

Globalization of the Frozen Potato Industry

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Selected Paper for 2004 AAEEA Annual Meeting

Food and Agricultural Marketing Session

Denver, Co

August 1-4, 2004

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Driven largely by the rising popularity of Western style cuisine, particularly the offerings of quick service restaurants (QSRs), frozen french fries and other frozen potato products have become global commodities generating billions of dollars in revenue worldwide each year. Although exact worldwide production and sales figures for frozen potato products are not available, it has been estimated that total world frozen potato production capacity is about 11 million metric tons a year (Huffaker, 2003). Worldwide exports of frozen potato products (over 90 percent of which are frozen french fries) in 2002 were valued at 2.2 billion dollars. This value is at the wholesale level and does not account for the billions of dollars in value added from the marketing at the retail level worldwide. However, after a long period of growth and expansion in the industry, many major markets are showing signs of maturing, with the growth rate in consumption slowing or even declining during the past few years. Concerns about health and increased consumption of alternative foods (e.g. other fruits and vegetables) in developed countries are likely to adversely affect the demand for potato products. On the other hand, per capita consumption of potatoes is low but growing in many developing countries. The growth of the frozen potato industry will critically depend on industry's ability to sustain growth in those developing markets.

This paper examines the globalization of the frozen potato industry, including the expansion of production and processing of potato products in the emerging markets, and prospects for the industry in the global market place. The paper analyzes a cross section of 33

¹ The authors gratefully acknowledge helpful comments received from Agapi Samwaru, Gary Lucier, Barry Krissoff, Daniel Pick, Demcey Johnson, and Joy Harwood. The views expressed herein are those of the authors and not necessarily those of the Economic Research Service or the U.S. Department of Agriculture.

foreign destinations that account for over 90 percent of total U.S. exports in frozen potatoes to identify critical factors that affect frozen potato exports.

1. Growth of Frozen Potato Industry

The rapid, continuing growth in the fast-food industry over the years is what spawned growth in the frozen potato industry, first in the United States, and then the world (Plummer and Makki, 2002). Although commercial production of french fries began in the United States on a small scale in the mid 1940's, it didn't develop into a major industry until after the inception of QSRs in the 1950's (Figure 1). As QSRs continued to expand, so did the frozen potato products industry, with U.S. output increasing from 0.58 million metric tons (129 million pounds) in 1955 to 3.5 million metric tons (7.8 billion pounds) in 2002, peaking at nearly 4 million metric tons (8.8 billion pounds) in 1999 (AFFI, 2003).

Despite this tremendous growth in U.S. frozen potato production, the ever-increasing domestic and international demand for frozen potato products far-exceeded U.S. processing capacity. By the 1970's, processors in Canada and Western Europe were producing frozen potato products to meet the growing demand. The United States is the largest producer of frozen potatoes in the world, producing an estimated 3.5 million metric tons in 2002. Canada is ranked second, with a production of 1.2 million metric tons, while the Netherlands is a close third with a production of 1.1 million metric tons. It is estimated that these three countries (The United States, Canada, and the Netherlands) collectively produce somewhere between 55 and 75 percent of the world production of frozen potato products (Figure 2). Canada and the Netherlands are currently very close in frozen potato production and capacity. Canada's frozen potato industry is still growing, while the industry in the Netherlands and the United States are each stagnant or possibly even declining slightly in size. The bulk of the remaining frozen potato production

resides in other European Union (EU) nations, particularly Belgium, France, Germany, and the United Kingdom. Production also occurs on a much smaller scale in Australia, New Zealand, Eastern Europe, Asia, Africa, and South America, and as frozen potato consumption increases in these areas, local production is likely to increase as well.

2. Major Markets for Frozen Potato Products

The major markets for frozen potato products are still predominantly the developed economies of the United States, the European Union, Canada, and Japan. However, as these markets mature, they are likely to have only limited growth potential in the future. This is most evident in the United States, the oldest and largest single-country market for frozen potato products, where demand seems to have leveled off in recent years. Per capita consumption of frozen potato products in the United States was an estimated 12.5 kg/person (27.6 lbs/person) in 2002 (product weight), down 5 percent from 2001 and 8.5 percent below the record level set in 1996. Further evidence of market maturity is the relatively slow expansion of traditional burger and fry outlets in the United States compared with the world. For example, in 2002 the number of McDonald's outlets in the United States increased by only 3 percent from the previous year compared to a 3.9 percent average growth in the rest of the world. With nearly 13,500 outlets in the United States in 2002, there was one McDonald's for approximately every 21,000 people.

Also showing signs of market maturity for frozen potato products is Japan, where consumption also seems to have declined recently following years of rapid growth. In 2002, per capita consumption of frozen french fries in Japan was 1.7 kg/person (3.7 lbs/person), down from a high of about 2.4 kg/person (5.3 lbs/person) in 1999. Most of this consumption occurs through the food service industry, with McDonald's by far the leading supplier. After the United

States and Canada, Japan ranks third in the number of McDonald's outlets per capita, with one outlet for approximately every 33,000 people.

The European Union markets for frozen potato products may also be nearing maturity. QSR's have been established in most EU countries since the 1970's, and in 2002 there was one McDonald's restaurant for roughly every 120,000 people (includes Eastern Europe, where the industry is largely underdeveloped). European per capita consumption of frozen potato products in 2002, although based on limited data from only 13 countries, is estimated at about 6.5 kg/person (14.3 lbs/person), about half the U.S. level. However, per capita consumption in the United Kingdom, by far the largest European market for frozen potato products, was an estimated 16 kg/person (35 lbs/person) in 2002. France ranks second in the EU, with a per capita consumption estimated at 7.1 kg/person (15.7 lbs/person) in 2002 (Pierce, 2002-03).

Markets with the most growth potential for frozen potato products in coming years are likely to be those that are still largely untapped by the QSR industries, particularly in Asia and Latin America. As these regions continue to develop economically, QSR outlets will likely expand, increasing demand for frozen potato products at a potentially rapid pace. In Latin America, there is currently only one McDonald's for every 331,000 people, and in the Asian/Pacific region, this number is only one outlet for roughly every half million people. Two countries with perhaps the most potential for QSR growth and potential demand for frozen potato products are China and India. Development of the QSR industry in China has occurred rapidly in recent years (e.g. McDonald's expanded the number of outlets by 67 percent between December, 2000 and December, 2002), but is still in its relative infancy. At the end of 2002, there was only one McDonald's for approximately every 2.3 million people in China. And in

India, with a population of one billion, the QSR industry hasn't really even started to develop, with only 54 McDonald's outlets in the entire country in 2002.

3. Handful of Companies Dominate Frozen Potato Processing Industry

Relatively few companies dominate the frozen potato processing industry. The three largest producers, McCain Foods, Lamb-Weston, and J.R. Simplot Company own and operate processing facilities around the world. Together they account for nearly three-quarters of total world frozen potato product production. McCain Foods is a Canadian-based company, while Lamb-Weston and J. R. Simplot are American-based companies. In the year 2003, McCain controlled an estimated 32 percent of world production capacity, while Lamb-Weston and Simplot controlled 22 and 17 percent, respectively (Figure 3). The other significant processing companies include Aviko and Farm Frites from Netherlands. Together, the latter two account for about another 10 percent of world capacity. Although based in the Netherlands, both companies own and operate plants in other countries within the European Union.

McCain Foods, Lamb-Weston, and Simplot have developed into large, multi-national corporations producing frozen potato products, particularly since the 1990's. While still maintaining much of their processing capacities in their home countries, each has branched out globally, building or acquiring processing facilities around the world. McCain's is perhaps the most globalized in terms of capacities spread around the globe. With production beginning in Canada in 1957, McCain's first international plant was built in England in 1969. Currently, they operate frozen potato-processing facilities in Canada, the United States, European Union, Poland, Australia, New Zealand, South America, and Africa. Lamb-Weston, founded in 1950 and now an independent operating company of ConAgra Inc, is the largest U.S.-based potato processor, but also own and operate plants in Canada, the Netherlands, India, and Turkey. J.R.

Simplot Company, another U.S. producer founded in the late 1940's, now operates frozen potato-processing facilities in the United States, Canada, Australia, and China.

The remaining 15 percent of production capacity lies in the hands of numerous small companies located around the world. Available information as of 2003 indicates that there are more than 2 dozen companies operating in 19 different countries around the globe. Much like with larger producers, most of the small firms are based and operate in the United States, Canada, and the European Union. Unlike the larger companies, however, most of the smaller producers operate only one or a few plants, and usually only within their home country. Smaller producers, unless they are affiliated with a larger producer through a joint venture or partnership of some sort, often cannot supply the volume necessary for the large QSR chains and, therefore, primarily supply local or regional restaurants and outlets.

4. Globalized Production and Foreign Direct Investment

Output of U.S. frozen potato products has benefited and expanded from the globalization of the QSR industry. At the same time, increased worldwide demand has led to globalization in the production sector. As worldwide demand for frozen potato products increased, a natural progression for the processing industry has been to invest directly in major markets abroad. Evidence suggests that the industry is building and expanding potato processing plants worldwide. This allows processors to utilize global sourcing to reduce transportation costs by minimizing shipping distances of finished product. Globalized production also stabilizes the supply by limiting the effects of local crop disasters and shortages should they occur in a particular production region, while also allowing suppliers to avoid trade barriers in some instances.

The motivation for foreign direct investment (FDI) in frozen potatoes is no different from that in other related sectors such as wineries or beverages. Economics literature suggests that FDI is motivated primarily by pressures to reduce transaction costs, access and develop foreign markets, and to overcome trade barriers (Pompelli and Pick, 1999). FDI in frozen potatoes is also driven by a need for a cost-effective, stable and adequate supply of frozen potatoes to meet the demands of a growing worldwide QSR sector. The expansion of processing plants around the world in recent years is a testimony to increasing FDI in the frozen potato industry.

5. Prospects for the U.S. Frozen Potato Industry

As mentioned previously, markets for frozen potato products in the U.S. and other developed countries are mature. Concerns about health and increased consumption of alternative foods in developed countries are likely to adversely affect the demand for potato products. On the other hand, per capita consumption of potatoes is low but growing in many developing countries. The growth of the frozen potato industry will critically depend on industry's ability to sustain growth in those developing markets.

The anticipated population growth in developing countries, combined with rising income levels and changing diets, is expected to lead to further expansion of QSR's in those countries. As a result, demand for frozen potato products in these countries is expected to continue growing. At the same time, major producers of frozen potato products will continue to compete for worldwide markets. World trade data shows that exports of frozen potatoes have expanded rapidly over the last 30 to 40 years, and that the number of exporting countries has increased dramatically. For example, in 1980 only 10 countries reported exports of frozen potatoes, but by 2002 this number had risen to 90. While a number of these countries are simply trans-shippers of frozen potatoes and do not produce the products domestically, there is no doubt that the

number of producing countries has increased significantly. In order for U.S. producers to remain competitive in a globalized market, they must be keenly aware of factors that affect U.S. frozen potato exports.

In this section, we examine various destination market characteristics that affect exports of U.S. frozen potato products in an attempt to identify growth markets and quantify the effects such market characteristics have on U.S. exports. We hypothesize that U.S. exports are likely to be affected by the size of the markets and the purchasing power of consumers, as well as policies and institutions of destination countries. We analyzed a cross section of 33 foreign destinations that account for over 90 percent of total U.S. exports in frozen potatoes over a time period of 1989-2001. The characteristics of developed and developing countries were examined separately, as market and other characteristics of these two groups are different and they affect exports differently. Depending on whether the country is developed or developing we expected the two country groups' characteristics to have different relationship with U.S. exports of frozen potato products. In this study, high-income OECD countries are considered as developed countries, while low and middle income countries are considered as developing countries. Of the 33 selected countries, 19 developing countries comprise our developing group with a combined urban population of 1.3 billion, and GDP of over \$13 trillion (Table 1). Even though developing countries accounted for only 25 percent of U.S. frozen potato exports in 2001, they offer the greatest potential for growth. During the 1991-2001 period, the annual growth rate of U.S. exports to developing countries was 21 percent, while the growth rate of exports to developed countries was only 8 percent (Figure 4).

5.1 Analytical Framework

To analyze the factors that determine U.S. exports of frozen potato products across a broad spectrum of economies with varying market sizes, per capita income levels, and institutions, we estimated time series cross section (TSCS) regressions that relate frozen potato exports to destination country characteristics. Our basic econometric specification is as follows:

$$(1) \quad E_{it} = \alpha + \beta X_{it} + e_{it}, \quad i = 1, 2, \dots, N; \quad t = 1, 2, \dots, T.$$

E is U.S. exports of frozen potato products, while X , a vector of exogenous variables, represents various country characteristics. α is the intercept term and β is the vector of unknown parameters to be estimated. e_{it} is the error term. Subscript i represents the country index and subscript t denotes time period, N is the number of countries, and T is the length of the time series for each country. The destination country characteristics that are examined in this study include market size, economic development, trade openness, inflation rate, FDI, and urban population.

The market size of the destination country is captured by the gross domestic product (GDP) in purchasing power parity (PPP) adjusted dollars, while the level of economic development is captured by the per capita income in the destination country, also in PPP-dollars. We expect both these variables to be positively associated with exports.

Trade openness, measured by the share of imports in the GDP, indicates the trade policies of the destination country. The annual inflation rate, on the other hand, is proxy for country's fiscal and monetary policies. A low and stable rate would indicate stable policies. The inflation rate is measured by the rate of change in CPI. We expect trade openness to be positively associated with exports, while inflation rate to be negatively associated with exports. We also control for gross FDI and urban population. FDI is measured in terms of aggregate inflow of

foreign investments as a share of GDP. Urban population is expressed as a share of total population.

The use of panel data has the advantage of providing additional insights into the effects of both time and location characteristics, but the error term may exhibit serial correlation and heteroscedasticity. However, appropriate data transformations can make the error term serial non-autoregressive and homoscedastic (Kmenta, 1986). We used the TSCSREG procedure included in the SAS software, which corrects the data for both serial correlation and heteroscedasticity (SAS Institute, 1979). Specifically, we chose the Parks method of estimation which offers an efficient procedure to model panel data (Parks, 1967).

5.2 Econometric Results

Table 2 presents the parameter estimates for the developed and developing countries, as well as a combined estimation. As the table shows, the model for developed countries fits the data slightly better than the model for developing countries. The adjusted- R^2 values are 0.93 and 0.85 for developed and developing countries, respectively. Our econometric analysis finds that U.S. exports of frozen potato products are affected by various destination country characteristics and their policies.

Market Size

Market size of the importing country is perhaps the most important factor for the growth of the frozen potato industry. In this analysis of market size, we use as a proxy the purchasing-power-parity (PPP) adjusted GDP and the size of urban population. PPP adjustment makes the GDP comparable across different economies with different exchange rates and costs of living. We expect larger market size to have a positive effect on U.S. exports. Our econometric results indicate that the larger the market size the higher are U.S. exports of frozen potato products to

both developed and developing countries. The estimated coefficients are statistically significant (Table 2).

In addition to GDP, urban population is expected to be another important factor determining the growth of U.S. frozen potato exports. This is because QSR's, the main outlet for frozen potato products, are typically more concentrated in urban areas. With rapid urbanization in developing countries, (the urban population is growing at 0.76 percent in developed countries compared to 2.87 percent in developing countries), the demand for high value food products including processed food and restaurant food is expected to increase. Our results, however, do not support this argument. The estimated coefficient for urban population is negative for developed and developing countries, but it is statistically significant only for developed countries.

Economic Development

Global per capita income grew rapidly in the 1990s, particularly in the emerging market economies. Increased purchasing power among consumers in those emerging economies has led to greater demand for food, in general, and restaurant food, in particular. According to estimates, per capita income in the next decade is expected to grow twice as fast in the developing countries relative to developed countries. This has significant implications for growth of the frozen potato industry in those markets. For this study, the economic growth is indicated by PPP-adjusted per capita income.

Results presented in Table 2 indicate that per capita income affects U.S. exports differently in developed and developing countries. In the case of developed countries, per capita income appears to be negatively related to U.S. exports of frozen potato products, while per capita income is positively related to U.S. frozen potato exports in developing countries (Table

2). The estimated coefficients are statistically significant for both developed and developing countries.

A possible explanation for the negative relationship between exports and per capita incomes in developed countries is that U.S. exports to developed country markets have leveled off somewhat in recent years due to market maturity and saturation. Consumers in these economies may be showing signs of declining interest in frozen potato products; perhaps the result of increased consumer concern about fat intake, and perhaps because of increased consumption of other foods as diversity in the diet tends to increase with income. On the other hand, income growth seems to be an important driving factor in the growth of U.S. exports in frozen potato products to developing countries. QSR's, often selling frozen potato products, are typically a relatively inexpensive source of away-from-home food and therefore often attract consumers with more restrictive budgets. The positive relationship implies that developing countries with high income growth rates are major growth markets for U.S. frozen potato products in the future.

Trade Openness

The trade openness of destination countries is a critical policy that influences exports. Openness of a country to imports is likely to have a positive effect on U.S. exports in frozen potato products. Our analysis indicates that openness, measured by share of imports of goods and services in the destination country's GDP, is positively associated with exports of frozen potato products both in developed and developing countries. The estimated coefficients for market openness are statistically significant in all three equations.

Inflation Rate

We have used the inflation rate as a proxy for the degree of macroeconomic stability of a country. The inflation rate, measured as the annual percentage change in consumer prices, is expected to be negatively associated with U.S. exports of frozen potato products. Our results support this argument for both developed and developing countries. The estimated coefficients are negative and statistically significant for both developed and developing countries (Table 2).

6. Concluding Comments

Globalization implies more interrelated world economies and competition. Globalization of the frozen potato industry is clearly evident as the largest suppliers have crossed borders and become multi-national corporations, producing and distributing product on a world-wide basis. As these producers compete for worldwide markets, driven by efforts to deliver products at the lowest feasible cost, they do so by continuing to build and expand production facilities around the world. This could lead to decreased market share for U.S. frozen potatoes, unless exporters take adequate measures to open and develop new markets. This would involve a better understanding of local consumer demands and importing country characteristics and policies.

QSRs, which are the most important retail marketers of frozen potato products, are growing much more rapidly in developing and emerging markets than they are in the developed markets of the United States, Western Europe, and Japan. These emerging markets may prove to be a potential source of future export growth for U.S. frozen potatoes, and key factors such as an importing country's local tastes, market size, economic growth, and competitiveness will likely determine the growth potential of the global frozen potato industry in the coming years. It is clear that differences between developed and developing countries are an important part of the explanation of U.S. exports in frozen potato products. Several developing Asian countries including China, India, Indonesia, Malaysia, Philippines, and Thailand, along with the Latin

American countries of Chile, Brazil, and Mexico, are poised for significant economic growth in the next decade. These emerging markets have combined urban population of over a billion, with a PPP-adjusted GDP of over \$11 trillion. Additionally, these economies are growing faster relative to developed country markets. Not only are GDP and per capita income growth rates higher in developing countries, but also their food demand is more income-elastic. Producers of frozen potato products are likely to face increased demand as the demand for fast food increases in these countries.

The United States, with a large concentration of frozen potato production centered in the Pacific Northwest, currently seems to have a comparative advantage in supplying markets in Asia and the Pacific Rim, although this advantage may diminish as production continues to develop in Australia and Asia. Canada, with production concentrated in Prairie and Eastern Provinces, has an advantage in shipping to the Eastern and Midwestern United States. The two countries currently compete fiercely for markets in Central and South America. European Union countries, led by the Netherlands, have an advantage in shipping to each other, and possibly to markets in the Middle East and Africa.

The Netherlands, Canada, the United States and Belgium are currently the leaders in frozen potato trade. However, as other countries develop suitable potato processing varieties and processing infrastructure, worldwide competition will continue to increase. While some of the competition may come from new, locally founded companies, much will come as existing multinational producers build new facilities around the world. In order for U.S. exports to thrive in such an environment, processors must continue to develop markets worldwide, and capitalize on the United States' frozen potato processing capacity (the largest in the world) and reputation as a producer of superior product quality.

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Figure 1 – Number of Quick Service Restaurants Worldwide and U.S. Frozen Potato Product Packs, 1960-2001

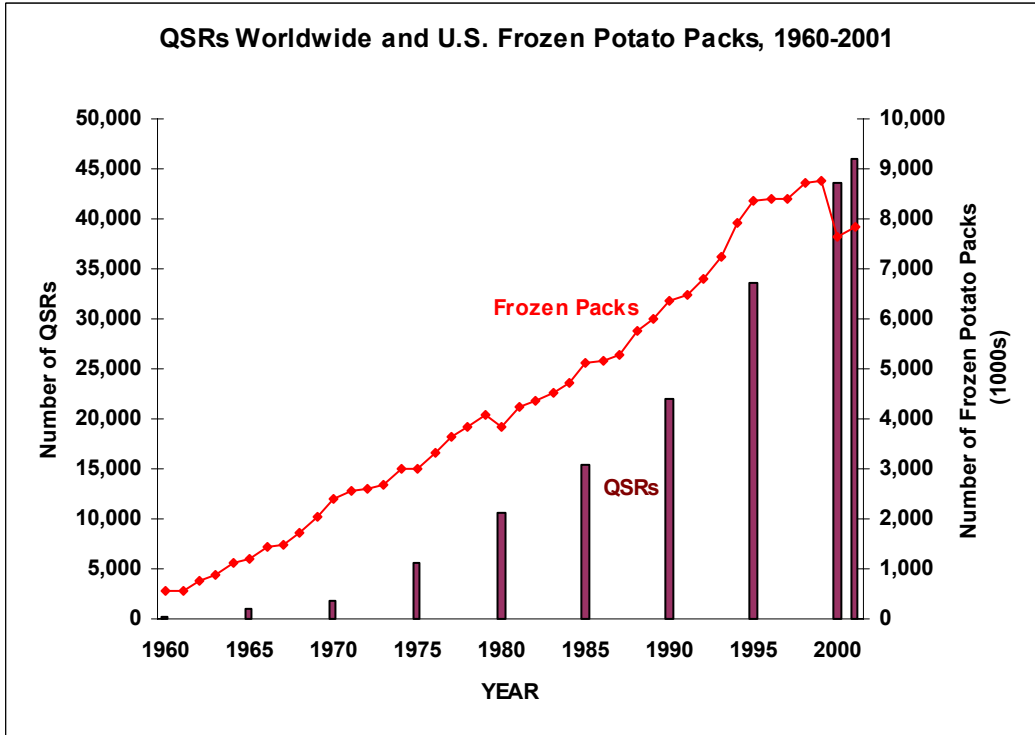


Figure 2 – World Frozen Potato Production Capacity Share by Country

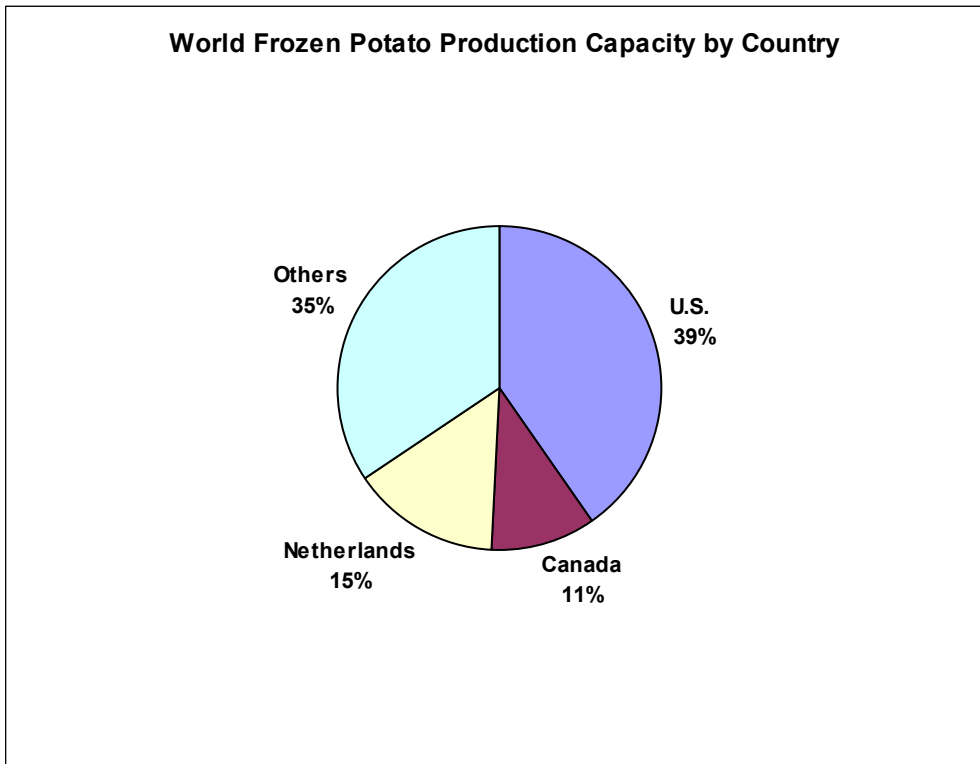


Figure 3 – World Frozen Potato Production Capacity Share by Processor

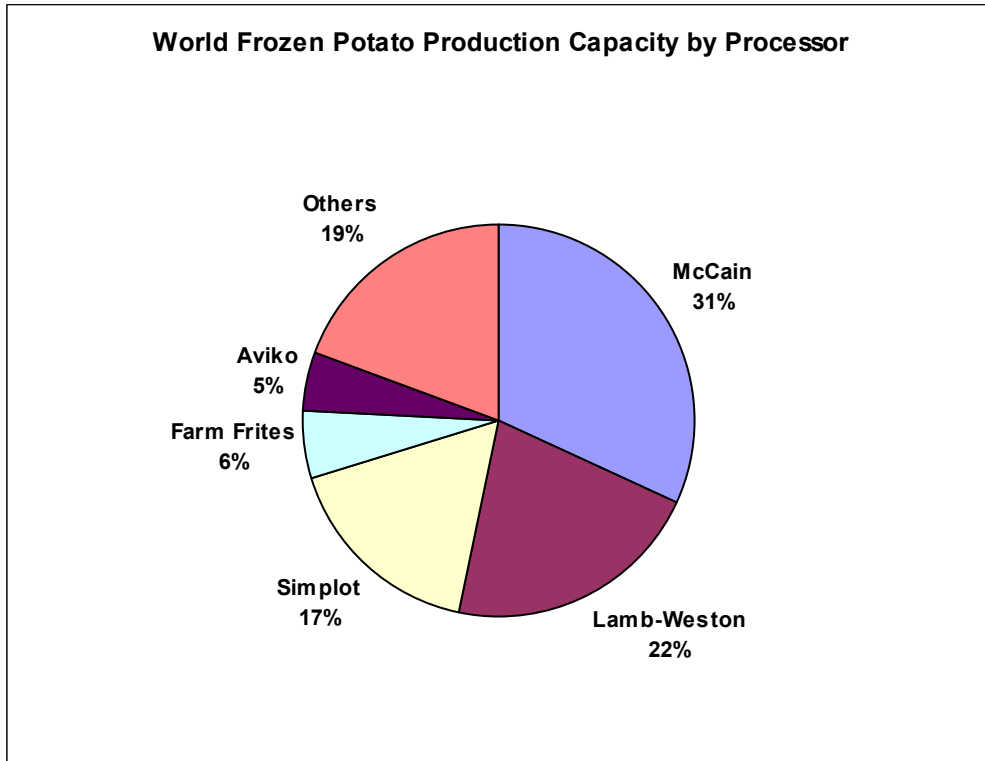


Figure 4 – U.S. Frozen Potato Exports to Developed and Emerging Markets, 1991-2001

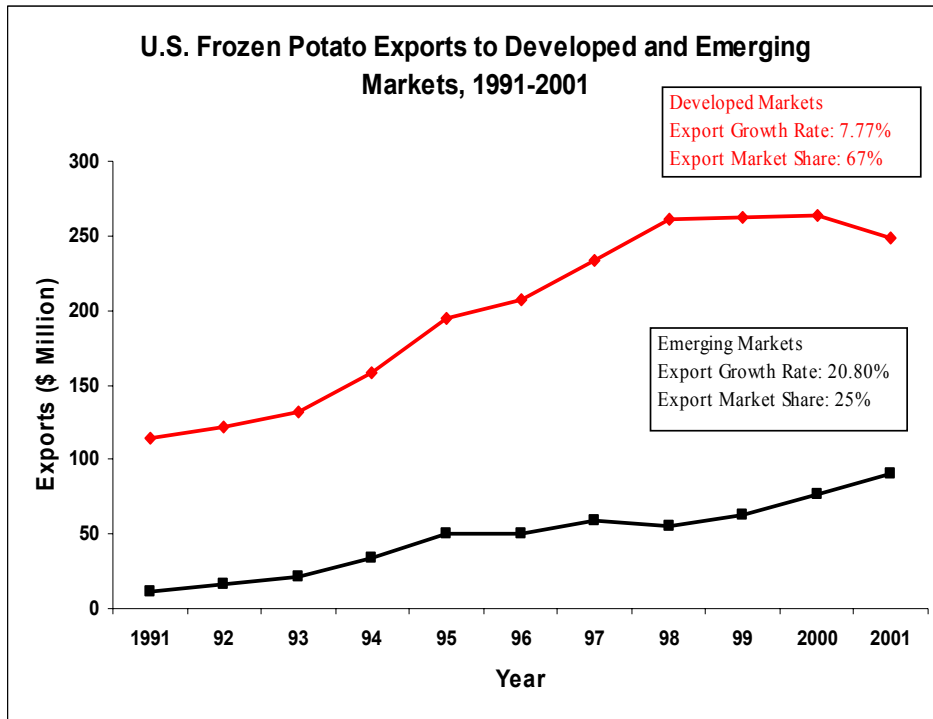


Table 1--U.S. Frozen Potato Industry: Export Growth Rate, Export Market Share, and Country Characteristics

Destination	Export Growth	Export Market Share	GDP PPP \$	GDP Growth	GDP per capita	GDP PC Growth	Urban Population	Growth Competitiveness
Country	Rate % 1991-2001	(%) 2001	Billion 2001	Rate (%) 1991-2001	PPP \$ 2001	Rate (%) 1991-2001	(Million) 2001	Index 2000-01 1/
Developed Markets								
Australia	13.70	0.33	492	5.44	25,370	4.29	17.66	82.00
Belgium	--	0.00	262	3.53	25,520	3.25	10.02	75.86
Canada	10.33	4.70	843	4.70	27,130	3.72	24.53	83.86
Hong Kong	9.88	5.14	167	5.17	24,850	3.62	6.73	78.14
Denmark	--	0.00	155	3.79	29,000	3.40	4.56	77.71
France	-6.38	0.00	1,420	3.50	23,990	3.11	44.71	75.57
Germany	-19.92	0.00	2,087	3.22	25,350	2.93	72.22	77.00
Japan	6.49	47.03	3,193	2.60	25,130	2.35	100.25	75.00
Netherlands	26.78	0.26	436	4.27	27,190	3.65	14.37	79.43
New Zealand	--	0.00	74	4.66	19,160	3.64	3.31	79.00
Singapore	6.29	1.94	94	8.42	22,680	5.67	4.13	70.29
South Korea	12.34	6.99	714	7.06	15,090	6.16	39.02	64.29
Spain	--	0.00	828	4.38	20,150	3.84	32.01	73.29
United Kingdom	23.85	2.23	1,420	4.09	24,160	3.92	52.65	78.71
	7.77	68.62	12,186	3.74	23,912	3.70	426	
Emerging Markets								
Argentina	--	0.00	424	4.45	11,320	3.16	33.12	58.71
Brazil	-27.25	0.00	1,269	4.50	7,360	3.13	140.83	60.86
Chile	14.05	0.07	142	7.27	9,190	5.81	13.25	70.00
China	67.51	6.36	5,111	11.30	4,020	10.27	466.71	62.86
Colombia	29.16	0.07	303	4.12	7,040	2.25	32.48	52.57
Costa Rica	23.59	0.29	37	6.50	9,460	4.37	2.31	64.14
Dominican Republic	54.92	0.20	60	7.59	7,020	5.88	5.61	58.57
Ecuador	-16.28	0.03	42	3.49	3,280	1.44	8.17	48.00
Guatemala	26.17	0.52	51	5.47	4,400	2.85	4.67	49.14
Honduras	7.38	0.07	19	4.31	2,830	1.61	3.53	44.43
India	1.09	0.03	2,930	7.30	2,840	5.55	287.73	54.86
Indonesia	10.34	0.97	615	5.21	2,940	3.80	87.73	52.71
Malaysia	8.96	2.10	208	8.08	8,750	5.64	13.82	69.00
Mexico	24.33	8.59	838	4.57	8,430	2.98	74.15	61.29
Panama	45.76	0.48	17	5.03	5,750	3.33	1.64	80.57
Peru	44.28	0.10	120	4.93	4,570	3.14	19.27	55.43
Philippines	14.44	3.50	301	4.34	3,840	2.04	46.47	55.00
Thailand	26.19	1.43	392	5.48	6,400	4.68	12.25	64.71
Venezuela	20.70	0.17	140	2.93	5,670	0.85	21.47	52.86
	20.80	25.00	13,018	7.53	6,058	3.75	1,275	

-- = growth rate not available due to no reported exports in 2001.

1/ In the WEF report, GCI is measured in a scale that ranged between 1 and 7. In this table we convert those scores to percentages.

Source: United Nations Statistics Division and World Bank's World Development Indicators

Table 2 – Parameter Estimates of U.S. Exports of Frozen Potato Products

Variable	Parameter Estimates		
	Developed Countries	Developing Countries	All Countries
Intercept	-5025.22 (-13.99)*	-2502.16 (-18.06)*	-781.45 (-2.89)*
Market Size	30.13 (29.29)*	3.0486 (5.68)*	16.64 (68.79)*
Per Capita Income	-0.1804 (-28.83)*	0.1782 (15.14)*	-0.0106 (-1.52)
Trade Openness	29.12 (22.32)*	32.97 (23.81)*	10.47 (7.48)*
Inflation Rate	12.26 (4.08)*	-0.055 (-4.92)*	1.6716 (0.45)
Urban Population	-0.0850 (-3.51)*	-0.0088 (-1.74)	-0.0957 (-6.50)*
FDI	-10.46 (-9.26)*	-30.50 (-10.65)*	-44.71 (-33.74)*
R-Square	0.9287	0.8530	0.9750

t-statistics in parentheses. * indicates t score within 1% or better level of significance.