, and 1.5 percent in September (FAS, 2000). Interestingly, there was a production increase in July for animal feeds which was likely due to a temporary slaughter ban that initially kept many animals on the farms (FAS, 2000).

The combination of slaughter bans, large price concessions, and reduced markets posed an economic burden on food producers. In particular, the Belgian swine industry suffered when test results in June 1999 confirmed dioxin contamination of swine on some farms (FAS, 1999). Contaminated swine farms were depopulated and the swine were destroyed. On other farms, stables of piglets and slaughter hogs became overpopulated because of reduced demand, adding unnecessary feed costs, limiting stable space, and prohibiting fatteners from buying piglets and starting new fattening cycles. A higher amount of pork was put into storage because of reduced markets. The Belgian pork sector received limited financial aid from the Belgian Government for this crisis and did not receive any financial aid from the EU Commission (FAS, 1999).

It is difficult to gauge the international trade and other economic impacts of this crisis. As of yet, 1999 data on Belgium exports are only available for quantities of beef, veal, pork, live cattle, and swine traded (table G-2). Although exports in 1999 decreased by 16 percent for beef and veal and by 5 percent for pork, exports of live cattle increased by 20 percent and 71 percent for swine. It is unclear what percent of any trade adjustments are due to the crisis or due to other factors and how prices affected net farm returns.

The estimated cost of this food safety incident to the Belgian economy exceeds $750 million (Ekperigin, 2000). And as other EU countries were also affected by export bans, the cost of this incident worldwide is likely to be higher. These costs are, however, offset to some extent by gains obtained by industries and countries that provided substitute products. In response to this scare and the temporary removal of some food products from Belgian supermarkets, Belgian consumers became more concerned about food safety and many began consuming more produce, organic eggs, and other organic products. The dioxin crisis also prompted increased consumption of mutton, lamb, and horsemeat (FAS, 2000). The clearest example of a Belgian food industry that profited from the dioxin crisis is that the production of fish products increased appreciably in June and July 1999 (FAS, 2000). And, in the German market, there appears to have been a temporary extra demand for pork and slaughter hogs (FAS, 1999).

As with the BSE crisis, the dioxin scare illustrates that a food safety crisis can pose high financial costs on industries and countries. Reverberations from the dioxin scare contributed to the Belgian Government's collapse later that year (Orden, Josling and Roberts, 2000). The dioxin scare also illustrates that delays in identification and mitigation actions can increase the extent and impact of the incident as trade and consumption of contaminated products continues unhindered. On the other hand, the financial stakes in the dioxin crisis were so high that Belgian regulators had some reason to be cautious about alerting the public and trading partners about the potential crisis until there was sufficient information on the source, extent, and risk posed by the crisis.

The dioxin crisis caused a high awareness and anxiety about food safety in Belgium that served as background stress for consumer reaction to another scare, this time over Coca-Cola (Nemery *et al.*,1999). Within a month of the announcement about the dioxin crisis, school children and other individuals across Belgium began complaining about nausea, headaches, and other symptoms that they believed were caused by drinking bottled Coca-Cola. There were never any significant

[10] For example, countries that took action included Australia, Bulgaria, Canada, Cyprus, Germany, Portugal, Saudi Arabia, Singapore, South Africa, and Thailand.

[11] Data are based on an index of production per working day (1995=100).

Table G-2—Belgian-Luxembourg exports, 1989-1999[1]

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Change[2]
						Metric tons						*Percent*
Bovine meat, fr, ch, w.bn	95,803	110,098	123,608	117,085	111,447	94,805	86,958	80,303	83,850	74,097	59,686	-19
Bovine meat, fr, ch, bnless	8,753	16,012	14,065	11,228	13,418	11,718	12,894	12,778	14,988	14,735	18,413	25
Bovine meat, frz, w.bone	4,680	1,089	1,566	5,831	3,461	981	988	3,344	4,519	2,291	2,141	-7
Bovine meat, frz, boneless	7,579	10,197	23,548	28,303	35,441	33,395	39,983	42,082	36,044	21,651	13,528	-38
Meat of swine, fr, chlld	163,253	164,759	225,308	255,158	303,100	312,721	380,216	389,984	375,100	422,131	400,652	-5
Meat of swine, frz	127,924	113,315	122,308	111,642	108,060	120,409	100,011	103,040	100,301	102,969	94,898	-8
Poultry, whole, fr, ch	4,692	9,086	11,311	13,651	18,734	18,372	17,128	21,617	25,405	27,868	28,598	3
Poultry, whole, frz	24,076	23,878	26,379	29,396	29,821	23,792	21,305	19,559	26,313	27,625	19,577	-29
Edible offal, bov. fr, ch	1,843	2,364	2,028	2,583	6,051	5,797	9,666	10,126	10,929	15,554	3,621	-77
Edible offal, bov., frz	4,791	5,461	7,950	9,441	10,175	10,050	9,999	12,281	10,802	7,126	23,699	233
Edible offal, swine, fh, ch	3,740	3,555	4,724	6,007	14,476	12,928	13,596	19,036	24,564	27,200	20,494	-25
Edible offal, swine, frz	17,546	17,336	17,872	20,894	20,695	25,518	23,130	24,449	29,002	31,743	218	-99
Sausage of meat, offl. etc	10,315	11,057	15,661	16,490	31,142	34,360	35,611	48,548	90,626	87,611	31,676	-64
Milk, fat cont. 1% or less	112,910	108,801	136,778	117,727	109,296	109,303	117,855	89,192	102,680	93,358	68,845	-26
Milk, cream fat cont.1-6%	513,589	478,418	564,070	693,685	683,570	801,064	823,817	779,161	682,509	690,327	693,046	0
Cream, fat content 6%+	23,402	18,186	21,645	33,628	21,850	34,248	30,397	45,477	45,926	91,210	93,388	2
Milk, solid, to 1.5% fat	84,832	63,038	83,660	90,003	102,217	76,406	150,836	88,946	65,808	62,361	90,491	45
Milk, crm solid 1.5%+ fat	36,126	34,430	69,614	72,173	99,578	119,699	176,401	115,213	92,427	90,237	71,961	-20
Milk, cream unsweetened	20,370	30,875	41,327	62,800	24,765	25,477	28,560	18,271	34,342	78,552	54,366	-31
Milk, cream, sweetened	12,576	16,626	20,423	20,940	20,057	11,936	20,329	16,185	12,239	12,854	15,663	22
Whey	102,768	103,497	106,480	122,462	94,220	66,948	76,097	78,660	94,564	88,949	56,171	-37
Milk products nes[3]	452	1,355	734	11,914	24,546	53,470	29,264	40,833	31,349	30,670	15,159	-51
Butter, other fat of milk	116,658	107,278	132,469	119,244	133,541	127,367	125,094	105,345	111,332	116,825	107,338	-8
Egg, unshelld; yolks, dried	664	893	1,175	1,117	1,728	2,177	1,343	1,848	3,477	3,488	4,295	23
Egg, unshelld; ylk, not dry	32,690	37,022	36,015	34,552	29,876	24,476	30,142	22,358	27,624	25,872	19,340	-25

[1] Select exports to the rest of the world in metric tons. [2] Percent change between 1998 and 1999. [3] nes = Not elsewhere specified.

Source: United Nations COMTRADE database, 2000.

lab or physical findings to support these claims and some people believed that features of this outbreak pointed to mass hysteria or mass sociogenic illness (MSI) (Nemery *et al*., 1999).[12] There was intense media coverage about the Coca-Cola crisis on the tails of intense media coverage about the dioxin incident.

The point here is that major food safety incidents can greatly increase consumer concerns about food safety. Even though this incident of dioxin-contaminated feed was identified and resolved at its source and there have been no apparent human illnesses, perceptions about food safety by the Belgian public and perceptions about the safety of Belgian agricultural products by foreign buyers may be slow to recover. This may be particularly true because so many different kinds of products were implicated and perhaps because it does not appear that accurate and sufficient information was supplied to the public and importing nations early in the crisis to assure people that the crisis was under control.

Looking Ahead…

Currently, the two most prominent conflicts with the potential to jeopardize trans-Atlantic food trade are the beef-hormone dispute and the EU's approval procedure for introducing genetically engineered products into the food chain (Josling, 1998). The issue about growth-promoting hormones in cattle is one example where risk perceptions vary internationally. These hormones are widely accepted as safe and are used on most farms throughout the United States and Canada, whereas the EU believes they pose human health risks and has banned their use in domestic and imported beef. The U.S./Canadian complaint that this ban is a protectionist measure is the only outcome of a food safety dispute that has advanced to the World Trade Organization (WTO) Appellate Body (Buzby and Roberts, 1999). As of May 2000, recent scientific reviews presented to the European Commission (EC)

[12] "MSI can be defined as a constellation of symptoms of an organic illness, but without identifiable cause, which occurs among two or more persons who share beliefs related to those symptoms" (Philen *et al*., 1989).

led the EC to conclude that the evidence that the hormone 17ß oestradiol could cause cancer in humans is sufficiently strong to justify permanently banning all of its uses for farm animals, and that the provisional ban on five other hormones should be continued because they need further study. The debate continues and some retaliatory tariffs on European products remain in place.

Similarly, European consumers are less likely than U.S. consumers to view biotech foods as safe. These differences are largely due to two main factors. First, European consumers are generally less trusting of food safety regulatory systems than are U.S. consumers because of recent incidents where European agencies initially failed to detect the extent of food safety problems and downplayed the likely consequences (Feldmann, Morris, and Hoisington, 2000). Second, European consumers are more aware than are U.S. consumers about the extent to which foods contain biotech ingredients (Feldmann, Morris, and Hoisington, 2000).

Labeling, in general, is a prominent issue relevant to domestic and internationally traded food. In addition to process-based biotech labeling to provide information to consumers concerned about genetically engineered foods, some of the proposed and new food labeling regulations include eco-labeling to promote environmental quality, mandatory country-of-origin labeling to promote domestic agriculture, and health and nutrition labeling to encourage healthier diets. Country-of-origin labeling can also provide consumers with information if they are seeking to avoid certain food imports from certain countries associated with previous or current food safety scares or lapses. To date, most countries do not use labeling as a regulatory tool for food safety (Caswell, 1998). Labeling may help consumers make informed purchase decisions, thereby increasing market efficiency and consumer welfare (Golan, Kuchler, and Mitchell, 2000). However, labeling raises costs of producing and marketing the products and will rarely be sufficient in correcting production externality problems (Golan, Kuchler, and Mitchell, 2000). And, some consumers and governments believe that labeling is an unfair trade barrier and will restrict trade.

As the three case studies have illustrated, an international food safety crisis can have profound impacts on the implicated industry, the exporting country, and international trade in general. For example, the relatively minor outbreak from Guatemalan raspberries had a tremendous impact on the industry, and other Guatemalan exports suffered as well. The BSE crisis virtually stopped international trade of U.K. live cattle and bovine products, and the dioxin crisis affected a large array of agricultural industries in Belgium.

The three case studies also illustrate that even after major international food safety incidents have been resolved or largely controlled, consumer perceptions about the implicated foods and the exporting country's ability to produce safe food may be slow to recover. However, a timely and appropriate response to a food safety crisis by the government and by the implicated industry can help minimize damage from the crisis to food markets and consumer confidence. The extent of scientific uncertainty about a food safety issue clearly plays a role in shaping food safety perceptions, and these perceptions affect what countries will accept in terms of food safety risks in domestic and imported food.

The mix of private and public strategies to control food safety risks is changing both in the United States and abroad, and in turn, the patterns of international food trade are also changing. Private control strategies include self-regulation, vertical integration (to ensure quality/safety of inputs, for example), Hazard Analysis and Critical Control Point (HACCP) systems, and third party certification such as the International Organization for Standardization (such as, the ISO 9000 series or "EN 29000" in Europe) (Buzby and Roberts, 1999).[13] Public control strategies range widely and include regulatory reorganization efforts for food safety as well as regulations for domestic and internationally traded food.

In general, countries are responding to arbitrage pressures and other trade-related tensions by adopting multilateral coordination mechanisms such as mutual recognition, coordination, and harmonization (Sykes, 1995). Mutual recognition means a country explicitly accepts the standards, certification procedures, and regulations of other countries (for example, U.S. inspection of meat is accepted for their imports). Coordination takes convergence one step further by jointly designing adjustments to each country's policies (using, for example, World Health Organization (WHO) control procedures for communicable diseases). Harmonization

[13] See Caswell and Henson (1997) for a discussion on the interaction of private and public systems to control food quality.

entails even higher levels of convergence such as regional or world standards or agreements.

Private-sector approaches are often intertwined with each other (ISO standards often use HACCP, for example) and with multilateral coordination mechanisms (such as Codex HACCP standards). Countries and firms within countries may use private system approaches differently, and this difference influences the marketing of food safety internationally. In general, the greater the coordination of multilateral mechanisms and private approaches among firms and nations, the more they will be able to provide verifiable and valuable information to trading partners and facilitate trade.

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Factors Affecting International Demand And Trade in Organic Food Products

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Abstract: With increasing presence in supermarkets and a broader base of consumer support among both occasional and regular buyers, organic food markets are expanding worldwide. Taste, freshness, quality, and food safety concerns drive consumer demand for organic foods. Price premiums, the price-quality trade-offs, as well as country of origin, GE content, and other social concerns will likely determine future market expansion.

Introduction

The organic foods market is supported by consumers in nearly every developed country in the world, with International Trade Centre (ITC) data indicating 1997 sales of nearly $10.5 billion in Europe, the United States, and Japan (ITC 1999). Many of the conclusions previously presented regarding consumer behavior also apply in the organic market. Preferences change in response to income changes (Chapters 1 and 2) and lifestyle decisions (Chapter 3), and are dependent on the age of consumers (Chapter 3). Food safety concerns are also shaping consumer demand (Chapter 7) and spurring interest in organic foods.

Organic foods are distinguished from non-organic foods by the methods used in their production and processing, rather than by observable or testable characteristics. Although there is no single international organic production regulation, all generally accepted organic rules prohibit use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives, and require long-term soil management, emphasis on animal welfare, and extensive record keeping and planning. Certain activities such as use of genetically modified stock, application of sewage sludge to organic acreage, and food irradiation are also prohibited.

To be **certified organic**, a farm or processing facility must be inspected by a credible third party state or private organization to verify that all requirements of the certifying body are met. **Conventional or non-organic** foods would not meet organic standards, if subjected to certification criteria. Intermediate categories of **eco-labeled** foods, such as certified Integrated Pest Management (IPM) in the United States, Low-Chemical foods in Japan, and some classes of Green Food in China, fall short of the strict requirements of organic certification.

Most studies characterize organic consumers as affluent, well-educated, and concerned about health and product quality (Richter *et al*., 2000; ITC, 1999; Thompson, 1998; The Hartman Group, 1996; HealthFocus, Inc., 1999; The Packer, 2000a and 2000b, 1998; FAS 2000b). Many are parents of young children or infants. Most regular consumers favor locally grown organic products, when available, in an effort to support local farmers and ensure freshness.

There is some variation in age and gender of purchasers across countries. In the United States, younger aged (18 to 29 years) and middle-aged (40 to 49 years) consumers are more likely to buy organics, but men and women are equally likely to buy organics (Thompson, 1998; Lohr and Semali, 2000). The typical Japanese organic buyer is female and in her 30s or 40s (FAS, 2000b). In the Netherlands, typical purchasers are between 25 and 50 years old and either living alone or in a dual-income household with children (ITC, 1999).

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This cross-country variation is most likely related to cultural differences regarding household shopping responsibilities as well as respondents' level of commitment to the environment and personal health.

Reasons for purchasing organics are similar across countries. In Europe and the United States, taste, freshness, and quality rank among the top reasons for organic purchases, especially for produce (ITC, 1999; The Packer, 2000 & 1998). The perception that organic foods are healthier is widespread among buyers, even though some countries prohibit advertising that suggests this. Food safety is the top reason driving Japanese interest in organic food, and was listed as the main concern by 80 percent of 1,000 consumers surveyed in 1995 (MAFF, 1996). Secondary factors for Japanese consumers are healthfulness (nutrition) and taste.

Food scares such as mad cow disease, *E. coli* contaminations, and pesticide poisonings, as well as concerns over genetic engineering (GE) in foods, have stimulated interest in organic foods. Until recently, consumer response to such incidents was localized or at most affected a single country. With increased trade, the impact of these events on consumer behavior are more widespread as more sources are utilized for imports.

European retailers have responded by advertising food safety and health aspects of organic foods, with this theme dominating retail messages in 12 countries (Michelsen *et al*., 1999). Environmental protection is the second most important argument presented by retailers in Europe, although consumers do not consistently select food products according to the environmental impact of the production and processing systems. The ITC (1999) noted inconsistencies in several countries between political views of self-described environmentalists and their shopping habits. Taste and freshness are not important parts of retailer's message in Europe, although consumers rate organics higher in this regard (Michelsen *et al*., 1999).

Japanese retailers have focused store promotions on food safety issues, touting perceived advantages of organic foods, which corresponds to the greatest concerns of their clientele (FAS, 2000b). Japanese consumers also are very concerned about freshness, which is believed to be linked to the nutritional content and functional value of foods (MAFF, 1996). This is also part of the message that Japanese retailers deliver to promote organic foods. Overall, Japanese retailers appear to be more attuned to their consumer interests than European retailers.

In the United States, retail managers who demonstrate personal interest in environmental and human health are more likely to offer organics in their stores (Lohr and Semali, 2000). Conflicting data on nutritional, environmental, and human safety qualities of organic foods, coupled with strict truth-in-advertising regulations in the United States, have limited the ability to promote organics on these grounds. Some States even prohibit comparisons that disparage conventional products by suggesting they are inferior in any way to organics. Retailers can educate about production methods, which may be interpreted by consumers as safer, healthier, or better for the environment than conventional production methods.

The current organic market situation in major consuming countries is described in this chapter. Effect on organic food demand of price premiums, price-quality trade-offs, GE content, country of origin, and consumer social goals are explained. Prospects for future market growth in the next decade are also discussed.

Market Status

Worldwide markets for organic foods are expanding, with annual growth rates of 15 to 30 percent in Europe, the United States, and Japan for the past 5 years. Using 1997 sales data and annual growth rates from the ITC (1999), and assuming a linear trend, projected market size in 2010 will be at least $46 billion in the European Union, $45 billion in the United States, and $11 billion in Japan. As many as 20 to 30 percent of consumers surveyed in Europe, North America, and Japan claim to purchase organic foods regularly (Lohr, 1998).

While there is interest in organic foods among higher income, better-educated population segments in nearly every country, consumers in the United States, Europe, and Japan drive demand expansion. The current value of the European organic market is estimated at $5.255 billion, of which U.S. imports contribute $200 million to $300 million, or about 4 to 6 percent (ITC, 1999; FAS, 1999c). The current value of the Japanese organic market is estimated at $3 billion, of which U.S. imports constitute $100 million, or about 3 percent (FAS, 2000b).

Few governments keep statistics on sales of organic foods, necessitating reliance on industry estimates collected by the United States Department of Agriculture's (USDA) Foreign Agricultural Service (FAS), the International Trade Centre (ITC, under UNCTAD), and various consultant reports. Estimates of retail value and market shares of organic foods vary considerably depending on the source of information. This lack of consensus is reflected in the data presented in this chapter.

Retail value, market share, import share, and projected market growth rates are typically used to assess a country's organic market. The retail value is the estimated total sales of organics in the country, including both domestically produced and imported foods. The retail share, also referred to as the market share, is the percentage of all food sales composed of organic, again both imported and domestically produced. The import share is the percentage of organic sales that is attributed to imported foods. Market growth is the expected annual percentage change in organic retail sales over the next 5 years. These statistics are related to each other, but are not equivalent measures due to the way they are constructed.

Total retail value indicates the absolute size of the organic market and is the product of price and quantity sold. The retail share is this value divided by the retail value of all food, and suggests how well organic foods sell compared with conventional foods. Import share is the value of imports divided by the total retail value, and is a function of domestic production as well as demand for organics. The annual market growth is a compounding factor over 5 years, based on each previous year's retail sales. From these descriptions, it can be seen that macro- and microeconomic factors do not necessarily result in a uniform change across these statistics. For example, population growth in a market might not result in all organic statistics improving, even if total retail sales are higher.

Growth will occur if organic food demand, whether in terms of volume or variety, is not being currently met, and if there is a means of supplying this demand, whether from domestic or imported sources. Historically, organic foods were first available in raw or lightly processed form—fresh produce, unmilled grains, meats, eggs, dairy, coffee and tea, and spices and herbs. Domestically produced or processed versions of these commodities were most consumers' first exposure to organic foods. Organic production, with its reliance on local ecology, emphasizes the comparative advantages due to climatic and soil factors that are observed in conventional production. Thus, most countries best produce organically what they best produce conventionally. For example, Western European countries are major producers of milk and dairy products, while Canada, Australia, and the United States are significant producers of grain (ITC, 1999). However, as the sophistication of the market has increased, consumers have demanded more variety, mimicking what is available in conventional form. This demand has greatly expanded organic trade, while further segmenting market share into product categories.

The European Market

Table H-1 shows the extent of European, Pacific, and North American organic markets for which data are available. Many developed and developing countries that produce and consume organic foods were excluded from table H-1 due to their small size, low income, or emphasis on value-added export and tourism markets.

Four countries in Europe account for 63 percent of its total retail value, yet have relatively small shares of organic as a percentage of retail sales. These countries are Germany ($1.6 billion in sales, 1.2 percent share), Italy ($750 million, 0.5 percent), France ($508 million, 0.4 percent), and the United Kingdom ($445 million, 0.4 percent). The highest organic market shares are in Austria ($225 million in sales, 2 percent share), Denmark ($190 million, 2.5 percent), Sweden ($110 million, 1.8 percent), and Switzerland ($350 million, 2 percent). Total population has a significant impact on these figures, with higher population countries tending to have larger organic retail value but lower market share.

There is substantial variation in market share across product categories, as documented by Michelsen *et al*., (1999) and the ITC (1999). Cereals and baked goods, fresh produce, especially vegetables, and milk and dairy products hold the largest organic market shares by product category in Europe, topping 10 percent in some categories. For example, in Denmark, 6 to 10 percent of vegetables, 3.5 percent of cereal and 14.2 percent of milk product sales were organic in 1997 (Michelsen *et al*., 1999). Rapidly growing sectors include organic meats and seafood, frozen foods, beverages, and home replacement meals (PSC, 1998).

Table H-1—Organic retail sales and import share in world markets[1]

Market	Retail value	Retail share	Import share	Annual market growth
	(US$)	*(% of sales)*	*(% of organic)*	*(% of retail value)*
Austria	$225 – $270 million	2.0 – 2.5	30	10 – 15
Belgium	$75 – $94 million	0.3 – 1.0	50	n.a.
Denmark	$190 – $300 million	2.5 – 3.0	25	30 – 40
France	$508 – $720 million	0.4 – 0.5	10	20
Germany	$1.6 – $1.8 billion	1.2 – 1.5	40	5 – 10
Italy	$750 – $900 million	0.5 – 3.0	40	20
Netherlands	$230 – $350 million	1.0 – 1.5	60	10 – 15
Spain	$32 – $35.5 million	1.0	50	n.a.
Sweden	$110 – $200 million	0.6 – 3.0	30	30 – 40
Switzerland	$350 million	2.0	n.a.	20 – 30
United Kingdom	$445 – $450 million	0.4 – 2.0	70	25 – 35
Japan	$3 billion	1.0	10	15
China	$6 million	n.a.	0	n.a.
Taiwan	$9.7 million	n.a	100	200
Australia	$123 – $130 million	0.2	10	400
United States	$6.6 billion	1.0	n.a.	20
Canada	$200 – $500 million	1.0	80	15
Mexico	$12 million	n.a.	0	n.a.

[1] 1997 estimates for European markets, except 1999 estimate for Italy. 1999 estimates for Pacific and North American markets, except 1997 estimate for China. Annual growth rates are projected for the next 5 years, except 3 years for Taiwan and historical for Canada.

Sources: ITC 1999, PSC 1998, FAS GAIN reports 1999 and 2000, US DOC reports 1999, US DOS reports 1999, Masuda 2000.

To the extent that domestic production can meet demand, there is little reason to import foods. Currently, organic acreage accounts for 10 percent of farmland in Austria (30 percent import share), 4 percent in Denmark (25 percent import share), 7 percent in Sweden (30 percent import share), and 8 percent in Switzerland, compared with an average of 2 percent in the European Union (ITC, 1999; FAS, 1999c). These countries are self-sufficient in many staple commodities, but are facing short-term market growth rates of 10 to 40 percent per year. This could place greater pressure on imports in product categories not domestically supplied.

Countries that have a significant presence in the food processing industry, such as Germany, Italy, Sweden, and France, also face greater demand for organic ingredients. European Union regulations require that 70 to 95 percent of a certified organic processed item be composed of organic ingredients. Spices and herbs, nuts, dried and powdered fruits, sugar, cocoa, and sauces are growth categories (PSC, 1998; ITC, 1999). For many countries, this will mean greater reliance on imports to meet demand. For example, Germany and Italy have two of the largest organic food processing sectors in Europe (ITC, 1999), each importing raw and lightly processed ingredients for use in food processing.

In addition to excess domestic demand, institutional factors affect market growth and import shares. National-level demand promotion campaigns initiated and financed by retailers, wholesalers, or processors continually remind consumers of claimed benefits of organic foods. Austria, Denmark, Sweden, and Switzerland have benefited from such campaigns, as have Germany and Italy (Michelsen *et al*., 1999). Both European Union and national government subsidy programs have aided supply more than demand, especially assisting market development in Belgium and to a lesser extent, France, Germany, Italy, and Sweden (Michelsen *et al*., 1999). Denmark additionally has aggressively supported market development, and research and development. Except for Germany, all these countries are expected to see short term market growth of 20 to 40 percent.

The unified minimum organic production standard for the European Union established by the EC Council Regulation 2092/91 is perceived to have had the strongest influence on market development (Michelsen *et al*., 1999). However, despite attempts to harmonize organic regulations internationally, there is substantial variability in ease of import entry. Trade may be impeded across national boundaries within the European Union. Even with a common minimum standard, stricter rules are permitted in individual countries and may give rise to protectionism to ensure integrity

of domestic standards (Michelsen *et al.,* 1999). Organic certification equivalency required for most countries exporting to the European Union is granted by the competent authority in the importing country, and transactions costs vary by country.

Based on an unpublished telephone interview of importers and exporters, Belgium, Denmark, the Netherlands, Sweden, and the United Kingdom were considered to be relatively easy markets to enter.[2] Of these, several have limited domestic organic production shares of total agricultural land and large import shares - Belgium (0.48 percent acreage share, 50 percent import share) and the United Kingdom (0.34 percent acreage share, 70 percent import share). The Netherlands' 60 percent import share is driven by its role as Europe's major re-exporter, rather than by its relatively low projected annual market growth of 10 to 15 percent (ITC, 1999).

France (10 percent import share) is considered very difficult to enter, reflecting significant cultural differences, particularly strong nationalism, language barriers, and regulatory approaches. However, France's projected growth of 20 percent is unlikely to be supplied by domestic production, which was only 0.4 percent of agricultural land in 1997 (ITC, 1999). Germany's consumers are considered the most discriminating in the world with respect to organic credentials, and apply several "green" political criteria beyond certification to their purchase decisions, which has resulted in a relatively small base of committed consumers. Combined with excess domestic supply for many commodities, this has resulted in projected growth of 5 to 10 percent (ITC, 1999). Yet, as a major food processor, certain organic ingredients that cannot be domestically produced must be purchased abroad to satisfy manufacturing needs.

This discussion illustrates that there is no simple way to characterize the European organic market. It is certain that demand is growing and that a greater variety of organic products is desired. Also, both domestic production and trade in Europe should increase over time to meet consumer demand.

The Pacific and North American Markets

The Pacific (Japan, China, Taiwan, and Australia) and North American (United States, Canada, and Mexico) markets are even more difficult to describe than the European market. As mentioned, there has been little attempt by government agencies to record statistics for these markets, so private sector organizations provide most of the data. These are less mature markets, where national standards have not yet been fully implemented in many countries. Consumer awareness of organics is also lower in these countries than in Europe.

The lower portion of table H-1 reveals that Japan ($3 billion, 1 percent retail share) and the United States ($6.6 billion, 1 percent retail share) dominate markets in the Pacific and North American markets. The Japanese market value includes eco-labeled product classes such as "low chemical" as well as organic. The organic portion of total value may be as low as $1 billion (ITC, 1999), which can be more accurately measured when products are classified according to strict national organic definitions to be implemented in 2001 (FAS, 2000b).

Seki (1997) estimated that 60 percent of the Japanese organic market is fresh produce and 40 percent processed foods. Japanese organic consumers buy mostly frozen vegetables, dried fruits, vegetable juice, soybeans, and fresh produce (FAS, 2000b). Domestic production in Japan includes acreage devoted to fresh produce, which is primarily sold directly to consumers via a subscription service called tei-kei or by home delivery distributors, and rice and soybeans for processing (ITC, 1999). Only 1 percent of vegetable acreage is in organic production (Sidiropoulos and Putland, 1997). The amount in organic rice and soybeans is not known. Japan imports 10 percent of its organic market value in the limited range of products mentioned.

U.S. statistics are collected by retailers and wholesalers, and so are delineated by sales category rather than by commodity, as is done in Europe. In the United States, fresh produce, packaged grocery items (cereal, sauces, etc.) and bulk/packaged items (pasta, grains, beans, etc.) were the top three categories in natural products stores in 1999, accounting for 49 percent of retail sales (Natural Foods Merchandiser, 2000). The Organic Trade Association (1998) projects average annual growth from 1997 through 2002 will be highest for grain snacks and candy (60 percent), cereals (54 percent), dairy (44 percent), and frozen foods (40 percent).

[2] Lohr and Graf, unpublished survey, 1999.

The United States is a net exporter of many organic commodities, although certified organic acreage and pasture make up less than 0.2 percent of total U.S. farmland (Greene, 2000). By acreage and category, 0.2 percent of grains, 0.1 percent of oilseeds and dry beans (including soybeans), 0.3 percent of hay and silage, 38 percent of herbs, 1.3 percent of vegetables, 0.9 percent of fruits and tree nuts, 0.2 percent of peanuts, and 0.3 percent of potatoes are certified organic. Livestock production is increasing, with the largest gains in milk, egg, and poultry production between 1992 and 1997 (FAS, 2000a), although the organic share of total production is even lower than for crops.

While quantity produced is sufficient to meet U.S. demand for most major organic food items, except for some tropicals such as coffee and bananas, the United States nevertheless imports organic food items. Imports are needed to satisfy food processing needs (flavorings, nuts, fruit concentrates and purees, dried fruits, cocoa, sugar, etc.) as well as to meet off-season demand for fresh fruit and vegetables, and to replace production allocated to foreign contract sales. American tastes for foreign foods also drive demand for imported processed items such as cheeses and wines. No estimate of the import share of the U.S. organic market is available, but it is probably not above 10 percent.

Growth in the U.S. and Japanese markets is anticipated to be strong, at 20 percent and 15 percent, respectively. However, regulatory changes may alter these expectations. Japan's national organic standards will be implemented in April 2001. The United States published its Final Rule for public comment in late December 2000. The rule became effective on February 21, 2001, and will be fully implemented in August 2001. The Japanese rule is expected to impose stricter standards and reduce imports (FAS, 2000b). This could slow Japanese market expansion since organic production in Japan is not anticipated to increase at the same rate as demand. In the United States, final rules are expected to harmonize trade with other countries, and should ease import entry by introducing a simplified certification equivalency process through accreditation of foreign certifiers.[3] U.S. standards are not stricter than many of the individual State regulations that importers had to meet prior to the implementation of national regulation.

Other markets in the region are smaller. China and Mexico both are net exporters, with export values of $600 million and $70 million, respectively (ITC, 1999; FAS, 2000c). Depending on development of food processing in these countries, which is currently heavily constrained by lack of capital and infrastructure, their import needs could grow. The China Council for International Cooperation on Environment and Development (CCICED, 1996) suggested that the Chinese retail market could reach $1.2 billion due to increasing education and affluence of its middle class, but Chinese production capacity should easily meet this growth.

The $9.7 million retail value of the Taiwanese market is expected to quadruple in the next 3 years (FAS, 2000d), but still represents only a niche for exporters who can recover transportation costs on small shipments. Growth in Australia ($123 million retail value) and Canada ($200 million to $500 million) will be supplied domestically as production capacity is realized. Australia and Canada are both net exporters of organic grains and specialty commodities such as maple syrup, beer (Canada), and fruit juices (Australia). Europe, Japan, and the United States should remain the primary import markets for at least the next 5 to 10 years.

Factors Affecting Demand

Market expansion for organic foods depends on the outcome of a number of evolving issues, which are discussed in this section. Key issues are organic price premiums, the price-quality trade off, country of product origin, GE content, and the integration of social goals into the production process.

Price Premiums

The percentage of consumers who purchase organic foods affects the relationship among the market statistics. Widespread acceptance among consumers stabilizes demand and generates economies of scale, lowering costs. Table H-2 describes demand conditions in Europe, Japan, and the United States in terms of consumer share and price premiums. Consumer share is defined as the percentage of consumers who buy organic food items at least once a week, and price premium is expressed as the percentage by which the

[3] As of this writing in February 2001, the Japanese organic standards may be found online at *http://www.maff.go.jp/soshiki/syokuhin/hinshitu/organic/eng_yuki_top.htm*. The European Union's EC Council Regulation 2092/91 may be found online at *http://europa.eu.int/comm/sg/consolid/en/391r2092/artm.htm*. The Final Rule for the U.S. National Organic Standards may be found at *http://www.ams.usda.gov/nop/nop2000/Final%20Rule/nopfinal.pdf*.

price of the organic product is above the price of a similar conventional product. The percentage of consumers who claim to buy organic foods regularly ranges from lows of 4 percent in Italy and 5 percent in the Netherlands to 32 percent in Denmark and Germany and 40 percent in Switzerland. In Japan and the United States, consumer studies have identified regular buyers by product category, resulting in the ranges of values in table H-2. In Japan, the greatest percentage of regular buyers is for fresh produce. In the United States, the largest percentage in 1998 was for naturally raised meat and poultry products (HealthFocus, Inc., 1999).

More consumers claim to "occasionally" purchase organic foods, where this time period may be "once a month" to "at least once in the last 6 months," depending on the definition applied by the particular consumer survey. About the same percentage of consumers are occasional buyers as are regular buyers in Denmark (38 percent buy occasionally) and Germany (32 percent) (ITC, 1999). There is a greater percentage of occasional buyers in France (38 percent), the Netherlands (34 percent), Sweden (40 percent), Japan (38 percent), and the United States (50 percent) (ITC, 1999; The Packer, 2000a). No data were available on occasional purchasers in Italy, Switzerland, and the United Kingdom.

These data suggest a slight positive correlation between percentage buying regularly (table H-2) and retail market share for organics (table H-1). A stronger correlation might be observed if the retail and consumer shares were decomposed into product categories, so that a weighting between higher priced, less frequently purchased items and lower priced, more frequently bought foods could be constructed. If a significant portion of occasional users were to become regular buyers, the retail share and retail values presented in table H-1 would increase dramatically. The market growth predictions in table H-1 assume recruitment of regular users from among current occasional buyers and non-buyers.

Richter *et al*. (2000) surveyed 2,600 consumers in the border region of Switzerland, Germany, and France to determine why frequency of purchase is not higher among occasional buyers. They found that these buyers are more price conscious and mistrust organic labels and enforcement more than regular purchasers. Both regular and occasional buyers use labels and retail sales personnel for information, but regular buyers are more informed about production methods and more concerned about local origin of foods purchased. Nonbuyers are most influenced by price considerations of the three groups.

In the United States, surveys of 1,000 households revealed that 19 percent of organic produce buyers in 2000 rated themselves as very or extremely likely to buy again in the subsequent 6 months, down from 62 percent in 1998 (The Packer, 2000b and 1998). Analysts speculated that an influx of occasional buyers related to greater product availability and consumer awareness made the total number of produce buyers much higher. Without increasing the number of subsequent purchasers, the reported re-purchase rate is much lower. In 2000, 49 percent of nonbuyers in the United States named price as a barrier to purchase compared with 33 percent in 1998.

Retailers in the United States also cite price as a barrier to offering organic foods. In 1999, 13 percent of 90 retailers surveyed in Atlanta, Georgia believed they could not sell organic foods if they charged a price premium and only 17 percent believed they could charge more than 20 percent over conventional prices (Lohr and Semali, 2000). Consumer price observations in 14 conventional groceries in Europe documented price premiums averaging 35 percent in Denmark, 43 percent in Austria, 53 percent in France, 54 percent in the United Kingdom, 64 percent in Italy, and 67 percent in Germany (Schmid and Richter, 2000).

Table H-2—Consumer share and price premiums in key demand centers

Market	Consumer share	Price premium
	Percent buying regularly [1]	*Percent above conventional*
Austria	20	25 - 30
Denmark	32	20 - 30
France	10	25 - 35
Italy	4	35 - 100
Germany	32	20 - 50
Netherlands	5	15 - 20
Sweden	15	20 - 40
Switzerland	40	10 - 40
United Kingdom	25	30 - 50
Japan	4 - 36[2,3]	10 - 20
United States	9 - 19[3]	10 - 30

[1] "Buying regularly" is defined as at least once a week.
[2] "Occasional" purchasers; percentage of regular buyers not available.
[3] Percentage varies by product category.

Sources: ITC, 1999; FAS GAIN reports, 1999 and 2000; HealthFocus, Inc. 1999.

Differences in premiums across product categories reflect both availability and frequency of purchase. In the European example, Schmid and Richter (2000) documented average category price premiums of 20 percent for cheese, 31 percent for cereals, 42 percent for milk, 52 percent for meat, 61 percent for vegetables, and 70 percent for fruits in the 14 retail chains they surveyed. In observations at 75 of the stores surveyed by Lohr and Semali (2000), the price premiums for specific processed goods varied even more widely. Average premiums were 32 percent for coffee, 24 percent for rice cakes, 20 percent for spaghetti sauce, 17 percent for milk, 5 percent for baby food, and -0.5 percent for breakfast cereal. The range could be accounted for by factors such as relative availability, product placement, and branding. For example, 44 of the stores offered organic cereal, but only 5 offered organic coffee. Organic cereal is often offered side-by-side with conventional cereal, so that price-dependent sales are more competitive.

Michelsen *et al*., (1999) documented that consumer price premiums are lowest in countries with large organic market shares and a high percentage of distribution through supermarkets. The combination of market size and supermarket involvement is thought to reduce distribution costs, exerting downward pressure on consumer price premiums. Due to their large customer base, supermarkets can generate turnover more quickly, thus saving money and maintaining product appearance and quality (Lohr and Semali, 2000; ITC, 1999).

In general, supermarkets are more resistant to charging high premiums than specialty stores. Occasional buyers of organics are more price-conscious and likely to seek organics in supermarkets (HealthFocus, Inc., 1999; FAS, 2000b; ITC, 1999). Ensuring that organics are available in supermarkets has been argued to be the fastest way to convert occasional to regular users of organic products in major markets (Lohr and Semali, 2000; ITC, 1999).

Table H-3 shows the distribution of sales by market outlet. Comparing these data with information in tables H-1 and H-2 reveals some interesting findings. Those countries with the highest share distributed through supermarkets (Austria, Denmark, Sweden, Switzerland, and the United Kingdom) have the highest retail shares and percentages of regular buyers (except Sweden) but not necessarily the lowest average price premiums. The United States and the Netherlands have the lowest average premiums, but the highest percentage of sales in specialty stores and among the lowest percentage of regular buyers of organics. This supports the hypothesis that supermarket availability, rather than lower price premiums, stimulates consumers to become regular buyers.

Price-Quality Trade Off

Consumers look for the highest affordable quality, given their household budgets and perceptions of product quality. Labels are used as quality cues, to the extent they are understood by consumers. Universal labels, such as national organic certifications, would reduce search costs. Easy identification of quality makes price comparison and choice easier.

Table H-3—Percentage shares of retail market by distribution channel

Market	Supermarkets[1]	Specialty stores[2]	Producer direct[3]
Austria	77	13	10
Denmark	70	15	15
France	45	45	10
Italy	25 - 33	33	33 - 42
Germany	25	45	20
Netherlands	20	75	5
Sweden	90	5	5
Switzerland	60	30	10
United Kingdom	65	17.5	17.5
Japan[4]	high-end stores	widely available	widely available
United States	31	62	7

[1] Includes supermarkets and hypermarkets that offer conventionally grown foods.

[2] Includes organic supermarkets, natural products and health food stores, cooperatives, and other.

[3] Includes on-farm sales, farmer markets, box schemes, CSAs, teikei, and other.

[4] Share data are not available for Japan, but qualitative information suggests the relative availability of product in each category.

Sources: ITC, 1999; FAS GAIN reports, 1999 and 2000.

Organic labels can be confusing to consumers, especially if different labels signify different production standards. Establishment of minimum standards through national or international accreditation of certifiers is expected to clarify the meaning of "organic" in the marketplace. However, most accrediting organizations permit certifiers to affix their own labels in addition to the accreditation label. This may not necessarily improve clarity for the consumer.

Examples of multiple standards and labels are found in some of the largest organic markets. Until 2000, Japan had six grades of reduced chemical foods, including organic, all carrying the same label. China recognizes several classes of "green food" including organic. In Germany and the United States, there are so many regional and local certification agencies that learning about each is burdensome, so consumers choose the most familiar label. This is typically the first one that appeared in their regular shopping place or the one promoted by the most aggressive advertising efforts. Internationally recognized accreditation logos (Japan, U.S., EU, or IFOAM[4]) may reduce this confusion.

Even when a label is well understood, it may lack credibility. Japanese consumers are particularly skeptical of imported products, in part due to an administrative scandal associated with the key exporting certifier in the United States (FAS, 2000b; Mergentime 1997). Michelsen *et al*., (1999) reported cases of rejected shipments or refusal of traders to handle foreign product, even when both the exporting and importing countries were in the European Union. Many consumers will still view their country's standards as stricter and "more organic."

The implications of label recognition and acceptance for international trade are explored by Lohr and Krissoff (2000). They note that consumer perceptions of product homogeneity are critical to product acceptance. Even with harmonization of accreditation standards at the country or market level, consumers may still reject imported organic products. Reassuring foreign consumers of import certification quality and maintaining cost-competitiveness are as important as legal considerations in international marketing.

Not all consumers view the price-quality trade offs in food choices the same way, and not everyone wants organic foods. Surveys show 10 to 20 percent of consumers in Germany are not willing to pay any premium for organic foods (ITC, 1999). As many as 18 to 35 percent of U.S. consumers would not purchase organics even if there were no price difference between organic and conventional foods (The Hartman Group, 1996). For these consumers, organic foods do not represent a superior product.

Country of Product Origin

Where and how food is produced matters to a significant portion of organic consumers. This local preference incorporates ethical views toward farming and local growers. Interest in supporting regional producers is strong among regular buyers of organic foods (Richter *et al*., 2000). Many consumers are also troubled by the long distances that food has to travel from farm to table.

Organic fruits and vegetables are in demand partly because they are perceived as fresher than conventionally grown foods. With longer distances between producer and consumer, this advantage declines. Consumers surveyed in the United States and Sweden preferred local conventionally grown products over organic products brought in from outside the region (Burress *et al*., 2000; Ekelund and Fröman, 1991). In Japan, organic imported soybeans sell for 14 percent less than domestically produced conventional (non-GE) soybeans (FAS, 2000b).

At the national level, fears of food safety problems have prompted country-of-origin labeling requirements. This issue is shaping consumer acceptance of imports in the Japanese and some European markets (FAS, 2000b; ITC 1999). Although a domestic certifier approves an imported product, if country of origin is known to the consumer and is not acceptable, the product may not be marketable (Lohr and Krissoff, 2000).

Programs that support domestic or regional production systems in developed countries have promoted supply of organic products and may have depressed imports (Michelsen *et al*., 1999). These programs were typically implemented for environmental or for extensification reasons, expanding acreage while reducing input intensity. Direct subsidies have been widely used in the European Union and by individual countries in Europe. In the United States, cost-sharing to assist in transition has been used in Iowa in the State-administered Federally-funded environmental protection

[4] The IFOAM Basic Standards (updated in 2000) may be found at *http://www.ifoam.org/standard/index_neu.html*.

program known as EQIP (Iowa Natural Resource Conservation Service, 1997).

Consumers have also taken direct action to support local organic farming by enrolling in subscription programs in which they pay a preseason fee for delivery of fresh produce through the growing season. These programs are known by various names - Community Supported Agriculture (CSA), available in 41 States and the District of Columbia in the United States, tei-kei farming in Japan, and vegetable boxes in Great Britain.

GE Content

GE labeling is foremost in many consumers' choice of organic products. Prohibition of GE in organic food production standards is nearly universal. GE is perceived as unacceptable by a vocal segment of consumers in almost every developed country. Market effects are sometimes exhibited in price differentials. In Japan, imported organic soybeans sell for 500 percent more than imported GE-soybeans (FAS, 2000b).

Through low-cost protein testing, most GE modifications can be detected in raw commodities, making it possible to detect organic foods that have been modified through cross-pollination or product mixing. Regardless of whether such commingling occurs, importers may require organic products to be tested and certified as "GE-free" if they are from countries where this is possible. The definition of "GE-free" is currently being debated in the conventional agriculture sector, which could prove instructive to the organic sector.

Social Goals

Consumers who want to advance social goals such as equitable income distribution and sustainable development have the option of supporting Fair Trade labels. The Fair Trade certification is different from organic certification, although 65 percent to 85 percent of Fair Trade imports also carry organic certification (ITC, 1999). One difficulty with Fair Trade certification is that it is process-based, according to local standards for sustainability, and thus all labels do not certify the same production system. Documenting that the principles of sustainability are followed is sufficient to earn a Fair Trade label, without necessarily using the same practices as another certified producer in the same region.

The Fair Trade model operates by direct purchase and import of crafts and tropical food items from small, democratically organized producers in the Southern Hemisphere (EFTA, 1995). The Northern Hemisphere importer pays producers the cost of production plus a locally competitive wage, typically higher than world commodity prices. The importer is not permitted to cancel its contract with the grower and must pay part of the contract price up front. Usually the importer also contributes to local causes in the producing region, such as a school or health clinic or for cultural preservation. Through the higher wages offered by Fair Trade importers, the producer group is able to reduce reliance on natural resource extractive activities and to ensure fair labor practices and an acceptable standard of living.

Although overhead is minimized by direct importer-producer contacts, the higher wages translate into retail markups that are about the same as for organic foods. The Fair Trade Federation (2000), an umbrella organization for coalitions and foundations that certify products, listed Fair Trade food and nonfood sales totaling $400 million annually, with $35 to $40 million in North America. The Food and Agriculture Organization (FAO, 1999) cited estimates for the European Fair Trade market of $140 million in food annually, with participation by 70 import organizations, 3,000 world shops dedicated mostly to craft items, and 50 supermarket chains in 14 countries. The primary food product exchanged under this system is coffee. In Germany and the United Kingdom, 4 percent of the coffee market is certified Fair Trade, and in the Netherlands, 3 percent is so designated (ITC, 1999). In 2001, Starbucks Coffee, one of the largest U.S. retail outlets, introduced certified Fair Trade coffee, giving this certification a major presence in North American markets. Among food items currently eligible for Fair Trade labels are tea, bananas, cocoa, and chocolate.

With expansion of Fair Trade certification to other products and increasing awareness for the labels, which should increase dramatically after the Starbucks Coffee adoption, the United States appears to be a prime opportunity for Fair Trade products. With a growing number of eco-labels on the market that are separate from organic labels, the expense of education programs to distinguish the various products will fall on the organic industry (Lohr, 1999). Eco-labeled products benefit by organic advertising, but crowd the market with more labels that are difficult for the consumer to interpret and, hence, costly for the consumer to sort out. Dual certifications could resolve

this problem, but American consumers have not demonstrated a readiness to pay an additional premium for such products.

Projected Market Growth

Many European countries are experiencing a deceleration in growth of organic markets from the last decade, compared with the United States, which projects continued 20 percent growth for the short term. Japan's rate of organic market growth has been projected at only 15 percent due to product availability and wariness about imports' conformity with the new national regulation. The next 5 years should see expanded trade as well as domestic production in an effort to meet rising demand.

The exchange of organic products internationally is increasing dramatically. Import and export figures by product category are provided by the ITC (1999), Michelsen *et al*., (1999), and FAS (various reports 1999, 2000). The implementation of national standards in the United States and Japan, developed with deliberate consideration of existing standards in Europe, should realign trade flows so that more exchange occurs among Japan, the United States, and Europe, as harmonization among the major markets takes place.

Markets are evolving to demand highly processed organic products as well as raw commodities. In Europe, markets are increasing for ready-to-eat meals, frozen foods, baby food, snacks, and beverages. Ingredients needed for organic food processing include juices, fruit powders, dried fruit, meat, flavorings, essential oils, herbs and spices, and nuts. Sample trade flows into Europe are from Israel (fresh produce), Brazil-Chile-Argentina (fresh produce, soy, wheat), other European countries (baby food, processed foods, cereals, meat), Canada (wheat, soy, canola), Mexico-Central America (bananas, citrus, coffee, cocoa), Sri Lanka-India (tea), and the United States (processed foods of all types, wheat).

In Japan, organic consumer goods in growing demand include fresh produce, frozen foods, juice, baked goods, baby food, chicken, sauces, and ready meals. The organic ingredients market is less extensive, but is growing for fresh vegetables for pickles, fresh fruits and sweeteners for jam, oils and semi-finished produce. Trade flows are not restricted to countries in the Pacific region, but are dominated by them. For example, products are imported from New Zealand (frozen vegetables, fresh fruit), Australia (citrus juice), China (tea, soybeans, rice), France (jams, coffee, cereal, ice cream), Brazil (soybeans), Canada (beer), Norway (seafood), and the United States (fresh produce, soybeans, rice).

Market options are expanding as well (ITC, 1999). Retailers have more opportunities to introduce store label or own-brand organic products as consumer awareness and market penetration increase. The food service and catering sectors are virtually untouched, although they offer higher wholesale margins than sales to brokers or wholesalers. Vegetarian restaurants, school and institutional programs, and airline (Swiss Air and Lufthansa) and hotel catering are experimenting with wider organic offerings.

Markets for direct sales to consumers could be the best option for opening developing country markets in which volume is low, but a segment of highly educated and high-income consumers are interested in organic products. Subscription and box sales enable farmer and consumer to have direct contact, although consumer buying clubs and electronic or mail order catalogs offer the opportunity to reach more consumers at higher margins. International sales via these outlets must meet all international trade regulations and importing country phytosanitary and organic standards, but with smaller shipments and with time to develop individual reputations, these obstacles may be overcome.

Supply competition is inevitable, particularly in market segments that are widely observed to be growing, and as such are attracting suppliers. Most raw commodities are now available in organic form, as production is widespread. The ITC (1999) reports commercial production in 27 countries in Africa, 7 in the former Soviet states, 20 in Europe, 3 in Australia, 15 in Asia, 25 in Latin America and the Caribbean, and 3 in North America. At the same time, with rising per capita income, increasing awareness of organic benefits as domestic commercial production increases, and greater government and private sector commitment, it is likely that global organic market demand will continue to keep pace with production for the next few decades.

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Impact of Consumer Demand for Animal Welfare on Global Trade

Lorraine Mitchell[1]

Abstract: Animal welfare has received increasing attention among wealthy consumers, mainly in industrialized countries. The passage of animal welfare laws may offer individual and social benefits to concerned consumers, while resulting in higher prices for all consumers. Higher domestic prices may cause unconcerned consumers to seek cheaper foreign alternatives, potentially leading to trade policy concerns.

Introduction

Consumer concerns about animal welfare are not a new phenomenon. Some of the ancient rules for slaughtering animals for kosher meat were originally intended to reduce pain to the animal. Many religions, including Native American religions, Hinduism, and Australian Aboriginal tradition, have held particular animals to be sacred, and have devised particular rules about whether and how such animals were to be used for food or service. The Society for the Prevention of Cruelty to Animals began in 1824 in Great Britain. During the last 20 years, however, consumer groups, mostly in industrialized countries, have brought much more attention to the topic of animal welfare. As consumers grow wealthier, their access to an adequate quantity of food becomes assured. At this point, consumers tend to turn their attention to the quality of their foods. Such quality concerns can include food safety and aesthetic attributes, but they also include concerns about how food is made, and the impact that food production techniques have on the environment, on labor, and on animal welfare. These concerns can result in consumer demand for foods made with certain production techniques.

A number of different types of consumer movements for animal welfare have sprung up. Some focus on animal rights and attempt to stop any activities that interfere with the ability of animals to live free from human interference. These groups generally encourage the complete cessation of the use of animals for economic activity. Other groups have focused on attempting to improve the treatment or welfare of animals that are to be used for food production purposes. In the European Union (EU), these groups have received a great deal of attention from the public and from legislators. A number of laws regulating how farm animals are to be treated have been passed in the EU. Additionally, a number of other countries have animal welfare regulations, although these generally do not specify production practices in as much detail as those in the EU. These laws regulate domestic production for the countries that pass them, but cannot regulate production abroad.

What does economic analysis have to say about the effects of animal welfare laws? This article attempts to answer that question in general, rather than country-specific, terms by looking at the economic motivation for passing regulations dealing with farm animal welfare[2], the potential effect on production costs, and the potential effects on trade.

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[2] While animal welfare concerns usually encompass pets, animals used for research, animals used in circuses, and hunting regulations, this paper will focus on the welfare of farm animals.

Economic Reasons for the Passage of Animal Welfare Regulations

Two types of economic motivation for the passage of animal welfare laws exist. The first occurs when consumers feel that they individually benefit from improved animal welfare. The second occurs when a society as a whole can benefit from improved animal welfare.

Individual Benefits

Many consumers have expressed their preferences for goods produced with higher levels of animal welfare. Consumers care about how products are made and get more satisfaction from consuming goods that are made with methods they approve. The increased market for "environmentally friendly goods" and the recent boycotts of clothing companies that manufacture goods in factories where workers are subjected to conditions that don't meet U.S. labor standards are both demonstrations that consumers care about production methods of the goods that they buy.

Consumers are concerned about animal welfare in food production, although how this concern compares with other food concerns is not entirely clear. FAS Online notes "Poultry production in the Netherlands remains flat as future growth in this sector is tempered by consumer concerns about animal welfare issues and the impact of production on the environment." (March 27, 2000). Blandford and Fulponi (2000) cite surveys which indicate that 80 percent of EU consumers are concerned about animal welfare when asked, but when asked to list their greatest concerns about food, only 5 percent volunteer animal welfare as a concern.

There are indications that consumers in industrialized nations are willing to pay more for products that feature higher degrees of animal welfare. In a survey taken in 1995, 67 percent of U.K. consumers surveyed indicated that they had purchased free range eggs or chickens in the previous year, which suggests that given a choice, consumers are, in some instances, willing to pay the extra expense of food produced with techniques that are perceived to be more friendly to animals (index to International Public Opinion, 1997/98). Bennett (1997), in a survey of British consumers, finds that consumers would be willing to pay 6-30 percent more for eggs, if such an increase were the result of a ban on battery cages (towers of small cages used to house individual hens) for hens. Bennett and Larson, in a 1996 survey of U.S. college students, find that students were willing to pay 18 percent over market price for free range eggs and willing to pay taxes of about $8.00 per person to fund practices that they believe will improve conditions for veal calves and hens.

However, consumers cannot tell by looking at a product how it is made, so they might lack adequate information to purchase the goods they prefer. Akerlof (1970) finds that if consumers can't determine the characteristics of the goods that they purchase, then goods with undesirable qualities will flood the market and consumers will be discouraged from buying. Firms have some incentives to provide consumers with information about products they purchase. If people value goods produced with perceived high standards of animal welfare more than those produced with what are perceived to be lower standards, then they will pay more for the higher standards. If the extra amount that people are willing to pay is greater than the cost of providing the perceived higher standards, then producers have an incentive to produce according to such standards. Producers whose production technologies meet higher standards of animal welfare have an incentive to reveal that to the consumer with a label or advertisement, thus providing the information without any need for government involvement (see Ippolito and Matthias, 1990; Grossman, 1981). For example, McDonald's publicly states that it only purchases meat that has been slaughtered in accordance with strict standards designed to improve welfare, and some studies indicate that humanely raised animals provide more meat of higher quality (Bjerklie, 2000). Indeed Browne *et al*. (2000) note that firms engage in "socially responsible sourcing" because they fear damaging their reputations. So why does the government need to regulate animal welfare?

Two potential problems could interfere with the firm's communication of information to consumers (Golan, Kuchler and Mitchell, 2000). First, the higher price that consumers are willing to pay for goods produced with high standards creates incentives for firms to commit fraud or to mislead consumers. If firms can convince consumers that they have used production methods that adhere more closely to animal welfare standards, even when they have not, then the firms can charge the higher price without paying the higher production costs. While there are incentives for consumers and rival firms to uncover fraud, and court systems to enforce truth-in-advertising laws, cases of

Animal Welfare Laws

Consumers that voice farm animal welfare concerns focus on a number of issues. Many of these issues are summed up by the Five Freedoms, a list outlined by a British Government commission investigating animal welfare in the 1960s. These include the freedom from thirst, hunger, and malnutrition; freedom from discomfort; freedom from pain, injury, and disease; freedom to express normal behavior (with adequate space and company of the animal's own kind); and the freedom from fear and distress (Winter, Fry, and Carruthers, 1998). Consumer groups are concerned about animal welfare on the farm, during transport, and during slaughter.

Animal welfare laws regulating the treatment of farm animals used for agricultural production have been in existence for some time, and are part of the legal code of a number of nations. Some laws simply generally prohibit cruelty to animals, including farm animals. Others specify with great precision the methods to be used in handling and housing animals.

In the United States, most animals used for food are covered by the Humane Slaughter Act of 1958 (amended 1978), which specifies how animals must be treated during the slaughtering process. Many U.S. States have additional laws on general and farm animal welfare. Additionally, many U.S. producer groups, like the American Meat Institute and the United Egg Producers, issue voluntary welfare guidelines for the handling of animals.

A number of nations, including Japan, Australia, and New Zealand, have animal welfare laws. New Zealand has recently revised its animal welfare laws to include the Five Freedoms. During the 1980s, European countries signed a small flurry of treaties specifying how animals were to be treated. Most of the signatories to these treaties were members of the Council of Europe, a regional organization with a membership that extends beyond the EU, and some of the more recent EU legislation is intended to put into practice the requirements of those conventions.

The following is not an exhaustive list of animal welfare laws (table I-1), but will give the reader some idea of the scope of such laws. (See Blandford and Fulponi, 2000, for a lengthier discussion.)

Table I-1–Examples of animal welfare laws

Type of law	Law or Country	Requirement
Laws that define and require general standards of treatment.	California Penal Code, Maine Statutes.	Requires that all animals be allowed adequate food, exercise, and freedom from torture and overwork.
	Japan's Law Concerning the Protection and Control of Animals, 1973.	Requires that animals not be treated cruelly or abandoned.
Laws that regulate slaughter.	U.S. Humane Slaughter Act of 1958.	Specifies how animals must be treated during the slaughtering process.
	European Convention for the Protection of Animals for Slaughter; EU Directive 93/119/EC.	Specifies rules for slaughterhouse conditions and the slaughtering process.
Laws that regulate the area and methods for confining animals.	Australia.	Specifies minimum cage sizes for hens of 450-600 square centimeters.
	Australia.	Prohibits hog tethering.
	European Convention for the Protection of Animals Kept for Farming Purposes; EU Council Directive 98/58/EC, 1998.	Outlines general requirements for keeping animals on farms, including the provision of food, freedom of movement, inspections, lighting which is altered to resemble night and day, air circulation and pens that can be cleaned.
	EU Council Directive 1999/74/EC, 1999.	Mandates hen cage sizes that allow laying hens a minimum of 550 square centimeters in which to move around by the year 2003.
Laws that govern animals during transport.	European Convention for the Protection of Animals During International Transport; EU Council Directive 91/628/EEC.	1991 regulations for the treatment of animals during transport, which specify the intervals during which animals were to be fed and the characteristics of the space in which they could be confined.

fraud are costly to prove. Additionally, sometimes the firm's communication can be made deliberately vague. If a retailer sells chickens labeled "free-range", what does "free-range" mean? Does it mean that the chicken had 25 square feet in which to roam, or an enclosed space of 5 cubic feet?

Secondly, while firms have an incentive to tell consumers about desirable qualities of the products they sell, they don't have an incentive to reveal undesirable qualities (Golan, Kuchler and Mitchell, 2000). This should mean that firms that sell products with good qualities will tell consumers about these qualities via ads and labels. Firms that sell products with undesirable qualities just won't say anything to the consumer. An informed consumer might conclude that the firms that don't provide information about positive qualities are providing lower quality goods. Ippolito and Matthias (1990) find that in the market for cereals, the more healthful cereals were labeled with health claims, and the less healthful ones were unlabeled. Consumers, they found, assumed that the unlabeled cereals had undesirable qualities. However, Zarkin and Anderson (1992) suggest that if consumers believe a product to universally have a desirable quality, firms won't bother to label. A government might decide to regulate production if it can't rely on firms to communicate quality information to consumers. In order to determine whether there are incentives for firms to reveal desired information about animal welfare, one would have to consider consumers' initial beliefs about current production practices and whether there are adequate incentives or institutions to safeguard against fraud.

Social Benefits

In addition to the private benefit that some consumers receive by purchasing goods made with more stringent animal welfare practices, there are associated social benefits. If some consumers are concerned with the welfare of animals, they are usually concerned with the welfare of all animals, not just the ones used to make goods that they themselves purchase. Bennett and Larson (1996) find that if battery cages were banned, about 10 percent of consumers surveyed felt that they would get some additional benefit from the fact that other people also wouldn't be buying battery-produced eggs. That is, if Consumer X cares about chicken welfare and buys some of his eggs from farms that raise free-range chickens, he gets the benefit of what he perceives to be an increase in animal welfare for those chickens. He also gets welfare from the free-range eggs purchased by everyone else, because in his mind, all of those chickens experience increased welfare as well as the ones that produced his eggs. However, Consumer X also buys some eggs from confined hens, because they are cheaper. At some point, the extra cost of the free-range eggs becomes greater than the benefit that Consumer X receives from the perceived improvement in hen welfare. From the point of view of people who care about chicken welfare, though, Consumer X should weigh the cost of free-range eggs against the sum of *everyone's* benefits from their perceptions of improved chicken welfare, not just his own personal benefits from improved chicken welfare. From the standpoint of the society as a whole, Consumer X is consuming too few free-range eggs and too many eggs from confined hens. Indeed, even if Consumer X cares about chicken welfare, he could decide to consume all conventional eggs, since he will receive benefits from everyone else's consumption of free-range eggs without paying any of the costs. Because consumers don't take the preferences of other consumers for animal welfare into account, then fewer free-range eggs will be purchased than society would like.

When consumption of goods by one person affects a lot of other people, government action is sometimes necessary. Consumers, if left to their own devices, will only take their own welfare into account when deciding what to consume. They won't think about damage that their consumption does to others in the form of pollution, noise, reductions of perceived animal welfare and other costs, so they consume more than their fellow citizens would like. The government may intervene to ensure that quantities produced and consumed more closely match the preferences of the society as a whole. The government sometimes does this by taxing the costly behavior. In other cases, the government might regulate the behavior, or subsidize less costly behavior.

Governments sometimes find these interventions to be difficult, as they must balance the welfare of members of society that want the regulations and the welfare of those that don't want such regulation. For instance, if the government forces all firms to conform to certain animal welfare standards, and these standards are very costly, consumers that don't care about animal welfare might pay more for food, without feeling like they received any real benefit for their extra expenditure.

How do governments go about weighing these different interests? Governments might attempt to measure costs and benefits of alternative animal welfare regulations with surveys or studies. A government can attempt to quantify and measure benefits from animal welfare changes, but this task is not easy. It is sometimes difficult to select criteria for animal welfare. Should one measure improved health, reduced agitation, or food intake? Research is required to determine which production practices satisfy the chosen criteria better. After the magnitude of a change in animal welfare has been determined, the government must then determine how much its citizens benefit from such changes. In other cases, governments effectively rely on groups with different preferences to communicate the strength of those preferences via lobbying. In the case of animal welfare, governments generally hear from farm animal producer groups, and animal rights groups, that is, consumers who care about animal welfare. Although consumers who have no preferences about animal welfare are also affected by legislation, they generally do not band together since the effect on each consumer has thus far been too small to spur them into political activism.

Interest groups have indeed influenced animal welfare legislation. The influence has been slightly different in the EU compared with the United States. Meat packers and the Livestock Conservation Institute in the United States supported the Humane Slaughter Act in 1958 and in 1978, as did the American Humane Association and several other animal protection groups; the industry argued that the law was a reflection of best practice for the industry (Francione, 1996). *The Economist* notes that animal rights activist groups in Britain have focused more on farming, while American animal rights groups have focused on the welfare of laboratory animals (1995). In 1994, animal rights advocates convinced McDonald's to require its suppliers to adhere to animal welfare guidelines, after having initially threatened to put the resolution before the company's shareholders (Francione, 1996). Additionally, the animal welfare movement in the EU includes a very broad base of support, with participation from people who have not been politically active on other issues. It appears that groups in the EU are more focused on encouraging the government to regulate, while in the United States, there is a more narrow focus on non-regulatory measures. This is borne out by the fact that voluntary guidelines are encountered more frequently in the United States, while regulation is more prevalent in the EU.

How Animal Welfare Laws Affect Production Costs

Animal welfare laws generally impose restrictions on livestock and dairy producers and processors that tell them under what conditions they may keep their animals, how often the animals must be fed, and how they may be slaughtered. Farmers, like most other firm owners, generally use the lowest cost technology to produce their products. Some animal-friendly technologies are already low-cost. Most livestock industry representatives note that keeping animals healthy improves production quantities. Some studies indicate that better treatment means higher yields (Bjerklie, 2000). If producers aren't already using the animal friendly technology, it might be because the technique was costlier, or delivered a lower quality good. Mandating the switch in production methods usually increases costs. In some cases, the cost increase is insignificant, but in other cases, switching technology can be quite expensive.

This increase in costs occurs through a number of different channels. Keeping animals in larger spaces means either that additional land must be purchased or fewer animals may be kept. This increase in resources per animal increases the costs of producing each animal or unit of animal product, which can, in turn, result in higher prices for the consumer.

How much does adherence to stricter animal welfare standards cost, and do citizens consider the standards to be worth the extra expenditure? The effect on costs is probably dependent on the type of regulation, and estimates of the size of the cost impact vary. Some studies in the United Kingdom indicate that a ban on battery farming can raise egg production costs by 8-30 percent; consumer willingness to pay might be high enough to cover these costs (Bennett, 1997). Blandford and Fulponi (1999, 2000) cite a study by McInerney (1995), which finds that adding some practices that are believed to be animal welfare enhancing would increase a consumer's food bill by only 0.25 percent, but they also note that an array of studies in EU countries suggest that costs might rise by anywhere from 5-17 percent. They also note that some analysis suggests that feed needs per animal might rise, leading to higher grain prices, which could even spill over into world grain markets and require those in poor, food-importing countries to pay more for grain.

If private benefits to consumers are not enough to outweigh animal welfare costs, the government must decide whether the benefits to individual consumers, plus the benefits to society of perceived improvements in animal welfare, outweigh the costs of imposing the regulations. An animal welfare regulation improves social welfare if the sum of all of the benefits to consumers of increased animal welfare is greater than the sum of the increased costs to the consumer and producer. This needs to be evaluated for each regulation.

Additionally, a country might care about how those costs are distributed. Food items considered as a whole, and some individual food items, have an inelastic demand; i.e., quantity demanded doesn't change very much with price. Bennett (1997) notes that when demand is inelastic, the costs of a battery cage ban would fall on the domestic consumer, who would see an increase in price, rather than on the domestic producer, who won't see a large drop-off in demand as prices rise. Since food is a much larger share of a poor person's budget and demand for some higher priced food items is more elastic among lower income consumers, industrialized nations passing animal welfare regulations might need to look at the impact of increased food prices on their poorest citizens. Indeed, willingness to pay for animal welfare is correlated with income (Bennett, 1997; Blandford and Fulponi, 2000).

Enforcement of animal welfare laws tends to vary somewhat, and if enforcement is low, cost effects could be smaller. Also, if cost impacts are high, producers have the incentive to attempt to evade enforcement. Most countries require that slaughter of animals be carried out in licensed facilities, so that inspection is facilitated. However, problems can still arise, especially if small producers slaughter animals in unlicensed and undocumented facilities. The EU Commission notes that for journeys originating outside the EU, regulations for animal welfare during transport are hard to enforce, and violations may occur (Press Release, February 17, 2000). A survey done by the Food Safety Inspection Service (FSIS) of a non-representative group of 61 slaughter plants in the United States found 48 had no evidence of inhumane handling, and 13 had incidents of inhumane handling (FSIS, 1998). McDonald's U.S. suppliers have increased their compliance with welfare guidelines since McDonald's began auditing firms (Bjerklie, 2000).

Implications for Trade

Domestic Industries

In general, any policy that imposes costs on a domestic firm that foreign firms do not face can potentially put domestic firms at a disadvantage. Because the domestic goods will be costlier, consumers are likely to purchase less expensive foreign goods instead of domestic goods (Blandford and Fulponi, 1999).

Domestic firms understand this consequence of differences in regulation. Thus, when a country passes legislation that increases costs for domestic producers, the producers sometimes apply political pressure to block imports or seek off-setting compensation from countries that don't have similar regulations. When the restrictive legislation has an objective that benefits consumers, the domestic firms are frequently joined by consumer groups in their lobbying efforts. Vogel (1995) refers to this as a "Baptist-bootlegger coalition", so named for joint efforts by Baptist temperance activists and underground liquor producers to lobby to keep Prohibition laws in place, because the restrictions kept liquor illegal, which, in turn, kept prices of illegally produced alcohol high. Despite the different objectives of the two groups, one piece of legislation served them both. Farmers' groups and animal welfare groups have an incentive to lobby for a ban on imports that don't comply with animal welfare laws. In the United States, for instance, the Humane Slaughter Act requires imported meat to have been slaughtered in accordance with certain standards.

The EU included in its 1998 law governing farm animals a provision to study the differences between the EU's laws and those of its trading partners, the effect of the new laws on the competitiveness of EU agricultural products, and the potential for "obtaining wider international acceptance of the welfare principles" (Council Directive 98/58/EC). The EU's proposal to the World Trade Organization (WTO) on animal welfare voices concerns about competitiveness of countries with costly animal welfare standards and suggests the formation of international animal welfare agreements, among other policies, to deal with the problem. The EU is therefore aware of the possibility that its more stringent laws could have an effect on whether it can compete with countries with different standards. The EU's only attempt thus far to restrict imports on the basis of animal welfare has been the

banning of imports of furs produced by countries that don't ban leghold traps. Tentative agreements are in place to allow trade among the EU and the United States and the EU and Canada, as the United States and Canada have signed an agreement defining humane trapping standards. The EU's legislation seems to imply that it would like to try to work out similar international standards with trading partners on farm animal welfare.

Trading Partners of Countries with Stringent Regulations

If countries with stringent animal welfare laws require their trading partners to adhere to those laws, such requirements could have an impact on imports from countries that can't meet the animal welfare standards. The reduced demand from the import-restricting country could reduce the prices of animal products in the exporting country. The domestic prices in the country restricting trade could rise, since supply is restricted to the more expensive domestic production. How large the impact is depends on the volume of trade that would occur in animal products in the absence of such regulations.

About 21 percent of the value of 1999 U.S. agricultural exports came from animal products (USDA-ERS, 2000a). The United States exported (to all countries) about 11 percent of its meat production (by volume) in 1999 and imported a quantity of beef and pork comparable with 8 percent of domestic production (USDA-ERS, 2000b). Current U.S. exports of animal products are not large compared with total production, and animal product exports do not come anywhere near constituting a majority of U.S. agricultural exports by value. Thus, importing nations' animal welfare laws would affect a fraction of current U.S. exports and production.

The size of the effect that a change in these trade volumes would have depends on the responsiveness of price to a change in demand. If one considers the most extreme example, where Country 1 bans the import of Country 2's animal products, the portion of Country 2's production that it exports to Country 1 would have no immediate buyer. In response, the world animal product market would have extra goods on it, and prices would fall outside of Country 1. This price decrease would cause some of Country 2's producers to pull their goods off the market and some consumers, attracted by the lower price, would buy more. If suppliers are very responsive to price, and can pull their goods off the market quickly, or if a small decrease in price makes consumers buy a lot more, price won't fall too much. However, if Country 2's producers are stuck trying to unload the animal products as soon as they can, since livestock is costly to store, or if the rest of the world has as many animal products as it wants, price tends to fall more, and Country 2's producers bear more of the costs.

Countries are beginning to discuss the effect of animal welfare legislation on developing nations. Consumers in developing countries don't have the extra income to pay for more expensive animal welfare standards. Thus, their domestic standards might not meet the standards of their trading partners. Some developing countries are concerned about potentially having to meet the stringent standards of wealthier nations. Additionally, some developing countries have expressed skepticism about the discussion of animal welfare in the WTO. The EU's position, outlined in their proposal to the WTO on animal welfare, states that intensive agriculture used by industrialized nations is much more likely to violate the EU's animal welfare laws.

Alternatives to Regulation

A criterion that policymakers, and the WTO, frequently apply to a trade-restricting regulation is whether regulations are the least trade-distorting mechanisms to achieve desired animal welfare objectives. In other words, is there a policy that informs consumers about the animal welfare effects of the goods they buy, and improves animal welfare by the socially desirable amount, without restricting trade? Two policy alternatives that are sometimes proposed, and which are included in the EU's proposal on animal welfare to the WTO, are labeling and targeted subsidies.

Labeling

Labeling is frequently suggested as a way of dealing with differences in product or process standards between trading partners. If the EU governments demanded or even allowed disclosure about animal welfare practices on food labels, would that provide information and improve animal welfare? If firms labeled their products with animal production techniques that they used, this would provide consumers with information. Indeed, as noted above, producers already have incentive to provide this information. Additionally, however, steps would have to be taken to prevent the misuse of labeling or confusion among consumers. Vague terms like "free-range" and "cruelty-

The WTO and Animal Welfare

In deciding whether or not animal welfare standards requirements for imports are legal, the World Trade Organization (WTO) might apply a number of standards. One important standard is that of national treatment. A country may not hold imports to standards that domestic firms do not have to meet. If the rules for the production of imports were the same as the rules for domestically produced goods, animal welfare import regulations would not be in violation of this standard. However, in practice, foreign firms could be at a disadvantage if they do not have access to the same inspection regimes that domestic firms have. If firms must prove that they are complying with the regulations, and domestic firms are certified by government inspections, foreign firms that don't have access to the domestic inspectors will be at a disadvantage. It might be difficult for a country to provide evidence of animal friendly production methods to a trading partner halfway around the world.

Another potential area of conflict between the WTO and animal welfare requirements for imports might be the attempt to regulate processes. The WTO is usually open to a country's placing restrictions on *product* quality, particularly when there is documented evidence of health and safety questions. However, restrictions on the *production processes* by which goods are manufactured are regarded differently. Some argue that process restrictions are never legal under the WTO, while other scholars argue that there might be some cases where the restrictions are consistent with WTO regulations. There have been a number of high profile WTO cases that dealt in some part with production processes, some with animal welfare implications like the Tuna-Dolphin case or the Shrimp-Turtle case, both challenges to U.S. restrictions on imports of seafood.

The WTO considers national treatment and production process versus production quality to be important issues in evaluating the legality of a country's requirements for its trading partners. However, clear standards for applying these principles to a given trade regulation is still evolving as the body of WTO case law grows.

free" would probably need to have standardized meanings for consumers to be able to understand them.

Blandford and Fulponi (1999) suggest that third-party accreditation could be used to ensure that labels mean what consumers think they mean. Those meanings would have to apply to goods coming from all countries, which could mean negotiating with other countries about meanings. Hobbs (1995) and Blandford and Fulponi (1999) note that marketing meat that is produced in accordance with animal welfare regulations can be more costly, as firms must separate their meat from mass-produced meat, arrange for separate shipping and packaging, and monitor production practices to make sure that they conform with standards of animal welfare.

While clear labels can provide information to consumers, they don't necessarily allow a society to achieve the desired level of some social goal. Even if consumers are well-informed and are able to purchase goods with animal welfare standards that they prefer, there is no guarantee that they will change their purchasing behavior as much as society would want. One consumer might be reluctant to buy a free-range steak because it is more expensive, but the extra expense might be small compared with the extra benefit that all of those who value animal welfare receive. Society might like the consumer to buy that steak, but even though it is labeled and he knows that it is free-range, he chooses not to buy it because the extra costs outweighs his extra personal benefit from consuming it. Labeling is sufficient in some cases to deal with the consumer information problem, but not with the problem of social goals (Golan, Kuchler and Mitchell, 2000).

Subsidization

Targeted subsidization to cover the costs of meeting animal welfare standards, coupled with labeling, is sometimes also suggested as a way of dealing with different beliefs about proper production standards. Under this policy, (Bennett, 1997; Blandford and Fulponi, 1999) a government would underwrite the producer's added costs of switching to higher animal welfare standards. If a chicken farmer needed to install larger hen cages or must keep fewer animals on his property, the government could subsidize all or part of the cost. In this case, labels could provide consumers with information about production practices. The subsidy reduces the cost difference between products

that are produced with higher animal welfare standards and those with lower standards. Consumers are therefore more likely to choose products produced with high animal welfare standards, because there is less of a price differential, and it is possible for society to achieve a more socially desirable level of animal welfare. The smaller price differences between the imported goods and the domestic goods would reduce the political incentives to try to keep the imported goods out. The smaller price increases also make the policy less costly to poorer members of a society.

Will subsidies result in trade distortions by encouraging production that might not have taken place without subsidies? In a recent debate in the United Kingdom, one Member of Parliament suggested that general livestock subsidies be lowered to reduce incentives for farmers to overproduce, thereby reducing intensity of farming, and increasing animal welfare. Another countered that preserving animal welfare is a more costly method of production, so that increased aid to farmers is needed to compensate them for that extra expense (Select Committee on Agriculture, 2000). Which argument is correct?

It is true that animal welfare laws might raise production costs, and subsidies generally help farmers cover costs. However, giving a farmer a general subsidy with no restrictions does not necessarily lead to the implementation of animal welfare standards, as the farmer can spend the subsidy on any production costs. General subsidies, by encouraging farmers to produce more, can also potentially distort trade by artificially reducing production prices.

It is possible that a non-targeted agricultural subsidy per unit of land or unit of output could even harm animal welfare. Some argue that agricultural subsidies, by encouraging farmers to increase output, encourage intensive production and mechanization, or "factory farming", and that such practices reduce animal welfare. To the extent that moving toward intensive production cuts costs, farmers have an incentive to make such changes anyway. However, subsidies might be the cause of such structural change, if they encourage intensification at the expense of other methods of production. One mechanism for this occurs when high agricultural subsidies make land more expensive, so farmers are inclined to force more animals into a given amount of space (Winter, Fry and Carruthers, 1998).

Targeted subsidies that require farmers to use the money given to comply with animal welfare standards are the only way to guarantee that farmers use subsidies in the manner intended. If the subsidies are given per animal, they could potentially increase production by lowering production costs per animal. However, targeted payments come with a requirement of higher cost production techniques, which can cancel out the incentive to increase production, but only if the government estimates the size of the payment correctly.

Subsidies must be paid for, however, so this policy is more likely to be more costly to the government budget than simply setting standards that farmers must meet. It is also difficult to determine the level of animal welfare desired by society, and therefore difficult to figure out how big the subsidy should be. Oversubsidization means that the government is spending more money to preserve animal welfare than the society would like, and is therefore sacrificing the ability to spend on other services that society desires more.

Conclusion

Concerns about animal welfare have prompted many industrialized nations to pass laws concerning animal welfare in research, commercial use, and farming. These laws seek to satisfy the desire for increased animal welfare on the part of individual consumers and societies as a whole. The laws could potentially raise production costs, thus making goods more expensive for domestic consumers. If countries with stringent animal welfare laws require trading partners to meet animal welfare requirements, in order to protect their domestic industries producing at a higher cost, world trade flows may be affected. The extent of these effects will depend on the relative sizes of trade in animal products. Policy alternatives to animal welfare regulations include labeling and subsidization of animal-friendly production methods. Labeling can help meet individual animal welfare goals, but not social goals. Subsidization can help meet both goals, and its effects on world trade depend on methods of implementation.

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Consumer Demand Sparks the Growth of Quality Assurance Schemes in the European Food Sector

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Abstract: Concerns over food quality and safety have led to the growth of quality assurance schemes that provide technical requirements for production and processing and provide inspection and monitoring to assure compliance. The schemes, increasingly prevalent in the U.K. livestock and meat industry, will impact market structure, international competitiveness, and trade.

Introduction

Developed countries are mature markets for food, as illustrated in Chapter 2. Income growth has less impact on expenditures for food and agricultural products *per se* compared with less well-off countries. However, higher incomes can drive increased demand for food with certain characteristics: safer, higher quality, more healthful, or produced in ways believed to be more beneficial to the environment.

The preceding chapters document the rise in consumer demand for organically-produced food and discuss the effects of consumers' perceptions of food safety and concerns about animal welfare on their demand for food and agricultural products. The factors contributing to these new demands are by now well-known: food scares, outbreaks of food-borne illnesses, concerns over food produced through biotechnology, concerns over humane treatment of animals in food production, and the environmental impacts of food production.

In Western Europe, consumer demand for food products with known and documented characteristics and with certified attributes has grown. This has been fueled by the possible linkage of BSE ("mad-cow disease") to human illness, by the widespread incidence of illness from contaminated food sources, by product recalls of processed foods, and by the growing awareness of the impacts of farm production practices on the environment and animal welfare.

An example of industry response to this demand has been the development and implementation of mandatory and voluntary quality control, management, and assurance schemes. Such schemes include certification systems for meat supply chains guaranteeing the ability to trace fresh and processed meat back to the originating animal and farm (commonly called "traceability"), certification schemes aimed at guaranteeing both product quality and environmental management of farms, and labeling and certification schemes covering organic and natural production. These schemes are an important part of the change in the way that food products are produced, marketed, and traded in Europe.

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This chapter reports on the emergence of food quality assurance schemes in the United Kingdom as an illustration of the trend in Western Europe[2]. It explains the reasons for the emergence of these schemes and analyzes the characteristics of the schemes in terms of the product *attributes* that the schemes' provisions aim to affect. Lastly, it discusses the potential economic and market impacts of quality assurance schemes and evaluates their potential trade impacts. The article focuses on those schemes that have arisen in the livestock and fresh meat sector; however, the implications may apply equally to schemes covering other sectors.

Characteristics of Quality Assurance Schemes

Quality assurance schemes define a series of technical requirements for producing, processing, or transporting food, and may include standards of environmental and other management practices. The schemes also delineate an inspection system to verify that members comply with these requirements. Labels or quality marks of these programs provide an indicator of an extrinsic product attribute, such as animal welfare, organic production practices, or some aspects of food safety, such as permitted uses of veterinary medicine (see box "Quality Assurance Schemes and Quality Attributes").

Quality assurance schemes have arisen in response to several developments in the European food sector.

- ***BSE.*** Revelations of a possible link between bovine spongiform encephalopathy (BSE) and a related human brain disease precipitated a widespread health scare in Western Europe that led to a ban on exports of British beef, restrictions on certain feed supplements, and a livestock slaughter program aimed at eradicating the disease. The crisis resulted in a significant drop in European beef consumption and a decline in public trust in the ability of government institutions to assure the safety and quality of food.[3] The late-2000 confirmation of cases of BSE in continental Europe resulted in plunging beef demand and broadened the erosion in consumer confidence.
- ***Food borne illnesses and food contaminants.*** Several food safety incidents in Europe have raised consumers' concerns regarding the quality and safety of their food supply. These have included outbreaks of food borne illnesses, including an outbreak of salmonella in the early 1990s, and several outbreaks of listeriosis during the 1990s. In 1999, the use of dioxin-contaminated feed in Belgium was discovered, prompting the emergency removal of a wide range of products from retail stores in Belgium, the Netherlands, and France.
- ***Animal welfare and the environment.*** Growing consumer awareness of and concern for the effects of production practices on the well-being of animals and the environment have led retailers to seek food products that are produced in more humane or environmentally sound ways.
- ***The Food Safety Act of 1990 (U.K.).*** This law required retailers and other participants in the food supply chain in the United Kingdom (U.K.) to exercise "due diligence" in ensuring that the food they sold was safe. As a result, retailers were no longer shielded from liability by a warranty or guarantee from their suppliers. They were required, as are other participants in the food chain, to proactively ensure that the food they sell is safe. This change raised concerns among food retailers, in particular, regarding a number of animal rearing practices and led them to seek documentation of their efforts to ensure the safety of products (Fearne, 1998). In effect, risk management (i.e., protecting themselves against liability), as well as vertical coordination, spurred the development of quality assurance schemes and the growth in their membership.

These developments led to increased demand for assurances regarding food production processes and practices. In addition, food safety incidents have given rise to calls for improvements in the ability to document the source of livestock and other food products, including the feed used to produce them. Quality assurance schemes meet this demand through identification and documentation requirements aimed at tracing animals (and sometimes meat) from the farm of origin to the slaughterhouse or market. Quality assurance schemes may require animals to be bought from farms certified by a recognized assurance scheme or may limit geographic origin. Most have extensive documentation requirements, including identification of animals/carcasses, feedstuffs or treatments used,

[2] A more in-depth treatment of quality assurance schemes, including those in Germany, and quality assurance systems for organic products, will be the subject of a forthcoming ERS report, *Agricultural Quality Assurance Schemes in the United Kingdom and Germany*, by Bredahl, Northen, and Boecker.

[3] Chapter 7 in this report discusses how consumer perceptions of food safety have been affected by the BSE incident and its surrounding publicity.

and slaughter and grade, through if not all levels, a large part of the supply chain.

A common aim of many quality assurance schemes is to communicate to a customer (either a final consumer or a customer in the supply chain) that the scheme has affected particular product attributes in a desired way. Quality assurance schemes play two main roles in the supply chain. First, they provide documented assurance to customers that the supply of the assured product contains all the attributes that the scheme seeks to affect (for example, improved animal welfare, improved trace-back capability, and elimination of objectionable feedstuffs). This assurance is particularly valuable for retailers who supply own-label meat and must, therefore, be confident that the meat they buy satisfies the requirement of a due diligence defense. Second, they can act as a coordinating mechanism in the supply chain where different levels of the chain are under different ownership. The ability of quality assurance schemes to provide certain physical characteristics or consumer attributes is crucial when there is limited control through the supply chain by consumers or retailers. This coordinating role is especially useful when farm level schemes tie in with other transport and processor level schemes to provide integrated supply chain coordination. For example, to be eligible to go through the pork processing assurance scheme (BQAP), pork must come from pigs that have met the pig farm assurance scheme (FABPIGS) standards.

For successful operation of a quality assurance scheme, an inspection system is required to assure compliance with their production or processing requirements. One way of assuring that an inspection is independent is to have a competent third party perform it, where the third party has no direct interest in the results of inspections. In the U.K. livestock sector, inspections are undertaken either by an independent inspection agency specifically set up for the purpose or by veterinarians. An additional tier of monitoring has developed for the U.K. fresh meat sector, where Assured British Meat [4](ABM) and Scottish Food Quality Certification Ltd. act as independent certification bodies for development of both quality assurance technical requirements and for the approval of competent third party inspection. In addition to an initial inspection to approve the producer or processor for membership, schemes may carry out routine audits, and the majority of schemes carry out some form of random inspection. Finally, the majority of schemes reserve the right to test carcasses for banned substances. The ability to support livestock production requirements with *post mortem* analysis is an effective way of reducing the extent to which these requirements are credence (not readily detectable or observable by the consumer—see box "Quality Assurance Schemes and Quality Attributes") in nature.

Quality Assurance Schemes in The United Kingdom

Reflecting food safety and quality concerns of consumers, producers, and other members of the food value-added chain, quality assurance schemes have proliferated in the United Kingdom over the last decade, with the majority of schemes implemented in the early 1990s. These programs now exist at many stages of the food supply chain and cover many different types of food. Quality assurance schemes are particularly prevalent at the production stage of the value-added chain: farm level production quality assurance schemes (commonly known as "farm assurance schemes") cover all major species of livestock, in addition to arable crops, milk, potatoes, and fresh produce. Further up the chain, processor level schemes cover meat from the major livestock species, as well as processed organic products.

Farm level quality assurance schemes include both "generic" schemes, which have been developed with broad public participation, and proprietary schemes developed and operated by food retailing chains and large processing firms. In the livestock sector, separate generic farm-level schemes have been developed for the major livestock species and for the different regions of the United Kingdom (i.e. England, Wales, Scotland, and Northern Ireland). Generic farm-level schemes may extend beyond the farm level to specify welfare and trace-back requirements when transporting animals to slaughter. Standards have also been developed for trace-back capability through livestock auctions. Process-level schemes often include animal welfare practices and provisions for the slaughter and processing of meat. Many farm-level schemes dovetail with processor level quality assurance schemes to

[4] ABM is now one of several umbrella quality assurance schemes which come under the 'British Farm Standard'. The logo for this standard is the 'Little Red Tractor' logo, which is increasingly being used in stores to advertise 'British' food. Other schemes include the National Dairy Farm Assurance Scheme, Assured Chicken Production, Assured Combinable Crops, and Assured Produce.

provide integrated quality assurance throughout the supply chain.

In addition, the major food retailers have implemented "proprietary" quality assurance schemes used in the production of own-label products. All proprietary schemes require their members to be a member of one of the generic farm-level schemes, but specify a variety of additional requirements, such as carcass specifications, age limits, breed, additional feed constraints, and enhanced ability to document the animal's source and how it was produced.

Generic Assurance Schemes

The United Kingdom has witnessed a rapid growth in the number of farm level assurance schemes covering the livestock sector. A generic quality assurance scheme now exists for cattle, sheep, and pigs for each major region of the United Kingdom (table J-1). The majority of schemes were implemented in the early 1990s, largely in response to food retailers' concerns regarding the due diligence defense for product safety. Membership in the programs jumped significantly following the BSE crisis in March 1996, and has been maintained at these higher levels since, as processors and retailers increasingly required product from farms adhering to these programs. For example, membership in Farm Assured British Beef and Lamb (FABBL) and other schemes became a de facto mandatory requirement of major processors, who were in turn responding to pressure from major food retailers, restaurants, and food service.

In 2000, about half of English beef producers and about a quarter of English lamb producers belonged to Farm Assured British Lamb and Beef (FABBL). They produced 76 percent of beef and 51 percent of lambs slaughtered in England. About 30 percent of pig producers belonged to Farm Assured British Pigs (FABPIGS), but they produced about 85 percent of the pigs slaughtered in England.

Generic processor-level assurance schemes in the fresh meat supply chain have existed for a similar length of time as the farm assurance schemes (table J-2). While proprietary quality assurance schemes require participation in a farm-level assurance scheme, membership in a processor-level scheme is not *de facto* mandatory. Generic processor-level schemes are used more widely when the processed meat is sold through other supply channels such as specialist butchers or restaurants and food service. However, 'Specially Selected Scotch' meat (through the SQBLA and GSQMS schemes) is increasingly being seen in supermarkets.

Proprietary Farm Assurance Schemes

Many food retail chains demand livestock that has come from farm assurance scheme members. In addition, many chains also run their own (proprietary) farm-level schemes, which go well beyond the requirements

Table J-1—Inventory of generic farm quality assurance schemes operating in the U.K. livestock sector

Scheme	Regions	Species	Date started	Members
Farm Assured British Beef and Lamb (FABBL)	England and Wales	Cattle and Sheep	1992	18,000
Scotch Quality Beef and Lamb Assurance (SQBLA)	Scotland	Cattle and Sheep	1990	6,500
Farm Assured Welsh Lamb (FAWL)	Wales	Cattle and Sheep	1992	6,700
Northern Ireland Farm Quality Assurance (NIFQAS)	Northern Ireland	Cattle and Sheep	1991	7,000
Farm Assured British Pigs (FABPIGS)	England and Wales	Pigs	1996	2,700
Scottish Pig Industry Initiative (SPII)	Scotland	Pigs	1990	200
Northern Ireland Pig Assurance Scheme (NIPAS)	Northern Ireland	Pigs	1999	n.a.

Source: Northen (2000)

Table J-2—Generic processor quality assurance schemes-U.K. livestock sector

Scheme	Region	Species	Origin	Members	Eligible Volume Percent
Guild of Scottish Quality Meat Suppliers (GSQMS)	Scotland	Beef and Lamb	1988	20	80
Scottish Pork Industry Initiative (SPII)	Scotland	Pork	1991	8	80
British Quality Assured Pork (BQAP)	England and Wales	Pork	n.a.	n.a.	n.a.

covered in the generic quality assurance schemes. There are several reasons why this has occurred:

- generic schemes' requirements do not fully meet the due diligence requirements of food retailers;
- food retailers are able to gain competitive advantage by developing additional quality requirements, such as carcass classification and breed; and
- closer cooperation with both processor and farmer guarantees the food retailer a more consistent and stable supply of meat.

The benefits to the farmer of joining one of these schemes appear to be either a premium for his stock, a more stable price, and/or a more stable supply channel. Table J-3 gives an overview of the requirements of these schemes for beef for five British food retailers. These five retailers account for over 60 percent of food sales and over 70 percent of meat sales in the United Kingdom (Meat and Livestock Commission 2000, FAS 2000).

Provisions of Quality Assurance Schemes

The main features of several U.K. quality assurance schemes are analyzed with a conceptual framework that identifies and categorizes desired product and process attributes and how they are communicated to consumers (see box "Quality Assurance Schemes and Quality Attributes"). Using this conceptual framework, the provisions of the quality assurance schemes can be presented not in terms of production requirements alone, but in terms of the product attributes that are affected by those requirements.

The U.K. Farm Assured British Beef and Lamb (FABBL) scheme provides an example of the provisions of a typical generic farm-level assurance program. Table J-5 demonstrates how farm assurance scheme requirements affect quality attributes. The FABBL scheme is a typical farm-level scheme in terms of the attributes affected. FABBL scheme requirements affect mainly process attributes such as animal welfare and trace-back capability at the farm level. In addition, technical requirements are laid down regarding the environment and food safety, in particular pathogens, toxins, and drug residues. The majority of quality attributes affected will be 'credence' in nature, hence only extrinsic cues can be used to communicate these attributes to the customer. Extrinsic cues at this level of the supply chain will generally take the form of a quality assurance scheme certificate presented by the seller as proof that the animals have been produced to scheme requirements.

Turning from farm level to the processing level, table J-6 highlights the provisions of a typical processor-level assurance scheme—the Guild of Scotch Quality Meat Suppliers (GSQMS) scheme—and the product attributes it affects. This scheme dovetails with the Scotch Quality Beef and Lamb Assurance (SQBLA) farm level assurance scheme to create an integrated scheme for beef and lamb. Any meat passing through both schemes can be labeled as "Specially Selected Scotch" to consumers. Compared with the earlier farm-level example, there are more requirements regarding animal welfare at both the transport and resting stages, and trace-back capability is covered through a large part of the supply chain. In addition, the food safety and quality attributes have several requirements affecting them both *pre* and *post* slaughter. Processor schemes additionally affect sensory attributes, such as "taste" and "tenderness,"

Table J-3—Proprietary quality assurance programs in the U.K. beef sector, 1998

Scheme Criteria	**Tesco** *Producer Clubs*	**Sainsbury** *Traditional Beef Partnership*	**M&S** *Select Scheme*	**Asda** *Beef Bond*	**Waitrose** *Beef Scheme*
Carcass Specification	270-360 kg Specified carcass requirements.	280-380 kg Specified carcass requirements.	270-350 kg Specified carcass requirements.	240-350 kg Specified carcass requirements.	230-360 kg Specified carcass requirements.
Target Animals	Steers, heifers, bulls. 12-30 months.	Steers, heifers. Under 30 months.	Suckler bred. Steers only. 18-26 months.	Steers, heifers, bulls. Bulls <14 months. Steers, heifers <18 months.	Sucklers, steers, heifers, only. 15-29 months.
Breeds Accepted	All breeds.	Sire: recognized beef breed; no restriction on dam.	Sire: Charolais Simmental, Limousin Scotch Angus Dam > 50% beef.	Three-quarter beef, single suckled.	Sire: Aberdeen-Angus Dam: Any breed.
Members	1,500 registered. Target 2,000.	1,200.	1,500 registered. 500 full approval.	40. Target 100-126 to source 600 cattle per week.	400.
Banned Feeds	Growth promoters.	Fishmeal; growth promoters; growth enhancers.	Fishmeal; growth promoters; growth enhancers.	Meat/bonemeal blood-based fertilizers on pasture; other.	Fishmeal; genetically engineered corn; growth promoters; digestive enhancers.
Farm Assurance	All national schemes recognized.	FABBL (Farm Assured British Beef and Lamb) approved.	None recognized.	FABBL and Asda approved.	FABBL, SQBLA, or FAWL members.
Traceability	Farm of birth; producer database.	Cattle born on finishing farms; farm of birth.	Farm of birth; producer database.	Farm of birth.	Farm of birth; producer database.

Note: Tesco, Sainsbury, M&S, Asda, and Waitrose are British food retailing chains. The use of these firms' names does not imply any endorsement of the firms or their practices by USDA.

Quality Assurance Schemes and Quality Attributes

Consumers purchase food products to consume a desired set of quality attributes. The two main attribute categories are process attributes and product attributes. Consumers purchase products to consume physical product attributes, such as sensory and nutrition attributes. Depending on personal values and cultural norms, consumers may also purchase products to consume process attributes, i.e. those which form part of the production process but which cannot be detected during consumption. Examples of process attributes include country or region of origin, animal welfare practices, or environmental impacts of certain production practices. Consumers are willing to pay a higher price for products that provide desired attributes.

Quality attributes can be further divided into two broad classes: those that are ascertained and evaluated by actually consuming the product, termed experience characteristics; and those that cannot be directly determined by consumers, termed credence characteristics. Experience attributes include sensory attributes such as 'taste', whereas credence attributes include many attributes within the process category in addition to some product attribute categories like nutrition and food safety.

Consumers use cues and indicators to detect attributes that they want to consume. Cues, such as color, odor, and size, are used to predict experience attributes, such as tenderness and taste. Extrinsic indicators (*e.g.* product labels and certificates) are used to detect both process and product attributes. Customers base the amount they are willing to pay for a product on cues of intrinsic product attributes and indicators of process or extrinsic product attributes. A label certifying that a product was produced to the requirements of a quality assurance scheme is one indicator guiding consumer purchases.

Examples of process and product attributes according to the types of cues used to detect them are presented in table J-4. For example, the presence or absence of many feed additives cannot be readily detected based on consumers' experience or perception (termed "credence" attributes) of a product and hence can be communicated only through an extrinsic indicator, such as a label. Many process attributes, such as how animals are treated in production and transport, can only be communicated through an extrinsic indicator.

Quality assurance schemes provide a system for assuring and certifying desired product attributes by establishing production and processing standards that relate to the provision of these attributes, inspecting to ensure that standards are being observed, and providing an indicator of these attributes through a mark, label, or certification.

Table J-4—Elements of process and product attributes and relationship to extrinsic and intrinsic cues

Process attributes	Product Attributes			
	Extrinsic cues		Intrinsic cues	
	Food safety	Nutrition	Sensory	Functional
Animal welfare	Pathogens	Fat content	Taste	Convenience
Biotechnology	Residues	Calories	Texture	Shelf life
Organic production	Growth promoters	Fiber	Tenderness	
Traceability	Additives	Sodium	Juiciness	
Feed	Feed	Vitamins		
	Toxins	Minerals		
	Physical contaminants			

Source: Based on Northen.

Table J-5—Provisions of a farm-level generic quality assurance scheme—Farm Assured British Beef and Lamb (FABBL)

Attributes	Examples of standards	Supply level affected*				
Process		**F**	**T**	**P**	**T**	**R**
Animal welfare	Animals must be treated and handled to avoid injury and minimize stress.	✓				
	All animals must have access to sufficient clean water.	✓				
	The use of electric prods is not permitted.	✓				
	Naturally suckled animals should have regular contact with the mother.	✓				
	All stock must have a well drained, dry lying area.	✓				
Traceability	Store animals, breeding stock, and young animals must be bought from a farm certified by a recognized assurance scheme. Alternatively, animals must be kept on the farm for minimum periods before slaughter.	✓				
	On-farm movement records, as required by legislation must be kept up-to-date and available for inspection and reconciliation with the relevant animals on request.	✓				
Environment	There must be systems to prevent pollution of the environment and spread of infectious disease.	✓				
	Animal waste and effluents must be stored and disposed of in such a way which avoids the danger of polluting the environment.	✓				
	All chemicals (e.g. organophosphates and synthetic pyrethroids) must be disposed of safely at all times.	✓				
Food Safety						
Pathogens/ Toxins	All feed must be free from contamination. All purchased compound feed must be obtained from a reputable source that manufactures to the relevant standard laid down by legislation.	✓				
	Diets must not contain any product of mammalian or avian origin with the exception of dairy products.	✓				
	Paints, preservatives, and other chemical compounds that may be toxic should not be used on surfaces accessible to cattle.	✓				
Residues	Withdrawal periods for veterinary medicines must be strictly adhered to.	✓				

*Key: F=Farm level; T=Transport from one stage to next; P=processing level; R=retail sector.

Table J-6—Provisions of the Guild of Scottish Quality Meat Suppliers scheme

Attributes	Examples of standards	Supply level affected*				
Process		**F**	**T**	**P**	**T**	**R**
Animal welfare	Unloading docks must be provided. Animals must be unloaded promptly.		✓	✓		
	Pens, gates, and walkways must be designed to minimize stress.			✓		
	Animals must be penned in the groups they were transported in.			✓		
	Animals must have access to adequate clean water and feed when necessary.			✓		
	Slaughter: animals must be slaughtered humanely and with minimum of distress.			✓		
Traceability	Animals must come from SQBLA farm assurance scheme members.	✓	✓	✓		
	Animals must be penned in groups they were transported in up to stunning.		✓	✓		
	After slaughter, sides must be clearly identified and bear slaughter no., date, classification, and cold weight.				✓	
	Precise and up-to-date records must be maintained to demonstrate the achievement of standards.	✓	✓	✓	✓	
Food Safety						
Pathogens/ Toxins	Product labels of retail packs should carry full instructions for domestic storage.					✓
	Processing: carcass must be dressed in accordance with official specifications. Brain, spinal cord, etc. must be removed.			✓		
	Chilling procedure must ensure that first 10 hours of slaughter the muscle temperature remains above 10^{o}C.			✓		
	Cutting must occur in clean, hygienic conditions and be quick enough to avoid contamination from microorganisms.			✓		
Sensory						
Taste	Packaging must not affect organoleptic characteristics of the meat. Specified carcass characteristics according to EU standards.			✓	✓	✓
Tenderness	If sides are to be aitch bone hung this must be done within 1 hour of stunning. Aitch bone suspended sides must remain on the hook for 48 hours.			✓		
Value/Functional						
Size	Specified carcass characteristics according to EU standards.			✓		
Convenience	When deboning all major tendons must be removed and the joints trimmed to remove excess seam fat, exposed blood vessels, glands, and blood staining.			✓		
Cues						
Color	Fat must be firm and white; muscle must be good color; muscle and fat must be free from bruising and blood splash.			✓		

*Key: F=Farm level; T=Transport from one stage to next; P=processing level; R=retail sector.

and lay down specific requirements that affect intrinsic cues (such as specifying the amount of visible fat on a piece of meat).

Detailed requirements for proprietary farm assurance schemes such as those presented for farm-level and processor-level generic schemes are not publicly available. Nevertheless, it is possible to take as an example the additional requirements presented for one of the proprietary schemes—Waitrose Beef Scheme—in table J-3 and place them into quality attribute categories (table J-7). The Waitrose scheme, like most proprietary schemes, accepts membership of one or several of the generic farm-level assurance schemes but covers additional areas, concentrating on those that mainly affect sensory quality attributes. The food retailer's name, or brand, on the product label will indicate to consumers the presence of attributes arising from producing to the technical requirements of their proprietary scheme.

In addition to the schemes discussed above, there are several organic assurance schemes operating in the United Kingdom. The organic schemes, not covered in detail here, cover a much broader range of quality attributes within the "process" attribute category. Organic schemes emphasize product requirements that target consumer concerns regarding residues, the use of hormones, and genetic engineering. Feed requirements are explicitly included as they form a mainstay of organic processing. Animal welfare, documentation through the supply chain, and environmental effects are also covered.

Market and Trade Effects of Quality Assurance Schemes

The quality assurance schemes considered here may impact domestic firms and markets, as well as trade. Market and economic impacts will depend on the provisions and credibility of the scheme, the market structure of the national food system, as well as consumer demand for the attributes targeted by the schemes.

Domestic Market Effects

Domestic firms—producers, processors, and retailers—may be affected both by changes in the direct costs of complying with and maintaining the required scheme standards and in terms of the transaction cost.[5] The effectiveness of the scheme's requirements and inspections will determine likely production cost changes for the supplier to and the customer of a scheme. A credible quality assurance system may reduce transaction costs, particularly the costs associated with searching and screening for suitable customers or suppliers, in negotiating the terms of a contract, and monitoring and in enforcing the terms of the contract. Quality assurance schemes may also provide a price from the provision of an extrinsic cue

[5] The effects of these schemes on costs are treated in detail in the forthcoming ERS report, *Agricultural Quality Assurance Schemes in the United Kingdom and Germany* (Bredahl, Northen, and Boecker).

Table J-7—Additional provisions of Waitrose quality beef scheme

Attributes	Examples of standards	Supply level affected*				
Process		**F**	**T**	**P**	**T**	**R**
Traceability	Animals and products must be accompanied by documents indicating farm of birth. Producer required to be on database.	✓				
Food Safety	Fishmeal, growth promoters, and digestive enhancers are banned.	✓				
Sensory	Weight: 230-360 kg., EU conformation and fat specifications.	✓				
	Acceptable breeds: Sire—Aberdeen Angus; Dam—any breed.	✓				
	Animals: sucklers, steers, heifers.	✓				
	Age: 15-29 months.	✓				
Value/ Functional	Weight: 230-360 kg, EU conformation and fat specifications.	✓				

*Key: F=Farm level; T=Transport from one stage to next; P=processing level; R=retail sector.

of production practices, as well as the intrinsic attributes of the product.

The development, operation, and interaction of voluntary food quality assurance schemes will be an increasingly important determinant of the competitiveness of agricultural and food industries through their effects on production, transactions costs, and prices. Quality assurance schemes may convey a competitive advantage to domestic producers covered by the program. For example, all of the large retail food chains in the United Kingdom require farm assured livestock. Clearly, in order to source this primary market, quality assurance scheme membership has become *de facto* mandatory, conveying an advantage to suppliers participating in the schemes, and a disadvantage to those who do not. These schemes may come to convey the same advantage for their members as other national systems that aim to create a competitive advantage for some domestic producers based on the sensory attributes of food, or even on the location of production, such as that used for wine and other products.

Trade Effects

The quality assurance schemes could have important impacts on trade in food products. Providing a product attribute that closely matches intermediate customer or final consumer demands may provide a competitive advantage to domestic producers and processors.

The trade impacts of food quality assurance schemes will depend on a complex set of factors. Ultimately, the impact depends on the value customers place on particular quality attributes and companies' relative ability to deliver them. The trade impact will also depend on whether the standards are mandatory or voluntary, and whether they are adopted at the national or European Union (EU) level.

Domestic customers' specifications may act to reduce the competitiveness of foreign suppliers, if not block imports entirely. By requiring imports to contain the same set of attributes as provided by products produced through domestic quality assurance schemes, trade could be blocked. Foreign suppliers may not have easy access to required certification procedures, imposing an enormous cost disadvantage relative to domestic producers. Or, foreign suppliers may simply be unable to produce products with the required set of attributes. For example, a required attribute that production take place in a particular region of a country would absolutely disadvantage foreign producers. This type of trade barrier is likely to become more prevalent for importers into the United Kingdom, as domestic customers increasingly insist that technical requirements in schemes, and inspectors of these requirements, are accredited to national or EU-level standards (Henson and Northen, 1998).

Alternatively quality assurance schemes could have a positive effect on trade by establishing a set of clearly defined and readily available performance standards (like ISO 9000 standards) that, by reducing transaction costs, facilitate commerce between countries. For this to occur, schemes would need to exist in each country, and foreign customers would have to accept the technical requirements and inspections of foreign schemes.

Taking the example of the FABPIGS farm-assurance scheme, several trade effects are suggested for countries exporting pork to the United Kingdom. The demand for farm-assured pigs (and other livestock) with animal welfare and trace-back attributes in the United Kingdom is well developed. Many retail food chains (the likely buyers of most imported meat) demand farm-assured livestock, hence quality assurance schemes such as FABPIGS have become *de facto* mandatory for supplying the primary retail market. Although retail food chains may be prepared to accept pork from comparable schemes in other countries, the animal welfare and trace-back elements of such schemes are likely to have been developed for their own domestic market and may therefore need significant revision to satisfy the U.K. market. In addition, the mechanism by which the foreign scheme is inspected may not be sufficiently rigorous. Any revision to their technical requirements or inspection procedures will result in additional expense for foreign suppliers, which in turn may affect their relative competitiveness. In the case of pork, the costs of compliance with U.K. customers' demands are not likely to be prohibitive for all foreign suppliers. More likely, discrimination between foreign suppliers will occur, as those countries with welfare and trace-back standards similar to those in the United Kingdom will incur lower costs of meeting U.K. standards (for example the Netherlands and Denmark).

On the positive side, however, where foreign schemes are acceptable to U.K. buyers, the presence of the quality label (an extrinsic cue) should be sufficient to indicate the necessary quality and/or safety of the meat and allow for reduced transaction costs of U.K. buyers. This in turn may encourage a greater trade of meat between countries.

Quality Assurance Programs in the United States

Quality assurance programs have been in place for some products for several years in the United States. In the livestock sector, a number of quality assurance programs aimed primarily at improving the quality and safety of the final product have been developed by producer organizations. Many programs establish guidelines for good practices. Some provide training to producers in implementing these guidelines and offer certification for producers who have completed the training. Some programs may verify the certification through on-farm inspections or other audits.

Fewer incorporate strict production/process controls and auditing to ensure that production standards are met. A few, recognizing the importance many consumers place on environmental issues, attempt to reduce adverse environmental impacts of livestock production. Some industry observers expect that more quality assurance plans like these will arise in the United States, partly in response to growing U.S. consumer demand for certain product attributes, and partly to remain competitive in export markets where these programs become more widespread abroad (Miller 2000).

A few examples of quality assurance programs established by U.S. producer groups include the following:

- National Cattlemen's Beef Association's (NCBA) Beef Quality Assurance (BQA) program was introduced in 1982 to address concerns of avoiding residues in beef. Since then, quality assurance programs have been launched in all segments of the beef industry to improve quality.

- National Pork Producers Council Pork Quality Assurance (PQA) program has been in place since 1989. Primarily a management education program, it emphasizes good management practices in handling and use of animal health products.

- The Texas and Southwestern Cattle Raisers Association's Beef Quality Assurance program, scheduled for implementation in 2001, will provide certification to those producers completing training aimed at raising their awareness of practices that have negatively affected meat safety or quality.

Quality assurance can also be provided by brand-name programs, such as those operated by IBP, Certified Angus Beef, Nebraska Corn-Fed Beef, and others. Brand-name beef programs impose additional requirements beyond those established by producer organizations.

U.S. quality assurance programs established to date differ substantially from the comprehensive quality assurance schemes in the United Kingdom. U.S. programs tend to be limited in scope, focusing primarily on health characteristics, and rarely on extrinsic product characteristics such as animal welfare and environmentally benign production. They also tend to be limited to on-farm quality assurance, rather than providing assurance throughout the supply chain.

Some processors and retailers are beginning to address some of the concerns—like animal welfare—targeted by quality assurance schemes in the U.K. For example:

- In 2000, McDonald's announced that it would only buy eggs from suppliers who follow animal welfare guidelines—specifically, requirements regarding the size of battery cages for laying hens and an end to the practice of "forced molting," withholding food and water from the birds so they will lay more eggs (McDonald's 2001).

- In September 2000, the American Humane Association (AHA) launched a voluntary labeling program—"Free Farmed Certification Program"—to assure consumers that dairy, beef, and poultry products come from animals raised under AHA guidelines established for humane care (AHA 2000). The program sets forth standards for housing, feeding, and environmental conditions for the animals, as well as training and education standards for farm management and staff. It provides certification that animals were treated according to these standards, and allows certified producers to use the "free farmed" label on their products. Compliance with standards is determined by on-site inspections carried out by a nonprofit organization set up by AHA.

These programs are too new (and too few) to determine their impact on consumer demand, or whether they will spur similar programs. The AHA, in developing its program, pointed to research that found that consumers would be willing to pay slightly more for meat and poultry products that are humanely produced. If consumers respond positively to these initiatives, producers, processors, and retailers may follow suit.

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Assured British Meat (ABH)

American Humane Association (AHA)

Agricultural Research Service of USDA (ARS)

Beef Quality Assurance (BQA)

British Quality Assured Pork (BQAP)

Bovine spongiform encephalopathy (BSE)

Controlled atmosphere (CA)

Common Agricultural Policy of the European Union (CAP)

China Council for International Cooperation on Environment and Development (CCICED)

Chlorofluorocarbon compounds (CFC)

Creutzfeldt Jakob Disease (CJD)

Community Supported Agriculture (CSA)

European Commission (EC)

European Fair Trade Association (EFTA)

Economic Research Service of USDA (ERS)

European Union (EU)

Farm Assured British Beef and Lamb (FABBL)

Farm Assured British Pigs (FABPIGS)

Food and Agriculture Organization of the United Nations (FAO)

Foreign Agricultural Service of USDA (FAS)

Foreign Agricultural Trade of the United States (FATUS)

Farm Assured Welsh Lamb (FAWL)

Food and Drug Administration of the United States (FDA)

Food Safety Inspection Service of USDA (FSIS)

Genetic engineering (GE)

Global positioning systems (GSP)

Guild of Scottish Quality Meat Suppliers (GSQMS)

Global Trade Analysis Project (GTAP)

Hazard Analysis and Critical Control Point (HACCP)

Hydrochlorofluorocarbon compounds (HCFC)

Hydrofluorocarbon compounds (HFC)

International Comparison Project (ICP)

International Food Policy Research Institute (IFPRI)

International Federation of Organic Agriculture Movements (IFOAM)

Integrated Pest Management (IPM)

International Organization for Standardization (ISO)

International Trade Centre (ITC)

Journal of Commerce (JOC)

Ministry of Agriculture, Fisheries, and Food of the United Kingdom (MAFF)

Mass sociogenic illness (MSI)

National Cattlemen's Beef Association (NCBA)

Newly industrialized countries (NIC)

Northern Ireland Farm Quality Assurance (NIFQAS)

Northern Ireland Pig Assurance Scheme (NIPAS)

Non-tariff barriers (NTB)

Organization for Economic Co-operation and Development (OECD)

Polychlorinated biphenyls (PCB)

Pork Quality Assurance (PQA)

Produce Studies Consulting (PSE)

Scottish Pig Industry Initiative (SPII)

Scottish Quality Beef and Lamb Assurance (SQBLA)

Twenty-foot equivalent (TEU)

United Kingdom (UK)

United Nations (UN)

United Nations Conference on Trade and Development (UNCTAD)

United States (US)

United States Department of Agriculture (USDA)

World Development Indicators, The World Bank (WDI)

World Health Organization of the United Nations (WHO)

World Trade Organization (UN)