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Prospects for Growth in U.S. Dairy Exports to Southeast Asia

Christopher G. Davis and Jerry Cessna

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Prospects for Growth in U.S. Dairy Exports to Southeast Asia

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Abstract

Food demand in Southeast Asia (SEA) is expected to grow in the coming decades, creating opportunities for exporters of dairy products. The top dairy product suppliers to the region are New Zealand, the European Union (EU), the United States, and Australia. This study analyzes trends in market share over the 2006-18 timeframe and the price sensitivity for the top four U.S. dairy products imported by SEA countries: skim milk powder (SMP), whey products, cheese, and lactose. In 2018, these four products accounted for 85 percent of the total value of SEA dairy imports from the United States. Our findings show differing trends in market share and price sensitivity across products and countries. Our analysis reveals that SEA importers are more likely to substitute U.S. products for EU dairy products than for dairy products from New Zealand or Australia. Our research indicates that the United States has the potential to gain market share as import expenditures increase (holding prices constant) for cheese in Indonesia; whey products in Malaysia, Singapore, and the Philippines; SMP in Indonesia and Vietnam; and lactose in the Philippines, Indonesia, and Malaysia. SEA imports of U.S. dairy products are sensitive, in varying degrees, to changes in U.S. prices—as well as price changes for products from competing suppliers, such as the EU, Australia, and New Zealand.

Keywords: Southeast Asia dairy imports, ASEAN, dairy trade, international dairy markets, dairy price elasticities, dairy expenditure elasticities, Rotterdam model, dairy price sensitivity, dairy market share, dairy competition.

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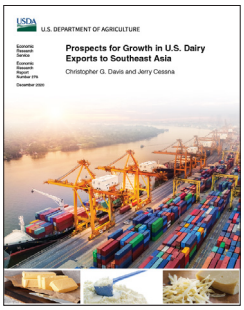
A report summary from the Economic Research Service December 2020



Prospects for Growth in U.S. Dairy Exports to Southeast Asia

Christopher G. Davis and Jerry Cessna

What Is the Issue?

The demand for dairy products in Southeast Asia (SEA) is expected to grow in the coming decades, creating opportunities for exporters in the United States and other countries. Top dairy suppliers to the region include New Zealand, the European Union (EU), the United States, and Australia. This study examines the prospects for growth of U.S. dairy exports to the SEA region, U.S. competitors in these markets, and the price sensitivity of SEA demand for the four top U.S. products imported by the region. In addition, this study explains how the U.S. potential to gain or lose market share varies from one SEA country to another and among products.

What Did the Study Find?

Trends in market share and sensitivity to prices for U.S. dairy products vary across countries and products. By examining trade patterns and using a statistical modeling approach, this study shows:

- SEA total dairy imports have grown in recent years, from $3.8 billion in 2006 (valued in constant 2018 U.S. dollars) to $6.3 billion in 2018. SEA dairy imports from the United States grew from $401 million in 2006 (valued in constant 2018 U.S. dollars) to $738 million in 2018. Over this period, the United States moved from the fourth to the third largest SEA dairy product supplier, behind New Zealand and the EU.
- Skim milk powder (SMP), whey products, lactose, and cheese are the major U.S. dairy products imported by SEA countries. SMP was SEA's top dairy product imported, by value, from the world and from the United States in 2018. Although the EU was the top supplier of SMP to the region in 2018, the United States was the largest supplier of SMP to the Philippines and Indonesia. And while the EU was the largest supplier of whey products to the region, the United States was the largest supplier of whey products to Vietnam; the United States was the second largest supplier of whey products to Indonesia. The United States was the top supplier of lactose to the region and supplied over half of the lactose imports, by value, to the SEA region in 2018. The region imported less cheese from the United States than from New Zealand, the EU, and Australia in 2018; however, SEA cheese imports from the United States have grown significantly since 2006.

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- Cheese has been the dairy product most consistently imported by SEA countries from most trading partners. Each of the five major SEA importing countries imports cheese from several trading partners almost every month. In addition to New Zealand, the EU, Australia, and the United States, consistent suppliers to the region also include Switzerland and Japan.
- SEA countries were sensitive to changes in U.S. export prices of dairy products in varying degrees. An analysis of 2006-16 data found that Malaysia and Singapore were the most sensitive to changes in U.S. cheese prices, while Malaysia and Indonesia were the most sensitive to changes in U.S. SMP prices. Malaysia was also sensitive to fluctuations in U.S. whey product prices. In some cases, SEA demand for U.S. dairy products increased or decreased significantly in response to price changes for products from competing suppliers, such as the EU, Australia, and New Zealand.
- If past trends continue, rising import expenditures in SEA could lead to an increase in U.S. market share for cheese, whey products, SMP, and lactose in some countries. If dairy import expenditures grow in SEA, the United States could gain market share for cheese in Indonesia; whey products in Malaysia, Singapore, and the Philippines; SMP in Indonesia and Vietnam; and lactose in the Philippines, Indonesia, and Malaysia. By contrast, the United States could lose market share for cheese imports in the Philippines, Malaysia, and Singapore. Although imports of cheese from the United States could grow for these countries, cheese imports from other trading partners may grow at a faster rate.
- The EU has been the chief competitor for the United States in the SEA dairy market. Over the 2006-16 timeframe, SEA importers were more likely to substitute U.S. dairy products for EU dairy products than for products from New Zealand or Australia. There are substitute relationships between the United States and the EU for cheese in Singapore; whey products in the Philippines and Malaysia; SMP in Indonesia and Singapore; and lactose in the Philippines, Indonesia, and Vietnam. The magnitude of these relationships between U.S. and EU dairy products could identify which of the two countries will benefit the most in trade, given a change in price.

Note: Sensitivities to prices and expenditures may potentially be much different than this study would indicate under conditions brought about by the coronavirus COVID-19 pandemic. At the time of publication, the potential impacts of the virus on economic trade are uncertain. The findings discussed below would be most representative if market conditions post-COVID-19 are similar to those in the 2006-16 time period.

How Was the Study Conducted?

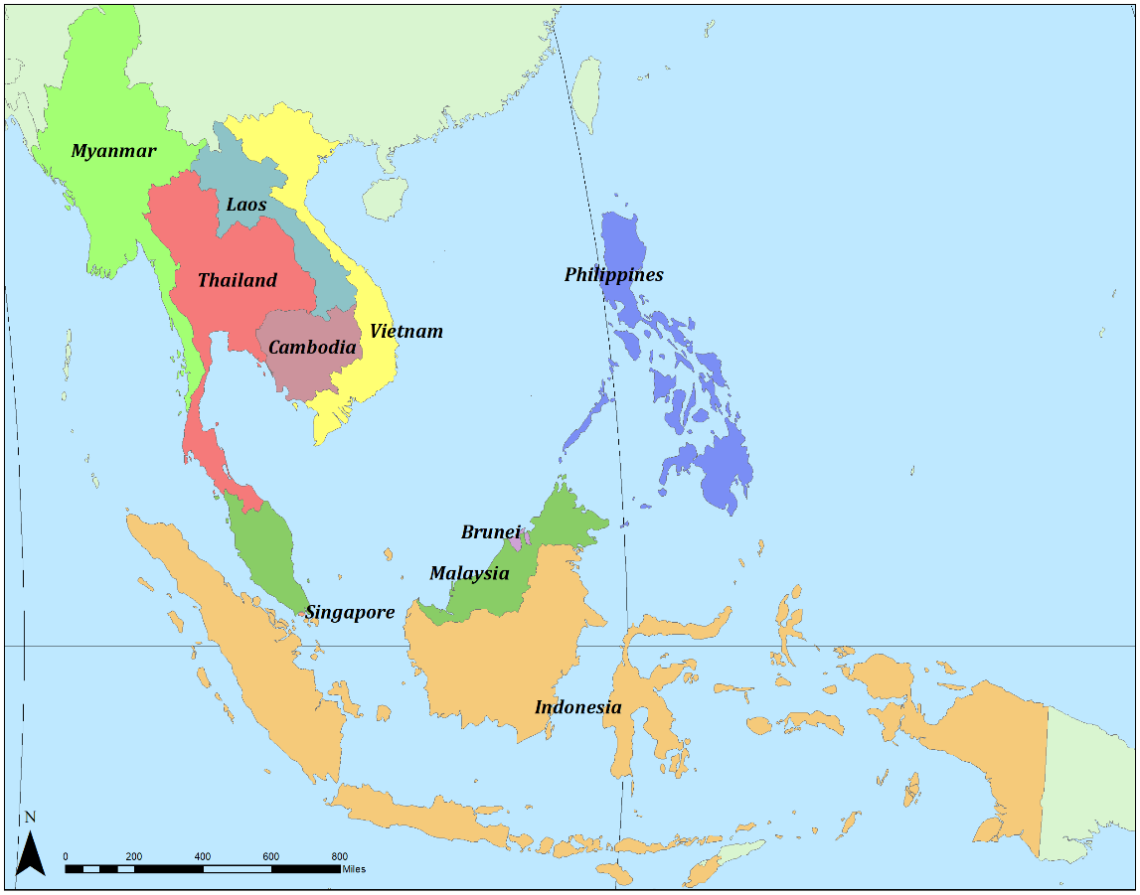
The study examined trade patterns and used a statistical modeling approach—the Rotterdam model—to estimate the sensitivities of price and dairy import expenditures on demand for dairy imports from five SEA countries. A Rotterdam model is a system of equations often used in econometric studies of consumer demand. The trade data were accessed through the Global Trade Atlas (GTA) database. Monthly import data from 2006 to 2016—including volumes, values, and tariff rates—were used for the Philippines, Indonesia, Malaysia, and Singapore. Since Vietnam import data are not published, export data of Vietnam's trading partner countries were used. Annual tariff data from the World Integrated Trade Solution (WITS) database were employed for each country. Unit values (trade values divided by volumes) plus tariffs were used as import price proxies. Sensitivity measurements, known as elasticities, were calculated for prices of dairy products from each supplying country (own-price elasticities), prices of dairy products from competing suppliers (cross-price elasticities), and dairy import expenditures of importing countries (import expenditure elasticities).

Prospects for Growth in U.S. Dairy Exports to Southeast Asia

Introduction

Southeast Asia (Philippines, Indonesia, Malaysia, Vietnam, Thailand, Singapore, Brunei Darussalam, Cambodia, Laos, and Myanmar [see figure 1]) is a region characterized by rapid economic growth, urbanization, and changing food consumption patterns. Most Southeast Asia (SEA) countries produce only small milk quantities. High-production milk cow breeds do not perform very well in hot, humid conditions that exist in much of the SEA region. Many of the SEA countries have a lack of grassland, which also limits milk production capacity. With expectations for strong economic growth but limited potential for milk production growth, SEA countries are a growing market for imported dairy products. In 2018, SEA countries imported dairy products totaling about $6.3 billion (table 1), up 66 percent from 2006 (valued in 2018 constant dollars).

Figure 1
Southeast Asian countries



Source: Environmental Systems Research Institute (ESRI) based map data, 2019.

In 2018, the top six dairy products imported into SEA, by value, were skim milk powder (SMP)[1], whole milk powder (WMP), infant formula, butterfat products (including butter, anhydrous milk fat, butteroil, and some high-fat dairy spreads), cheese, and whey products (including dry whey, modified whey, whey protein concentrate, and milk albumin) (table 1). The major products imported from the United States in 2018 were SMP ($382 million), whey products ($114 million), cheese ($73 million), and lactose ($58 million, included with "other dairy products" in table 1). Cheese was the dairy product most consistently imported by SEA countries from 2006 to 2018; each of the top five SEA importing countries imported cheese from more than one trading partner almost every month. Cheese imports to SEA from the United States were substantially less than each of its major trading partners (New Zealand, the European Union (EU), and Australia) in 2018.

Table 1
Southeast Asia dairy product import values for all trading partners and the United States (millions of constant U.S. 2018 dollars)

	2006		2018	
Product	All trading partners	United States	All trading partners	United States
Skim milk powder	1,074.3	237.3	1,337.4	381.6
Whole milk powder	946.9	17.9	1,018.2	57.3
Infant formula	358.0	0.4	838.2	5.8
Butterfat products	232.6	0.9	798.0	3.0
Cheese	188.8	10.1	642.0	72.5
Whey products	310.1	70.3	504.8	113.5
Other dairy products	708.8	64.1	1,207.2	104.7
Total	3,819.5	401.0	6,345.6	738.3

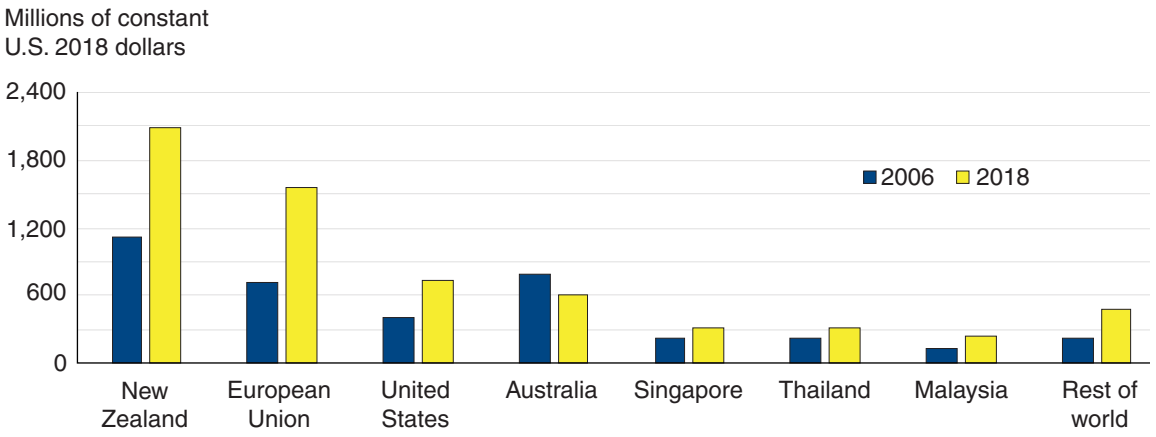
Totals may not add precisely due to rounding.
This table aggregates imports of Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Import data are used for countries that report such data. For countries that do not have import data reported in the Global Trade Atlas, export data of trading partners are used.

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

[1]Export data do not distinguish between two very similar products, nonfat dry milk and skim milk powder. In this report, skim milk powder (SMP) refers collectively to both nonfat dry milk and skim milk powder. Nonfat dry milk is defined by a U.S. Food and Drug Administration Standard of Identity. Skim milk powder is defined by Codex Alimentarius international standards. SMP is often used when talking about the products collectively since SMP has an international standard. The products traded under HS code 040221 (Harmonized System code used by member countries of the World Trade Organization) are identified as "SMP" in this report. For a discussion of domestic and international standards for milk powders, see *Growth of U.S. Dairy Exports* by Cessna, et al., Appendix B, Discussion of Domestic and International Standards for Milk Powders.

The SEA market is a potential growth market for U.S. dairy products, but U.S. products must compete with products from other exporters (figure 2). In 2018, SEA dairy imports from the United States totaled $738 million. This total was well below imports from New Zealand (USD 2.084 billion) and the EU (USD 1.557 billion) but more than dairy imports from Australia (USD 602 million). While SEA dairy imports from New Zealand, the EU, and the United States all grew from 2006 to 2018, dairy imports from Australia fell. The United States rose in rank from fourth to third, while Australia fell from third to fourth. There has also been some dairy trade among countries within the region. Three SEA countries—Singapore, Thailand, and Malaysia—supplied SEA dairy imports totaling USD 882 million in 2018.

Figure 2
Southeast Asia dairy import values by trading partner



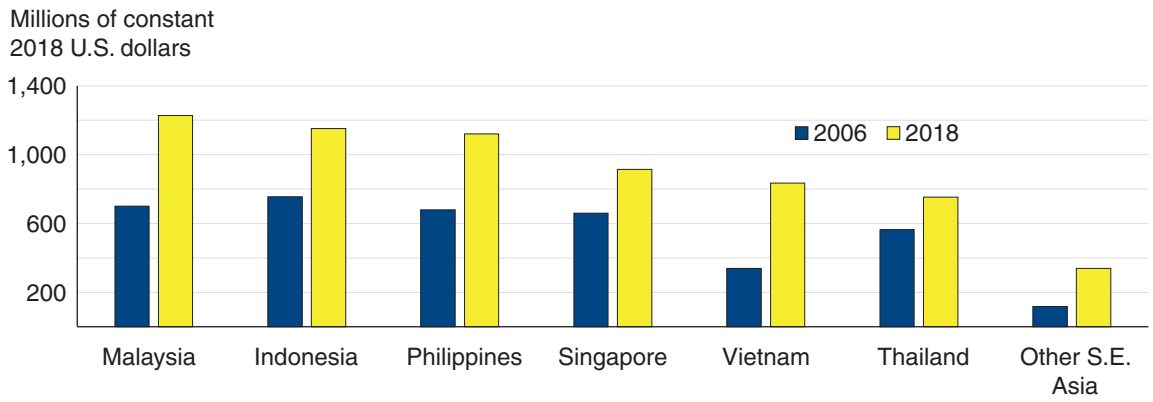
Southeast Asia includes Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Import data are used for countries that report such data. For countries that do not have import data reported in the Global Trade Atlas or Trade Data Monitor, export data of trading partners are used.

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics and USDA, Economic Research Service calculations.

The top SEA importer of dairy products from the world by value in 2018 was Malaysia (figure 3). Malaysia also had the greatest growth of dairy imports, from $702 million in 2006 (valued in constant 2018 U.S. dollars) to $1.229 billion in 2018. The country with the second highest dairy import value in 2018 was Indonesia, with dairy imports valued at $1.152 billion, followed by the Philippines at a close third of $1.121 billion. Vietnam had the greatest percentage increase, more than doubling from $340 million in 2006 (in constant 2018 U.S. dollars) to $836 million in 2018. Indonesia, the Philippines, Singapore, and Thailand also had substantial growth of dairy imports.

The Philippines was the largest SEA importer of U.S. dairy products in 2018 by value and had the largest growth between 2006 and 2018 (figure 4). Indonesia, Vietnam, Malaysia, and Singapore all increased imports of U.S. dairy products between 2006 and 2018. Of the top six SEA dairy importing countries, Thailand was the only country for which U.S. dairy imports (valued in 2018 constant dollars) declined over the period.

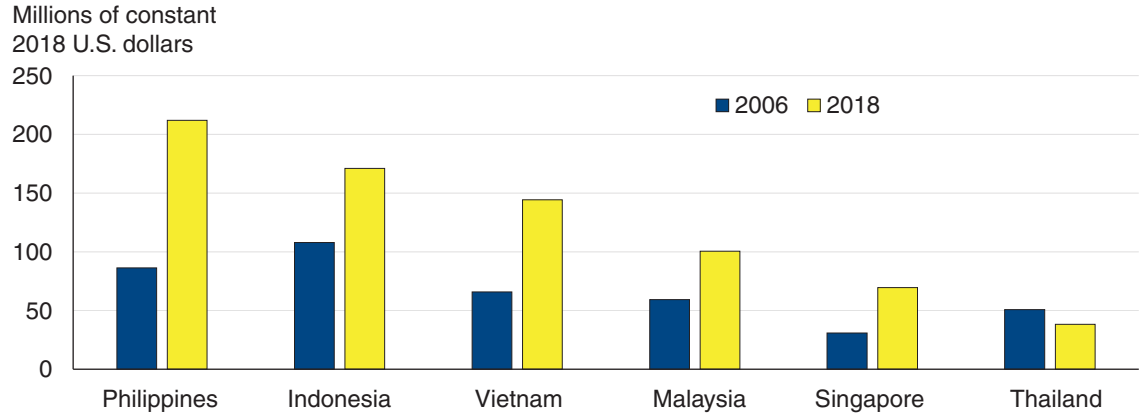
Figure 3
Total dairy imports for Southeast Asia countries



Import data are used for Indonesia, Philippines, Malaysia, Singapore, and Thailand. For Vietnam and some other Southeast Asia countries, export data from trading partners are used because import data are not reported in the Global Trade Atlas or Trade Data Monitor. Other Southeast Asia countries include Brunei Darussalam, Cambodia, Laos, and Myanmar.

Sources: Global Trade Atlas, Trade Data Monitor, and USDA, Economic Research Service calculations.

Figure 4
Dairy imports from the United States for top six Southeast Asia dairy importing countries



Import data are used for all countries except Vietnam. Since Vietnam import data are not reported in Global Trade Atlas or Trade Data Monitor, export data for partner countries are used.

Sources: Global Trade Atlas, Trade Data Monitor, and USDA, Economic Research Service calculations.

Rising incomes and population growth in SEA contributed to the growth of dairy product consumption. Real gross domestic product (GDP) in SEA grew by 81.1 percent from 2006 to 2018, the population grew by 14.3 percent, and real per capita GDP grew by 58.5 percent (table 2).

As GDP has grown throughout the region, SEA countries have been following a dietary transition common throughout Asia: Per capita consumption of meat and dairy products tends to rise while consumption of staple foods like rice and coarse grains falls (Pingali, 2007).

Table 2
Selected macroeconomic data for Southeast Asia

Country	Real GDP, billions of constant 2010 U.S. dollars			Population in millions			Real per capita GDP, constant 2010 U.S. dollars		
	2006	2018	Percent increase	2006	2018	Percent increase	2006	2018	Percent increase
Indonesia	603	1,147	90.3	232.2	262.8	13.2	2,595	4,364	68.2
Thailand	298	442	48.3	65.5	68.6	4.8	4,550	6,437	41.5
Malaysia	216	382	76.7	26.4	31.8	20.3	8,183	12,013	46.8
Singapore	188	328	74.4	4.7	6.0	27.2	39,952	54,777	37.1
Philippines	165	322	95.2	86.7	105.9	22.2	1,905	3,044	59.8
Vietnam	91	188	105.6	85.5	97.0	13.5	1,068	1,934	81.0
Other S.E. Asia[1]	61	130	112.5	69.56	79.76	14.7	880	1,631	85.3
Southeast Asia	1,623	2,939	81.1	570.5	651.9	14.3	2,844	4,509	58.5

[1]Other Southeast Asia countries include Brunei Darussalam, Cambodia, Laos, and Myanmar.

Source: World Bank and U.S. Department of Commerce, Bureau of the Census.

Indonesia had the highest population of the region by far (262.8 million) in 2018. The Philippines population size was a distant second (105.9 million), followed by Vietnam (97.0 million), Thailand (68.6 million), and Malaysia (31.8 million). Singapore's population was much smaller (6.0 million).

There is wide diversity in incomes across the SEA region. Singapore, with real GDP per capita among the highest in the world at $54,777 in 2018 (valued in 2010 constant dollars), has been in dietary transition to greater consumption of milk products for decades. The transition is in very early stages in countries in the region with low incomes—such as Myanmar, Cambodia, and Laos—all with GDP per capita of less than $1,000 in 2018. The rest of the countries—Indonesia, Thailand, the Philippines, Malaysia and Vietnam—are in the middle of the dietary transition. These differences influence the rate of growth and the mix of dairy products consumed in each country.

None of the SEA countries produce large quantities of milk. Most countries have tropical climates that limit milk yield per cow, and some countries have little land suitable for dairy farming. Most milk produced in the region is used for domestic fluid beverage milk needs. Thailand was the largest SEA milk producer in 2018, with dairy farms producing 2.7 billion pounds of milk (solid-corrected milk, or SCM [2]) (table 3). Thai government support for the dairy sector contributed to its growth over the last 20 years (Chungsiriwat and Panapol, 2010). Indonesia was the second largest milk producer, producing 2.0 billion pounds, followed by Vietnam, which produced 1.9 billion pounds. With intervention by the Vietnamese Government through a National Dairy Development Plan (NDDP), Vietnam had the greatest increase in milk production from 2005 to 2018, an increase of 1.5 billion pounds.[3] The NDDP focused largely on a breeding strategy of developing Holstein-Friesian cross-bred cattle (Phong, 2010).

[2]SCM = solid corrected milk. The SCM calculation adjusts for milk components to allow milk production estimates comparable from one country to another. The International Farm Comparison Network computation for milk production data presented in table 3 adjusts milk production to 4 percent milk fat and 3.3 percent protein using the following formula: SCM = (milk production X (fat percent + true protein percent) / 7.3).

[3]For table 3, 2005 milk production data are displayed in contrast to other tables that show data from 2006. Comparable milk production data for 2006 are not readily available.

Table 3
Milk production and per capita milk production in selected Southeast Asia countries

Country	2005		2018	
	Milk production (mil. pounds, SCM)	Per capita milk production (pounds)	Milk production (mil. pounds, SCM)	Per capita milk production (pounds)
Thailand	1,874	28.8	2,668	38.9
Vietnam	419	5.0	1,962	20.2
Indonesia	1,124	4.9	1,896	7.2
Malaysia	44	1.7	88	2.8
Philippines[1]	22	0.3	44	0.4

SCM = solid-corrected milk, assuming 4 percent milk fat and 3.3 percent true protein.
SCM = (milk production X (fat percent + true protein percent) / 7.3

[1]International Farm Comparison Network indicates that milk production for the Philippines includes that of cows and buffalos. Only milk production of cows is indicated for the other countries in this table.

Sources: International Farm Comparison Network, U.S. Census Bureau; USDA, Economic Research Service calculations.

Thailand had the highest milk production per capita in 2018, at 38.9 pounds of milk (SCM) per person. For all the countries, milk production per capita has been increasing, with the greatest per-capita increase for Vietnam (from 5.0 pounds in 2005 to 20.2 pounds in 2018). However, for all the SEA countries, milk production per capita has been relatively low. As a frame of reference, the United States had milk production per capita of 642.2 pounds of milk (SCM) in 2018.

Countries with relatively low milk production per capita are more likely to have greater import needs as incomes rise. Taking population, income, and milk production into account helps us gain an understanding of the differences in dairy import values among the SEA countries. For example, although Indonesia had more than eight times the population of Malaysia in 2018 (table 2), Malaysia had the highest dairy imports (figure 3). Malaysia's milk production is very small for its population size, only 2.8 pounds per person compared to Indonesia's 7.2 pounds per person. Dairy imports for the Philippines were almost as high as those for Indonesia. Per capita milk production for the Philippines is extremely small at 0.4 pounds per person. It is interesting that Singapore, with a population of only 6.0 million in 2018, had higher dairy imports by value than Vietnam, with a population of 97.0 million. Singapore's high income and lack of milk production have undoubtedly been important reasons for the relatively high dairy import value for such a small country.

A Look at SEA Dairy Imports by Product, Trading Partner, and Over Time

Table 4 provides for an examination of SEA dairy import values along three dimensions: by product, trading partner, and over time (showing data for 2006 and 2018). Trading partners for the region are listed in order from top to bottom by import value for 2018, and dairy products are listed from left to right in order by import value.

New Zealand was the top supplier of WMP, butterfat products, cheese, and casein products in 2018. The EU was the top supplier of SMP and whey products. The United States was the top supplier of lactose. Singapore was the top supplier of infant formula to the region. Singapore has virtually no milk production; dairy products supplied by Singapore are manufactured from dairy ingredients supplied by other countries. Imports of dairy products such as ice cream, evaporated milk, and yogurt were largely supplied by countries within the SEA region (Thailand and Malaysia) since these products are bulky (with high water content) and perishable, making them expensive and difficult to transport long distances.

The United States was the second highest supplier of SMP and whey products to SEA in 2018. Of the total SEA dairy imports from the United States of $738.3 million in 2018, SMP accounted for most of the value (51.7 percent). Whey products, cheese, and lactose accounted for 15.4 percent, 9.8 percent, and 7.9 percent of total SEA imports from the United States, respectively.

SEA imports of dairy products grew from $3.820 billion in 2006 (valued in constant 2018 dollars) to $6.346 billion in 2018, an increase of 66.2 percent. U.S. market share increased from 10.5 percent to 11.6 percent over that period. Market shares for New Zealand and the EU also increased, but the market share for Australia declined.

Table 4

Southeast Asia dairy product import values by trading partner and product (millions of constant U.S. 2018 dollars)

2018															
Trading partner	Skim milk powder	Whole milk powder	Infant formula	Butterfat products	Cheese	Whey products	Fluid milk and cream	Ice cream	Evap. and cond. milk	Lactose	Yogurt	Casein products	Other dairy products	Value per partner	Percent per partner
New Zealand	304.3	761.1	29.1	538.3	221.4	20.6	81.9	2.1	1.5	8.5	0.7	35.3	79.6	2,084.3	32.8
European Union	431.2	104.5	166.8	153.0	153.7	288.6	76.1	22.6	21.7	36.5	13.5	8.0	81.0	1,557.2	24.5
United States	381.6	57.3	5.8	3.0	72.5	113.5	6.2	16.8	4.4	58.3	1.1	0.1	17.7	738.3	11.6
Australia	171.5	44.6	20.5	58.0	144.8	32.7	82.6	2.9	8.4	4.0	22.8	0.1	9.1	601.9	9.5
Singapore	1.7	6.1	292.8	0.5	5.9	0.4	5.0	0.8	1.9	0.1	0.5	0.1	2.4	318.1	5.0
Thailand	2.6	8.0	84.5	2.2	3.3	3.2	93.4	62.2	12.5	0.6	34.6	0.0	6.8	313.8	4.9
Malaysia	10.3	16.7	82.1	9.6	1.4	1.3	2.2	17.6	87.4	0.1	4.6	0.0	17.1	250.4	3.9
Rest of world	34.3	20.0	156.6	33.6	38.8	44.5	15.9	91.6	16.3	7.1	10.1	6.2	6.5	481.5	7.6
Value per product	1,337.4	1,018.2	838.2	798.0	642.0	504.8	363.3	216.5	154.2	115.1	87.9	49.9	220.2	6,345.6	100.0
Percent per product	21.1	16.0	13.2	12.6	10.1	8.0	5.7	3.4	2.4	1.8	1.4	0.8	3.5	100.0	

2006															
Trading partner	Skim milk powder	Whole milk powder	Infant formula	Butterfat products	Cheese	Whey products	Fluid milk and cream	Ice cream	Evap. and cond. milk	Lactose	Yogurt	Casein products	Other dairy products	Value per partner	Percent per partner
New Zealand	420.0	365.7	17.4	108.3	60.4	13.1	19.6	1.1	3.7	11.4	0.5	25.9	74.7	1,121.8	29.4
European Union	103.0	118.1	139.9	54.4	33.6	142.2	12.2	9.0	2.2	19.3	2.3	47.5	39.5	723.0	18.9
United States	237.3	17.9	0.4	0.9	10.1	70.3	2.7	3.2	5.8	41.1	0.5	0.4	10.4	401.0	10.5
Australia	275.5	200.8	26.3	57.3	73.6	67.2	28.7	2.8	16.1	5.3	5.4	5.7	29.7	794.5	20.8
Singapore	7.3	66.4	99.8	4.2	2.8	3.0	3.1	0.7	24.0	0.4	0.3	0.6	3.9	216.6	5.7
Thailand	1.9	21.8	24.6	0.4	0.2	6.4	33.4	22.2	84.9	0.2	9.9	0.2	9.6	215.7	5.6
Malaysia	4.9	51.3	36.9	1.7	0.6	0.6	1.4	11.1	10.6	0.1	4.6	0.5	1.5	125.7	3.3
Rest of world	24.4	104.9	12.6	5.4	7.7	7.3	16.4	16.2	8.9	2.8	3.7	8.2	2.6	221.1	5.8
Value per product	1,074.3	946.9	358.0	232.6	188.8	310.1	117.7	66.4	156.2	80.6	27.0	88.9	171.9	3,819.5	100.0
Percent per product	28.1	24.8	9.4	6.1	4.9	8.1	3.1	1.7	4.1	2.1	0.7	2.3	4.5	100.0	

Notes: Evap.=Evaporated milk. Cond.=Condensed milk. Totals may not add precisely due to rounding.

This table aggregates imports of Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Import data are used for countries that report such data. For countries that do not have import data reported in the Global Trade Atlas, export data of trading partners are used.

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

A Closer Look at SEA Dairy Imports by Country

Tables 5 through 10 provide data for each of the top six SEA dairy importing countries by product, by trading partner, and by changes over time. The tables are listed in order of rank by import value from the United States in 2018 (the Philippines, Indonesia, Vietnam, Malaysia, Singapore, and Thailand), and imports from the United States are emphasized in this brief discussion.

Of the top six SEA dairy importing countries in 2018, dairy import values from the United States ranged from $212.0 million for the Philippines (18.9 percent of the Philippines total dairy imports) to $38.1 million for Thailand (5.1 percent of Thailand's total dairy imports). For the Philippines, Indonesia, and Singapore, the U.S. market-share percentage increased from 2006 to 2018. However, for Vietnam, Malaysia, and Thailand, the U.S. market-share percentage declined.

For the Philippines, Indonesia, and Malaysia, SMP was the top dairy product imported by value in 2018; infant formula was at the top for Vietnam; and whole milk powder was at the top for Singapore and Thailand. Considering only dairy imports from the United States, SMP was the top dairy product imported by value for the Philippines, Indonesia, Vietnam, Malaysia, and Thailand. For Singapore, lactose was the top dairy product by value imported from the United States, totaling $14.2 million in 2018 (included in table 9 as part of "other dairy products").

Table 5
Philippines dairy product import values by trading partner and product (millions of constant U.S. 2018 dollars)

2018								
Trading Partner	Skim milk powder	Butterfat products	Cheese	Infant formula	Evap. and cond. milk	Other dairy products	Value per partner	Percent per partner
New Zealand	50.0	165.2	56.7	0.2	0.0	104.3	376.4	33.6
European Union	73.5	7.2	20.2	27.8	1.1	89.9	219.6	19.6
United States	136.9	0.0	23.7	0.0	0.1	51.3	212.0	18.9
Singapore	0.8	0.0	0.0	82.7	0.9	5.3	89.7	8.0
Rest of world	1.4	0.1	0.0	8.1	56.1	65.1	223.2	19.9
Value per product	286.1	186.4	135.2	126.3	71.2	315.9	1121.0	100.0
Percent per product	25.5	16.6	12.1	11.3	6.3	28.2	100.0	
2006								
Trading Partner	Skim milk powder	Butterfat products	Cheese	Infant formula	Evap. and cond. milk	Other dairy products	Value per partner	Percent per partner
New Zealand	103.4	13.6	22.8	5.7	0.1	118.5	264.2	38.9
European Union	3.6	0.8	2.5	51.9	0.1	45.7	104.6	15.4
United States	58.4	0.2	1.8	0.1	0.1	25.7	86.2	12.7
Singapore	1.0	1.0	0.4	29.6	0.6	7.1	39.6	5.8
Rest of world	69.5	6.8	10.2	10.3	20.2	68.1	185.2	27.2
Value per product	235.9	22.4	37.8	97.5	21.1	265.0	679.7	100.0
Percent per product	34.7	3.3	5.6	14.4	3.1	39.0	100.0	

Sources: Global Trade Atlas, U.S. Bureau of Labor Statistics, Trade Data Monitor, and USDA, Economic Research Service calculations.

Table 6

Indonesia dairy product import values by trading partner and product (millions of constant U.S. 2018 dollars)

2018								
Trading Partner	Skim milk powder	Whole milk powder	Whey products	Butterfat products	Cheese	Other dairy products	Value per partner	Percent per partner
New Zealand	41.5	144.4	1.9	96.8	69.8	24.0	378.4	32.8
European Union	96.2	21.5	108.6	46.4	18.8	49.4	340.8	29.6
United States	104.6	5.6	21.5	0.0	21.8	17.4	170.9	14.8
Australia	72.4	0.8	16.9	3.1	20.4	7.0	120.6	10.5
Rest of world	8.1	0.1	12.4	5.3	5.9	109.9	141.7	12.3
Value per product	322.8	172.4	161.2	151.6	136.7	207.7	1152.3	100.0
Percent per product	28.0	15.0	14.0	13.2	11.9	18.0	100.0	
2006								
Trading Partner	Skim milk powder	Whole milk powder	Whey products	Butterfat products	Cheese	Other dairy products	Value per partner	Percent per partner
New Zealand	77.6	46.1	3.3	13.4	9.1	30.7	180.1	23.8
European Union	26.5	12.4	37.9	11.1	2.0	34.3	124.3	16.4
United States	78.4	9.1	9.7	0.0	4.1	6.4	107.8	14.3
Australia	39.0	66.5	26.5	6.3	22.3	10.7	171.4	22.7
Rest of world	12.0	129.0	1.1	0.6	0.7	28.7	172.2	22.8
Value per product	233.4	263.2	78.6	31.3	38.3	110.9	755.7	100.0
Percent per product	30.9	34.8	10.4	4.1	5.1	14.7	100.0	

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

Table 7
Vietnam, trading-partner value of dairy products exported (millions of constant U.S. 2018 dollars)

2018								
Trading Partner	Infant formula	Skim milk powder	Whole milk powder	Butterfat products	Whey products	Other dairy products	Value per partner	Percent per partner
New Zealand	1.5	23.5	121.1	84.7	0.0	29.8	260.6	31.2
European Union	37.0	68.2	5.0	8.5	18.1	42.7	179.6	21.5
United States	2.2	67.2	30.6	0.0	21.9	22.4	144.4	17.3
Singapore	72.7	0.3	0.3	0.0	0.0	1.6	74.9	9.0
Rest of world	84.4	15.6	6.5	5.1	6.6	58.1	176.3	21.1
Value per product	197.8	174.9	163.5	98.3	46.6	154.6	835.7	100.0
Percent per product	23.7	20.9	19.6	11.8	5.6	18.5	100.0	
2006								
Trading Partner	Infant formula	Skim milk powder	Whole milk powder	Butterfat products	Whey products	Other dairy products	Value per partner	Percent per partner
New Zealand	0.0	22.8	68.9	20.6	0.4	4.4	117.1	34.4
European Union	27.5	23.7	2.1	3.6	11.7	11.2	79.8	23.5
United States	0.0	42.3	0.4	0.0	8.8	14.5	65.9	19.4
Singapore	0.1	0.9	7.8	1.4	0.5	0.5	11.1	3.3
Rest of world	13.5	16.8	20.9	5.0	2.7	7.3	66.3	19.5
Value per product	41.1	106.5	100.1	30.7	24.0	37.8	340.1	100.0
Percent per product	12.1	31.3	29.4	9.0	7.1	11.1	100.0	

Sources: Global Trade Atlas, U.S. Bureau of Labor Statistics, Trade Data Monitor, and USDA, Economic Research Service calculations.

Table 8

Malaysia dairy product import values by trading partner and product (millions of constant U.S. 2018 dollars)

2018								
Trading Partner	Skim milk powder	Infant formula	Whole milk powder	Butterfat products	Cheese	Other dairy products	Value per partner	Percent per partner
New Zealand	89.7	14.0	183.0	93.0	39.0	48.3	467.1	38.0
European Union	79.4	70.1	5.8	14.8	27.3	104.9	302.4	24.6
Australia	22.5	5.5	9.8	16.5	39.1	31.7	125.1	10.2
United States	58.5	1.2	2.4	0.4	11.7	26.3	100.5	8.2
Rest of world	11.5	160.2	1.3	2.6	7.1	51.0	233.6	19.0
Value per product	261.6	251.1	202.3	127.3	124.3	262.3	1,228.7	100.0
Percent per product	21.3	20.4	16.5	10.4	10.1	21.3	100.0	
2006								
Trading Partner	Skim milk powder	Infant formula	Whole milk powder	Butterfat products	Cheese	Other dairy products	Value per partner	Percent per partner
New Zealand	82.8	9.8	75.2	16.8	11.6	23.0	219.3	31.2
European Union	8.7	28.6	36.8	4.4	2.7	41.9	123.1	17.5
Australia	37.0	7.8	49.6	12.7	15.1	28.0	150.2	21.4
United States	31.9	0.0	2.7	0.1	1.7	22.9	59.4	8.5
Rest of world	2.0	54.8	8.3	0.5	1.4	82.7	149.7	21.3
Value per product	162.4	101.1	172.6	34.5	32.5	198.6	701.7	100.0
Percent per product	23.1	14.4	24.6	4.9	4.6	28.3	100.0	

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

Table 9

Singapore dairy product import values by trading partner and product (millions of constant 2018 U.S. dollars)

2018								
Trading Partner	Whole milk powder	Skim milk powder	Butterfat products	Fluid milk and cream	Cheese	Other dairy products	Value per partner	Percent per partner
European Union	47.2	60.5	59.2	23.4	33.6	60.0	283.9	31.1
New Zealand	115.3	43.5	48.2	5.7	14.4	29.7	256.8	28.1
Australia	10.3	22.1	13.8	36.1	29.9	26.5	138.8	15.2
United States	12.8	6.5	2.2	1.6	6.8	39.6	69.4	7.6
Rest of world	10.7	7.9	13.0	52.3	10.3	71.1	165.2	18.1
Value per product	196.3	140.4	136.4	119.3	95.0	226.8	914.1	100.0
Percent per product	21.5	15.4	14.9	13.0	10.4	24.8	100.0	0.0
2006								
Trading Partner	Whole milk powder	Skim milk powder	Butterfat products	Fluid milk and cream	Cheese	Other dairy products	Value per partner	Percent per partner
European Union	48.3	6.6	31.8	4.9	15.3	35.7	142.7	21.6
New Zealand	46.9	65.1	22.0	2.6	9.2	18.3	164.3	24.9
Australia	49.3	60.9	17.8	13.4	19.6	33.9	194.9	29.5
United States	1.7	9.7	0.4	1.5	2.1	15.4	30.9	4.7
Rest of world	44.0	3.0	2.8	20.4	4.1	52.6	126.9	19.2
Value per product	190.2	145.3	74.9	42.8	50.4	156.0	659.6	100.0
Percent per product	28.8	22.0	11.4	6.5	7.6	23.6	100.0	

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

Table 10

Thailand dairy product import values by trading partner and product (millions of constant 2018 U.S. dollars)

2018								
Trading Partner	Whole milk powder	Skim milk powder	Cheese	Butterfat products	Infant formula	Other dairy products	Value per partner	Percent per partner
New Zealand	144.2	49.6	26.4	43.6	12.5	32.7	309.0	41.0
European Union	12.8	48.9	28.3	14.9	3.1	82.7	190.7	25.3
Australia	20.2	26.9	21.5	20.7	0.0	10.6	100.1	13.3
Singapore	0.0	0.0	0.0	0.0	44.8	0.1	44.9	6.0
United States	0.0	7.9	6.5	0.2	0.1	23.4	38.1	5.1
Rest of world	5.1	3.0	6.9	3.6	17.8	34.8	71.1	9.4
Value per product	182.3	136.4	89.6	83.0	78.3	184.2	753.9	100.0
Percent per product	24.2	18.1	11.9	11.0	10.4	24.4	100.0	
2006								
Trading Partner	Whole milk powder	Skim milk powder	Cheese	Butterfat products	Infant formula	Other dairy products	Value per partner	Percent per partner
New Zealand	55.1	68.0	6.1	20.4	0.0	22.8	172.4	30.5
European Union	12.8	33.8	4.0	2.5	13.8	75.6	142.4	25.2
Australia	19.2	60.4	5.7	11.4	15.4	16.2	128.3	22.7
Singapore	0.1	0.0	0.1	0.2	35.6	0.3	36.2	6.4
United States	0.0	16.7	0.2	0.2	0.1	33.4	50.6	9.0
Rest of world	3.8	5.7	2.3	0.3	15.8	6.8	34.8	6.2
Value per product	91.0	184.7	18.5	34.9	80.7	155.0	564.7	100.0
Percent per product	16.1	32.7	3.3	6.2	14.3	27.5	100.0	

Sources: Global Trade Atlas, Trade Data Monitor, U.S. Bureau of Labor Statistics, and USDA, Economic Research Service calculations.

Elasticity Definitions

To fully comprehend the objectives and results of this study, it is necessary to understand some elasticity definitions.

Elasticity is a measure of a variable's sensitivity to a change in another variable. It can be quantified as the ratio of the percentage (%) change (Δ) in one variable (X) to the percentage change in another variable (Y), when the latter variable has a causal influence on the former.

$$\text{Elasticity} = \%\Delta X / \%\Delta Y$$

If the absolute value of the ratio is less than 1, changes in variable X are relatively insensitive to changes in Y, and the relationship is said to be relatively **inelastic**. If the absolute value of the ratio is greater than 1, changes in variable X are relatively sensitive to changes in variable Y, and the relationship is said to be relatively **elastic**.

Own-price elasticity, as used in this study, is an importing country's percentage (%) change (Δ) in import quantity demanded from a particular exporting trading partner (Q_x) corresponding to a 1-percent change in that exporting country's export price (P_x), all other things being equal.

$$\text{Own-Price Elasticity} = \%\Delta(Q_x) / \%\Delta(P_x)$$

Thus, a negative sign for own-price elasticity is consistent with demand theory: Holding all things constant, as the price of a dairy product rises, the quantity demanded will decline. If a trading partner's own-price elasticity is negative and elastic (absolute value greater than 1), a decline in price would cause market value to go up because the increase in imports would be more than enough to offset the decrease in price. Conversely, if the own-price elasticity is negative and inelastic (absolute value less than 1), a decrease in price would result in lower import value because the increase in imports would not be large enough to offset the price decline.

Cross-price elasticity, as used in this study, is an importing country's percentage (%) change (Δ) in import quantity demanded from a particular exporting trading partner (Q_x) corresponding to a 1-percent change in the export price of *another* exporting trading partner (P_y), all other things being equal.

$$\text{Cross-Price Elasticity} = \%\Delta(Q_x) / \%\Delta(P_y)$$

A positive cross-price elasticity indicates that the same product imported from the two exporting trading partners are substitutes.[4] If the absolute value of the cross-price elasticity is greater than 1, then there is a strong response to a price change from the competing exporter, while if the absolute value of the cross-price elasticity is less than 1, then there is a weak response to a price change from a competing exporter.

[4]A negative cross price elasticity would indicate the same product imported from the two countries are complements. This would be unlikely.

In the context of this study, the **expenditure elasticity** is the percentage (%) change (Δ) in an importer's quantity demanded for a good from a particular trading partner (Q_x) divided by the percentage (%) change (Δ) in total import expenditures of the importing country (E_i) for the particular good from all trading partners—holding all other things constant.

$$\text{Expenditure Elasticity} = \%\Delta(Q_x) / \%\Delta(E_i)$$

An expenditure elasticity is usually positive, meaning that imports from the exporter increase as total import expenditures for the good increase. An expenditure elasticity greater than 1 indicates that imports of a product from a trading partner rise at a faster rate than the growth in the importing country's total imports of that product, while an expenditure elasticity between 0 and 1 indicates a slower rate of growth. If the expenditure elasticity is negative, imports of a good from the particular trading partner decrease as total imports for the good increase. In this case, the exporter's good is considered inferior compared to the same type of good imported from other countries.

Objectives of Empirical Analysis

This study uses demand analysis techniques in order to understand the trends and price sensitivity of U.S. market share for key SEA dairy imports. The analysis provides insights regarding the U.S. competitive position as a dairy supplier in SEA and the U.S. price-competitiveness with other major dairy suppliers such as Australia, New Zealand, and the EU by estimating own-price, cross-price, and expenditure elasticities of demand for key dairy product imports by five SEA countries. The price elasticities take tariffs into account. Thus, the elasticities could be useful for studying the effects of changes in prices due to market forces as well as trade policies. The expenditure elasticities could help inform dairy industry stakeholders on how market shares for the United States and its competitors are likely to change as SEA importers increase import expenditures for each type of dairy product.

Rotterdam Model for Import Demand

This study uses the Rotterdam model, a system of equations developed by Barten (1964) and Theil (1965) for use in econometric studies of consumer demand. The Rotterdam model has a strong theoretical foundation and can be estimated using a system of linear equations. The model is commonly used to estimate household price and expenditure elasticities of demand for food products (Seale et al., 1992; Muhammad et al., 2014; Davis et al., 2018). This study uses the Rotterdam model to analyze (1) the sensitivity of importing countries to changing prices of dairy products from various exporting countries and (2) expected changes in imports from each country associated with changes in the importing country's import expenditures for the product being analyzed.

Rotterdam Model Structure

The Rotterdam model for dairy imports can be defined as follows:

$$\overline{w}_{it} Dq_{it} = \theta_i DQ_t + \sum_{j=1}^{n} \pi_{ij} Dp_{jt} + \varepsilon_{it}$$

where $\overline{w}_{it}$ is the share of the import value for a particular dairy product from country i in time t. D is the log difference operator for any variable v such that $Dv_t = \log(v_t) - \log(v_{t-1})$. q_{it} is the quantity of dairy products from country i, time period t, and p_{jt} is the price of dairy products in country j for time period t. θ_i is the marginal share of the ith country, which is the additional amount spent on dairy imports from country i when total dairy imports increase by one dollar. DQ_t is a finite-change version of the Divisia volume index, where $DQ_t = \sum_{j=1}^{n} \overline{w}_{it} Dq_{it} \cdot \pi_{ij}$ = the (i,j)th Slutsky coefficient of the Rotterdam model. Homogeneity, symmetry, and adding up conditions are imposed on all SEA dairy models and can be tested in a straightforward matter (Seal, et al., 1992). Demands are homogenous if $\sum_{j=1}^{n} \pi_{ij} = 0$. Adding up conditions are satisfied when $\sum_{i=1}^{n} \pi_{ij} = 0$ and $\sum_{i=1}^{n} \theta_i = 1$. Demand is symmetric if $\pi_{ij} = \pi_{ji}$. Also, compensated demands should be negative semidefinite, which they will be if the matrix of $[\pi_{ij}]$ is negative semidefinite. Compensated demand elasticities for importing countries are $\frac{\%\Delta q_{it}}{\%\Delta p_j} = \pi_{ij} / \overline{w}_j$. The expenditure elasticities are $\frac{\%\Delta q_{it}}{\%\Delta Exp} = \theta_i / \overline{w}_i$ where Exp is the total import expenditure for country i for the particular product being analyzed. In the analyses presented in this study, the compensated demand elasticities are derived for imports of each dairy product by country, showing the relationships between the prices of dairy products and the quantities purchased on the assumption that utility is held constant. The number of estimated demand equations for each model is one less than the number of trading partner countries to avoid singularity (Attfield, 1985). Barten (1969) proved that the system's estimates are independent of the equation excluded from the model. This study used the Time-Series Processor (TSP) software to estimate the demand systems.

The empirical analyses included the top five SEA dairy-importing countries: Indonesia, Malaysia, the Philippines, Singapore, and Vietnam. Monthly observations from 2006 to 2016 are analyzed. Thailand is excluded from the empirical analysis because of the complications of its tariff rate quota (TRQ)[5] system; with the data available, in-quota imports cannot be readily disaggregated from over-

[5]A TRQ is a two-tiered tariff (tax) where a lower (in-quota) tariff is charged on imports within a quota volume, while a higher (over-quota) tariff is charged on imports in excess of the quota volume.

quota imports. Dairy products included in the empirical analyses include cheese, whey products, SMP, and lactose. These are products for which the United States has been a consistent supplier to the region, representing 89 percent and 92 percent of the value of U.S. dairy exports to SEA in 2006 and 2016, respectively.

To provide a valid Rotterdam model analysis for imports of a particular dairy product for a particular importing country, there must be at least three trading partners with consistent imports (no zero values) over the time period. A Rotterdam model will not provide proper results if there are zero import values for any month. While a quantity of zero can be determined, a unit value (proxy for price) is undefined. In cases where there were only a few instances of zero imports of a particular dairy product for a trading partner for an importing country, the average import value, import unit value, and import quantity for the time period was substituted. This allows for the data to be used and minimizes statistical bias. The model with the most occurrences of zero imports from a particular country where this approach was taken was for Vietnam's imports of cheese. For the 132-month period, there were 9 months of zero imports from Australia. There were no consecutive months of zero imports in this case.

In cases where there were more than a few cases of zero imports in a particular month, the trading partner's data was included in an aggregate rest of world (ROW) total. Although each of the trading partners within ROW is not a consistent partner, ROW is treated as a trading partner if there are consistent imports from ROW over the period. Data from the ROW countries are aggregated to compute import values, quantities, and weighted-average unit values (including tariffs) for ROW.

The number of consistent trading partners (with few or no months of zero imports) varies among the various importer-product combinations. For example, Singapore had consistent monthly imports of cheese from the EU, New Zealand, Australia, the United States, Switzerland, Japan, and ROW from 2006 to 2016. In this case, all of these trading partners are included in the Rotterdam model. By contrast, the EU, the United States, and ROW were the only consistent suppliers of lactose to the Philippines. For the Rotterdam model, New Zealand and Australia cannot be included since they were several months when they did not supply lactose to the Philippines.

Altogether, 19 Rotterdam models are estimated for this analysis. For cheese, models are estimated for all five countries. For whey products, models are estimated for three countries: Malaysia, Singapore, and the Philippines. Data were too inconsistent to provide models for whey product imports of Indonesia and Vietnam. For SMP, models are estimated for all five countries. For lactose, models are estimated for four countries (the exception being Singapore, which had only consistent imports from the United States). A butterfat product model was estimated for Indonesia, and a whole milk powder model was estimated for Singapore; since the United States has not been a consistent supplier of either product, those models are discussed only in the appendix.

Brief Discussion on Dairy Tariffs of SEA Countries

Tariffs can affect the competitiveness of U.S. dairy products. As members of the World Trade Organization (WTO), each SEA country assesses most favored nation (MFN) tariffs on U.S. dairy products. MFN tariffs are rates that WTO members promise to charge other WTO members unless a preferential trade agreement exists between the countries.[6] As illustrated in table 11, for the 5 countries included in the empirical analyses, MFN tariffs for dairy products range from zero for Singapore—which has no tariffs for any of its WTO trading partners—to 10 percent for some whey products imported by Vietnam. On May 25, 2020, Vietnam's Prime Minister announced that MFN tariffs on dairy products would be reduced by 50 percent or more, effective July 10, 2020. Thailand, which is not included in the empirical analyses, has some very high MFN tariffs, including a 216-percent rate for products imported outside its TRQ for SMP. The Thailand Government sometimes changes its tariffs based upon changing needs and market conditions.

All the SEA countries considered in this report are members of the Association of Southeast Asian Nations (ASEAN) which has formed an ASEAN Free Trade Area (AFTA), giving preferential treatment for trade among countries in the region. Many ASEAN countries assess no tariffs on dairy products from other AFTA members, while others charge tariffs that are well below MFN tariffs charged by those countries.

ASEAN countries have also signed several FTAs with countries outside the region. The ASEAN-Australia-New Zealand FTA (AANZFTA), with two major dairy-exporting countries, is the most important for dairy trade. By 2020, most SEA countries had eliminated most tariffs for dairy products imported from New Zealand and Australia under AANZFTA.

[6]According to the World Bank, "In current usage, MFN tariffs are what countries promise to impose on imports from other members of the WTO, unless the country is part of a preferential trade agreement (such as a free trade area or customs union). This means that, in practice, MFN rates are the highest (most restrictive) that WTO members charge one another." (World Bank, 2010).

Table 11

Tariff rate percentages of selected Southeast Asia countries for dairy product imports from major exporters in 2016 and 2020[1]

Product	Importer	Exporter		
		U.S., European Union, and most other countries (MFN[2] rate)	Australia and New Zealand (AANZFTA[3])	
		2016 and 2020	2016	2020
Skim milk powder	Indonesia	5	5	0-4
	Malaysia	0	0	0
	Philippines	1	0	0
	Singapore	0	0	0
	Vietnam	5	0 to 5	0
Cheese	Indonesia	5	5	0-4
	Malaysia	0	0	0
	Philippines	1 to 7	0	0
	Singapore	0	0	0
	Vietnam	10	0 to 5	0
Whey products	Indonesia	5	5	0
	Malaysia	0 to 5	0	0
	Philippines	1 to 3	0	0
	Singapore	0	0	0
	Vietnam	0 to 10	0 to 5	0
Lactose	Indonesia	5	5	0
	Malaysia	0	0	0
	Philippines	1	0	0
	Singapore	0	0	0
	Vietnam	0	0	0

[1]For some products, ranges are provided because tariffs differ among subcategories for each product. For example, for tariffs for whey products could differ for dry whey, whey protein concentrate, and modified whey.

[2]MFN = most favored nation. This is the tariff rate used for imports from members of World Trade Organization if no preferential tariff treatment program is in effect.

[3]AANFTZ = ASEAN-Australia-New Zealand Free Trade Area. ASEAN = Association of Southeast Nations.

Sources: World Integrated Trade Solution (WITS) and Schedules of Tariff Commitments for AANFTZ.

Finally, individual countries within the ASEAN region have entered into numerous bilateral free trade agreements. Some of these agreements overlap. For example, under AANFTZ, Thailand has reduced some tariffs on dairy products from New Zealand and Australia. However, under the bilateral Thailand-Australia Free Trade Agreement, Australia receives even more favorable treatment. Although Thailand has reached bilateral agreements with New Zealand and Australia, tariffs remain high for some dairy products imported from those countries. The only ASEAN country for which the United States has a Free Trade Agreement is Singapore, but this agreement is inconsequential for dairy trade since Singapore's MFN rate is zero.

Although SEA importers buying from the United States often pay higher import tariffs than buyers importing from competing countries, many SEA importers continue to buy from the United States. Differences in quality and customer service from one supplier to another may influence decisions to purchase products from the United States despite the higher tariffs. However, in general, tariffs affect prices and therefore impact SEA importers decisions to purchase from a particular country.

Data for Empirical Analysis

This study uses data from the Global Trade Analysis (GTA) database from 2006 to 2016. To analyze the effects of prices on imports, we include landed costs of the merchandise to the extent that data are available.[7] The cost, insurance, and freight (CIF) import value plus the tariff are the closest approximation to the landed cost. For Indonesia, Malaysia, and Singapore, CIF values are available through GTA. For the Philippines, the CIF value is not available; therefore, we use a free on board (FOB) import value, which does not include insurance and freight costs. However, assuming that these costs are fairly stable, changes in CIF and FOB values should be similar. For Vietnam, import data are not available, so export data from trading partners were used instead. Again, changes in CIF import values should be similar, assuming that insurance and freight costs are fairly stable. We include the Philippines and Vietnam despite the fact that the data are not exactly comparable to what is available for other countries in order to provide the most complete analysis across SEA. However, we recognize that the results are not as precise as they would be if we had more complete data. Data were aggregated at the 6-digit Harmonized System Codes (HS Code)[8] for determining basic unit values (import values divided by import quantities).

Tariffs at the 6-digit level were collected from the World Integrated Trade Solution (WITS) database.[9] For Rest of the World (ROW) tariff estimates, weighted averages were used. The tariffs were added to the basic unit values to calculate price proxies for the analysis. Depending upon the product, some of the data were further aggregated by combining data from two or more HS codes. Products were defined by HS code as follows:

- Cheese: 0406
- Whey products: 0404.10 and 3502.20
- Skim milk powder (SMP): 0402.10
- Lactose: 1702.11 and 1702.19
- Butterfat products: 0405
- Whole milk powder: 0402.21 and 0402.29

[7]Landed cost is the total price of a product or shipment once it has arrived. It includes the price of the product, transportation costs, customs duties, insurance, and other costs incurred along the way.

[8]HS codes at the six-digit level are uniform for countries that are members of the World Trade Organization. However, many countries further subdivide categories of products using codes at the 8- or 10-digit level. The GTA provides this more detailed data for many countries. Data for this report were collected at the most granular level available in the database. Large outliers were removed from data collected at this granular level. In most cases, this left sufficient data to analyze imports from major export suppliers when data were aggregated at the 6-digit HS level.

[9]In some cases, tariffs were not available for a particular year from the WITS database. In these cases, tariffs could sometimes be determined from tariff rate schedules that were readily available. In other cases, it was necessary to estimate a tariff by interpolating from tariffs of nearby years that did appear in the WITS database.

Summary of Empirical Results Concerning SEA Imports From the United States

This discussion emphasizes results that are directly applicable to the United States, which are summarized in Table 12.[10] Notice that all U.S. own-price elasticity estimates are negative, meaning that import prices (unit values plus tariff serving as proxies) are inversely related to quantities of imported products demanded, as expected.

In most cases, results for own-price elasticities are significant at the 1-percent level. In four cases, results for the U.S. own-price elasticities are insignificant (Indonesia and the Philippines imports of U.S. cheese, Singapore imports of U.S. whey products, and Philippines imports of U.S. SMP), meaning that we are unable to conclude that imports of these U.S. products by these countries are significantly responsive to prices.

Table 12
Summary of price and expenditure elasticities for U.S. dairy products by product and trading partner (based on data from 2006-16)

Product and importing country	U.S. product own-price elasticity	Cross-price elasticities for products from U.S. competitors			U.S. product expenditure elasticity
		European Union	New Zealand	Australia	
Cheese					
Philippines	–0.129	–0.003	0.308*	–0.145	0.931***
Indonesia	–0.046	0.117	–0.206	0.146	1.106***
Malaysia	–1.375***	–0.061	0.690*	0.881***	0.686***
Singapore	–1.668***	0.436***	–0.076	0.928***	0.839***
Whey Products					
Philippines	–0.318***	0.179***	0.016*		1.192***
Malaysia	–1.043***	0.560***	0.027	–0.007	1.360***
Singapore	–0.217	0.029	0.007	0.057	2.311***
Skim Milk Powder					
Philippines	–0.255	0.027	0.028	0.212***	0.634***
Indonesia	–1.155***	0.769***	–0.064	0.301	1.275***
Vietnam	–0.894***	0.199	0.389	0.217	1.291***
Malaysia	–1.315***	0.005	0.652*	0.729***	0.723***
Singapore	–0.358***	1.426***	–1.236	0.314	0.996***
Lactose					
Philippines	–0.317***	0.222*			1.027***
Indonesia	–0.602***	0.264***	0.181***		1.199***
Vietnam	–0.458***	0.331***			0.945***
Malaysia	–0.212***	0.073			1.047***

Note the following: (1) first column (highlighted in gray) is the U.S. own-price elasticity for dairy products in Southeast Asia (SEA); (2) columns 2 through 4 (highlighted in gold) are the cross-price elasticities for the United States and the top competing suppliers; and (3) the fifth column represents the U.S. expenditure elasticity for the SEA importing countries. Note:*** represents significance at the 1 percent level and * represents significance at the 10 percent level. Standard errors are reported in the appendix tables.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

[10]The Slutsky coefficients used to compute elasticities are not presented in order to limit the length of the report.

There are some fundamental reasons that elasticity estimates could differ in magnitude by country and product:

1. Demand for products that are considered necessities is generally less sensitive to price changes than demand for other products. Consumers will tend to continue purchasing necessities even if prices increase substantially. Demand for products that are considered luxuries, on the other hand, is generally more sensitive to price changes.

2. Price competition from other suppliers: If there is substantial price competition from other suppliers, relatively small price changes could result in large percentage changes in import volumes. The importing country can easily substitute products from one country with products from another country. The opposite is the case if there is not substantial price competition from other suppliers.

3. The relative size of the import volume from a particular country: If imports from a particular country are small, relatively small changes in import volumes from that country could appear as large changes in percentage terms. The opposite is the case when imports from a country are relatively large; relatively large changes in import volumes could appear small in percentage terms.

4. Product differentiation: If a country produces a particular product that is perceived as having higher quality or characteristics that are significantly different from the same types of products produced in other countries, there may be less sensitivity to price changes for the product than if the product is homogenous with products of other countries.

Notice that there are wide ranges of importers' sensitivities to U.S. prices. Although it is not practical to discuss each elasticity in table 12, examples at the extremes provide some context. The largest own-price elasticity is for Singapore's imports of cheese from the United States. A 1-percent increase in the U.S. price of cheese results in nearly a 1.7-percent decrease in Singapore's imports of U.S. cheese. There are several possible reasons why Singapore's demand for U.S. cheese would be elastic with respect to price:

1. Cheese has not traditionally been a part of diets in SEA countries (Ishige 2008). Although Singapore is a high-income country, and high-income countries tend to consume more cheese, it is not likely to be considered a staple for most Singaporeans.

2. Singapore imports cheese from many suppliers. From 2006 to 2016, Singapore had six consistent suppliers of cheese imports: EU, New Zealand, Australia, the United States, Switzerland, and Japan.

3. Singapore imports only small quantities of cheese from the United States (see table 9). Even small quantity changes could appear as large changes in percentage terms.

At the other end of the spectrum, a 1-percent change in the U.S. lactose price results in only about a 0.2-percent change in Malaysia's imports of lactose; thus, Malaysia's demand for U.S. lactose is relatively inelastic.

1. Lactose is often used as an ingredient in infant formula, confections, dry mixes and blends, and pharmaceuticals (as a filler or diluent in tablets or capsules). In many of these applications, lactose is a necessary ingredient that accounts for a modest share of the cost. Thus, a relatively inelastic demand estimate for lactose seems reasonable (Zadow, 1984).

2. Malaysia has had only two major suppliers of lactose from 2006 through 2016, the EU and the United States. U.S. exports of lactose to Malaysia (4,281 metric tons in 2016) have been much higher than EU exports (991 metric tons in 2016), suggesting that Malaysian importers generally have more well-established relationships with U.S. lactose exporters than EU exporters.

3. Although Malaysia's imports of lactose are relatively small compared to Malaysia's other dairy product imports, they are relatively large compared to imports from other countries. Therefore, a relatively large change in exports could appear as a small change in percentage terms.

For cross-price elasticities, we would usually expect positive signs, meaning that products from competing countries are substitutes for U.S. products. In all the cases where we have statistically significant results, this is the case, as indicated in Table 12. There are many cases where cross-price elasticities are statistically insignificant, meaning that our results are inconclusive concerning price competition between the United States and other major suppliers. Notice that there are more cases with statistically significant results for EU cross-price elasticities than for New Zealand cross-price elasticities. This suggests that the United States generally competes in pricing with the EU more than it does with New Zealand. Perhaps factors besides price (factors that are outside of the scope of this study) play a more significant role in the competition between New Zealand and the United States for SEA dairy import markets. In some cases, cross-price elasticities indicate that imports of U.S. dairy products are sensitive to Australia's prices. For cheese, this is the case for Malaysia and Singapore. For SMP, this is the case for the Philippines and Malaysia. Cross-price elasticities were not estimated for several New Zealand and Australia products because their imports were too inconsistent to include in the models.

In most cases where significant results are found for cross-price elasticities, the estimates are relatively inelastic, meaning that a 1-percent change in the foreign country's price results in less than a 1-percent change in imports from the United States. The exception is the EU cross-price elasticity for Singapore's imports of SMP; the results show that a 1-percent change in the EU price results in an increase in Singapore's imports of U.S. SMP of about 1.4 percent. Since Singapore's imports of SMP from the United States have been very small (see table 9), small quantity changes could appear relatively large in percentage terms.

In all cases, expenditure elasticity estimates are statistically significant and positive. This means that as total import expenditures of a particular dairy product for a country increase or decrease, imports from the United States increase or decrease in the same direction. There is a wide range of expenditure elasticity estimates. The greatest is the estimate of about 2.3 for Singapore's imports of whey products. This means that for a 1-percent increase or decrease in Singapore's total imports of whey products, Singapore's imports of whey products from the United States increase or decrease in the same direction by about 2.3 percent. At the other end of the spectrum, given a 1-percent increase or decrease in Philippine imports of SMP, Philippine imports of SMP from the United States would increase or decrease in the same direction by only about 0.6 percent. Since Philippine imports of SMP from the United States have been relatively large, relatively large changes in imports could appear relatively small in percentage terms.

Specific import demand analyses of cheese, whey products, SMP, and lactose for various SEA countries are estimated and highlighted in the appendix section. There were other dairy products in which the United States did not display a consistent flow of trade transactions. However, Rotterdam models for other countries were developed for SEA imports of butterfat products and whole milk powder, which are both important products of global dairy trade. The elasticity estimates for butterfat products and whole milk powder are also highlighted in the appendix section.

Scenario Analyses To Illustrate Trade Implications for the United States

This section demonstrates how the elasticity estimates can be used to evaluate markets for U.S. products. Using imports of whey products as an example, we illustrate how elasticities can be used for quantitative analysis by calculating the impact on SEA imports of a 10-percent reduction in the U.S. whey product price (see tables 13 and 14) and a 10-percent expansion in import expenditures (see tables 15, 16, and 17). Similar analyses could be conducted for cheese, SMP, or lactose.

Baseline for the Scenarios

As a baseline for the scenario analyses, we used average import volumes and unit values from 2014 through 2016. Using the whey product imports for the Philippines as an example, the baseline average for U.S. whey product imports over the 3 years (2014 – 2016) was 22.66 million metric tons (mmt), with a value of $25.34 million (not including tariffs), which accounted for 42.1-percent of the market share in terms of value (tables 13 and 15). Although tariffs can vary depending upon the type of product within the whey-product category, we assume a 2-percent MFN tariff for the purpose of this illustration, the midpoint of the range of MFN tariffs for 2016 within the category. With the tariffs included, the value for imports from the United States is $25.85 million, adding $0.51 million that importers from the Philippines pay for dairy products from the United States. The MFN rates are applied to imports from the EU, the United States, and most of the ROW. Imports from New Zealand are assessed tariffs of $0, due to the AANZFTA. The values including tariffs are proxies for the totals paid by Philippine importers, while the values not including tariffs are proxies for the totals received by trading partners.

The same types of calculations are used for Malaysia (tables 14 and 16) and Singapore (table 17). For Malaysia, a MFN tariff of 2.5 percent is assumed since this was the midpoint of the range of tariffs for whey products in 2016. The MFN rate is applied to imports from the EU, the United States, and the ROW. Imports from New Zealand and Australia have no tariffs due to the AANZFTA. For Singapore, the values in table 17 are the same for the columns labeled "With tariff included" and "Not including tariff" because Singapore has no tariffs for dairy product imports from any country.

Impact of a 10-Percent Reduction in the Import Price for U.S. Whey Products

Our first illustration outlines the implications for U.S. whey product trade with the assumption that prices for imports from the United States are reduced 10 percent for the Philippines and Malaysia. Although results of a Rotterdam model were provided for Singapore, they were not included in this scenario because the U.S. own-price elasticity estimate is not significant.

Table 13 shows the results of the scenario for the Philippines. The price elasticities apply to the values, including the tariffs, since the tariffs affect demand for the products. With a U.S. own-price elasticity of -0.318, a 10-percent price reduction in the U.S. whey product price would cause the import quantity to rise by 0.77 mmt. Since the U.S. own-price elasticity is inelastic, the impact on the import value from the United States is negative; the increase in quantity is not large enough to offset the decrease in price. The value of imports from the United States, including the tariffs (a proxy for what importers pay), would fall by $1.79 million. The value of imports from the United

States, *not* including the tariffs (a proxy for what exporters receive), would fall by $1.76 million. The value impact for U.S. exporters is slightly less than the value impact for the Philippine importers; since the tariffs are based on the price as a percentage, the Philippine importers benefit from both a lower U.S. price and a slightly lower tariff. Market shares are based on values that do not include tariffs. The U.S. market share would decrease by 1.3 percentage points, and market shares for the EU, New Zealand, and ROW would increase by 0.8, 0.1, and 0.5 percentage points, respectively.

Table 14 shows the results of the scenario for Malaysia. With a U.S. own-price elasticity of –1.043, a 10-percent reduction in the import price, U.S. whey product price would cause Malaysia's whey product imports from the United States to increase by 1.57 mmt. Since the U.S. own-price elasticity estimate is elastic, the impact on the import value from the United States is positive; the increase in quantity more than offsets the decrease in price. With a cross-price elasticity of 0.262, the quantity imported from the EU would fall by 1.42 mmt. Import quantities for New Zealand, Australia, and ROW are assumed to remain the same because the elasticity estimates from the model were insignificant. Market shares for the United States, New Zealand, and Australia would increase by 0.4, 0.2, and 0.1 percentage points, respectively—but the market share for the EU would fall by 0.7 percentage points.

In summary, a 10-percent U.S. price reduction for whey product imports would lead to a lower value of imports (from the United States) for the Philippines but a higher value of imports for Malaysia. With the Philippines' inelastic demand for whey products from the United States, the fall in price more than offsets the rise in the import quantity, causing a reduction in the import value. With Malaysia's elastic demand for whey products from the United States, the rise in import quantity more than offsets the fall in price, causing an increase in the import value. While import quantities from the United States increase for both the Philippines and Malaysia, the United States loses market share for the Philippines but gains market share for Malaysia.

Table 13
Philippine imports of whey products, 10-percent reduction in U.S. price

Supplier	Baseline				Elasticity for change in U.S. price	Scenario: 10 percent increase in U.S. price				Impact (scenario minus baseline)			
		With tariff included	Not including tariff				With tariff included	Not including tariff			With tariff included	Not including tariff	
	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent		Quantity 1000 mt	Value mil. $	Value mil. $	Share percent	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent
European Union	13.30	20.67	20.26	33.6	0.161	13.08	20.32	19.92	34.4	-0.22	-0.35	-0.34	0.8
New Zealand	1.45	1.53	1.53	2.5	0.111	1.43	1.51	1.51	2.6	-0.02	-0.02	-0.02	0.1
United States	22.66	25.85	25.34	42.1	-0.318	23.43	24.06	23.59	40.7	0.77	-1.79	-1.76	-1.3
Rest of World	13.93	13.37	13.11	21.8	0.173	13.68	13.13	12.87	22.2	-0.25	-0.24	-0.24	0.5

Source: USDA, Economic Research Service analysis.

Table 14
Malaysia imports of whey products, 10-percent reduction in U.S. price

Supplier	Baseline				Elasticity for change in U.S. price	Scenario: 10 percent increase in U.S. price				Impact (scenario minus baseline)			
		With tariff included	Not including tariff				With tariff included	Not including tariff			With tariff included	Not including tariff	
	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent		Quantity 1000 mt	Value mil. $	Value mil. $	Share percent	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent
European Union	52.04	68.89	67.21	63.3	0.262	50.62	67.01	65.38	62.6	-1.42	-1.88	-1.83	-0.7
New Zealand	3.26	15.45	15.45	14.6	0.000	3.26	15.45	15.45	14.8	0.00	0.00	0.00	0.2
Australia	3.26	4.49	4.49	4.2	0.000	3.26	4.49	4.49	4.3	0.00	0.00	0.00	0.1
United States	13.55	17.94	17.50	16.5	-1.043	15.12	18.02	17.58	16.8	1.57	0.08	0.08	0.4
Rest of World	1.39	1.52	1.48	1.4	0.000	1.39	1.52	1.48	1.4	0.00	0.00	0.00	0.0

Source: USDA, Economic Research Service analysis.

Impact of 10-Percent Increase in Whey Products Expenditures by SEA Countries

Now let us examine the impact that changes in SEA import expenditures would have on U.S. whey product exports. For this 10-percent expenditure-expansion scenario, differences from the baseline were calculated similarly as for the 10-percent change-in-price scenario.

Notice from tables 15 through 17 that U.S. whey product import expenditure elasticities for all three countries examined are positive and relatively elastic (1.192 for the Philippines, 1.187 for Malaysia, and 2.311 for Singapore). For all three countries, as import expenditures increase (assuming that prices remain constant), U.S. import quantities increase as well. Since the expenditure elasticities are positive for all the suppliers of all three countries, import quantities and values increase across the board.

Given that the expenditure elasticities are relatively elastic for the United States, the United States gains market share for all three countries. In most cases, expenditure elasticities for the other countries are relatively inelastic, so they lose market share as expenditures increase. The exception is Malaysia's imports of whey products from New Zealand, which has an elastic expenditure elasticity. As a result, when Malaysia's import expenditures of whey products increase and prices remain constant, New Zealand gains market share.

Table 15
Philippine imports of whey products, 10-percent increase in expenditures

Supplier	Baseline				Expenditure elasticity	Scenario: 10 percent increase in expenditures including tariffs				Impact (Scenario minus baseline)			
		With tariff included	Not including tariff				With tariff included	Not including tariff			With tariff included	Not including tariff	
	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent		Quantity 1000 mt	Value mil. $	Value mil. $	Share percent	Impact Quantity 1000 mt	Value mil. $	Value mil. $	Share percent
European Union	13.30	20.67	20.26	33.64	0.943	14.55	22.61	22.17	33.3	1.25	1.94	1.91	-0.3
New Zealand	1.45	1.53	1.53	2.54	0.120	1.47	1.55	1.55	2.3	0.02	0.02	0.02	-0.2
United States	22.66	25.85	25.34	42.07	1.192	25.39	28.96	28.39	42.7	2.73	3.11	3.05	0.6
Rest of World	13.93	13.37	13.11	21.76	0.997	15.32	14.70	14.41	21.7	1.39	1.33	1.31	-0.1

Source: USDA, Economic Research Service analysis.

Table 16
Malaysia imports of whey products, 10-percent increase in expenditures

Supplier	Baseline				Expenditure elasticity	Scenario: 10 percent increase in expenditures including tariffs				Impact (Scenario minus baseline)			
		With tariff included	Not including tariff				With tariff included	Not including tariff			With tariff included	Not including tariff	
	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent		Quantity 1000 mt	Value mil. $	Value mil. $	Share percent	Impact Quantity 1000 mt	Value mil. $	Value mil. $	Share percent
European Union	52.04	68.89	67.21	63.3	0.896	56.68	75.03	73.20	62.7	4.64	6.14	5.99	-0.6
New Zealand	3.26	15.45	15.45	14.6	1.410	3.73	17.67	17.67	15.1	0.47	2.22	2.22	0.6
Australia	3.26	4.49	4.49	4.2	0.339	3.37	4.64	4.64	4.0	0.11	0.15	0.15	-0.3
United States	13.55	17.94	17.50	16.5	1.187	15.17	20.09	19.60	16.8	1.62	2.15	2.10	0.3
Rest of World	1.39	1.52	1.48	1.4	0.672	1.48	1.62	1.58	1.4	0.09	0.10	0.10	0.0

Source: USDA, Economic Research Service analysis.

Table 17
Singapore imports of whey products, 10-percent increase in expenditures

Supplier	Baseline				Expenditure elasticity	Scenario: 10 percent increase in expenditures including tariffs				Impact (Scenario minus baseline)			
		With tariff included	Not including tariff				With tariff included	Not including tariff			With tariff included	Not including tariff	
	Quantity 1000 mt	Value mil. $	Value mil. $	Share percent		Quantity 1000 mt	Value mil. $	Value mil. $	Share percent	Impact Quantity 1000 mt	Value mil. $	Value mil. $	Share percent
European Union	11.37	18.68	18.68	23.9	0.284	11.68	19.19	19.19	22.4	0.31	0.51	0.51	-1.6
New Zealand	6.07	19.96	19.96	25.6	0.631	6.45	21.20	21.20	24.7	0.38	1.24	1.24	-0.9
Australia	6.11	7.40	7.40	9.5	0.602	6.47	7.84	7.84	9.1	0.36	0.44	0.44	-0.4
United States	4.79	24.87	24.87	31.9	2.311	5.97	31.00	31.00	36.1	1.18	6.13	6.13	4.2
Rest of World	3.39	7.09	7.09	9.1	0.728	3.63	7.60	7.60	8.9	0.24	0.51	0.51	-0.2

Source: USDA, Economic Research Service analysis.

Summary and Conclusion

The findings of this report provide insight into the potential for the United States to expand exports of dairy products to SEA countries. Rapid growth population and per capita GDP in SEA countries is increasing the demand for dairy products in this region, and SEA natural resource constraints prevent production in this region from meeting the increased demand for dairy products.

From 2006 to 2018, SEA dairy imports from the United States gradually increased, and the United States moved from fourth to the third largest dairy product supplier to the region. Although the United States was the third largest supplier of total dairy products by value to the region in 2018, it ranked second behind the EU for SMP whey products, and it was the top supplier of lactose to the region. The Philippines was the SEA country with the highest value of dairy product imports from the United States, followed by Indonesia, Vietnam, Malaysia, Singapore, and Thailand. Analyzing the expenditure and price elasticities of demand for imports can help U.S. exporters evaluate the potential for further growth in sales to SEA.

Using a Rotterdam model framework, own-price, cross-price, and expenditure elasticities were estimated for SEA dairy product imports. The importing countries analyzed were Malaysia, Vietnam, Singapore, the Philippines, and Indonesia. In most cases, results show statistically-significant own-price elasticities for SEA's imports from major global dairy suppliers—including the United States, the EU, New Zealand, and Australia. Statistically significant cross-price elasticities indicate that imports from major suppliers are substitutes for U.S. products. Statistically significant dairy import expenditure elasticities were found for the major SEA importers and suppliers.

In most cases, SEA importers of dairy products from the United States were found to respond to changes in U.S. prices, but the estimated responses were relatively inelastic. In these cases, lower U.S. prices would likely result in higher import quantities from the United States (with prices of other suppliers remaining constant) but import values would be lower because the lower prices more than offset the higher import quantities. The exceptions are relatively elastic U.S. own-price elasticity estimates for cheese imports by Malaysia and Singapore, SMP imports by Malaysia and Indonesia, and whey product imports by Malaysia. In these cases, lower U.S. import prices would likely result in both higher import quantities and values.

In most cases where statistically significant cross-price elasticities for SEA imports of U.S. dairy products were found, the estimated responses were relatively inelastic. The United States' largest competitor in the SEA dairy market is the EU. There are statistically significant substitute relationships among the U.nited States and EU for cheese in Singapore; whey products in the Philippines and Malaysia; SMP in Indonesia and Singapore; and lactose in the Philippines, Indonesia, and Vietnam. The magnitude of these positive cross-price elasticities between U.S. and EU dairy products could identify which of the two countries will benefit the most given a change in price.

For all cases where the United States has been a consistent supplier of the dairy products analyzed, expenditure elasticity estimates for imports from all major suppliers were positive and significant. This implies that the increase in SEA expenditures position the United States to benefit from all SEA dairy imports. However, our analysis of historical data suggests that the benefits to U.S. exporters from rising SEA imports are likely to be uneven. For the Philippines, Malaysia, and Singapore, expenditure elasticity estimates for U.S. whey product imports indicate that the United States is likely to gain market share as expenditures for these products rise. For cheese, expenditure

elasticities indicate that the United States could gain market share for Indonesia but lose share in other markets. For SMP, the United States could gain market share in Indonesia and Vietnam but lose market share in other markets. For lactose, the U.S. market share for the Philippines, Indonesia, Vietnam, and Malaysia could remain relatively stable since the expenditure elasticities for all of these countries are close to 1.

If SEA dairy product imports continue to grow as expected, expenditure elasticity estimates imply that U.S. dairy exports to SEA will continue to grow. However, the analysis clearly indicates that the magnitude of the growth and competition for market share will depend upon the relationships between import quantities and prices of the United States and the prices of major competitors.

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Appendix

Detailed Empirical Results

This study applied a Rotterdam model to estimate price and expenditure elasticities of demand to dairy import data from five SEA countries. For each of the appendix tables 1-1 through 1-19, own-price elasticities relevant for each exporter can be found in the gray diagonal boxes. The numbers in the orange boxes are cross-price elasticities. Each column displays the own-price and cross-price elasticities associated with imports by a SEA country. Expenditure elasticities are presented in the blue boxes on the right side of each table (Note that all the elasticities appearing in the rows for the United States also appear in table 12).

Cheese Imports

Cheese has been the dairy product consistently imported by most SEA countries from their trading partners; each of the top five SEA importing countries imported cheese from more than one trading partner almost every month. Thus, sufficient data were available to analyze cheese imports for all five importing countries included in the Rotterdam analysis. While the United States has not been the leading supplier of cheese imports for any of the SEA countries modeled (as can be seen in tables 5 through 9), U.S. cheese exports to the region have increased (GTA, 2006 and 2016).

Model results relative to SEA cheese imports are presented in appendix tables 1-1 through 1-5. Notice that the number of consistent suppliers differs from one importing country to another. Singapore has had the most diverse sources for cheese imports; the EU, New Zealand, Australia, the United States, Switzerland, and Japan have all been consistent suppliers of cheese. Since per-capita consumption of a wide variety of cheeses is usually greater in high-income countries, it is not surprising that Singapore would have the greatest number of consistent suppliers. At the other extreme, Vietnam consumes less cheese and has had only three consistent suppliers: the EU, New Zealand, and Australia. Vietnam's cheese imports from the United States have been inconsistent and are included with the rest of the world (ROW).

For the Philippines, cheese from the United States and New Zealand are substitutes. Notice from appendix table 1-1, that a 1-percent increase in New Zealand's price results in a 0.3-percent increase in cheese imports from the United States. However, a 1-percent increase in the U.S. price results in only a 0.1-percent increase in cheese imports from New Zealand. The model results also suggest that SEA cheese imports from the United States are very responsive to changes in the U.S. price for cheese exports to Malaysia and Singapore, with own-price elasticities of –1.4 and –1.7, respectively. The model results suggest that SEA cheese imports from the United States are responsive to changes in prices of competitors in some cases. For Malaysia, the findings suggest that a 1-percent increase in the cheese price for Australia would result in a 0.9-percent increase in cheese imports from the United States. Likewise, a 1-percent increase in New Zealand's cheese price would lead to a 0.7-percent increase in cheese imports from the United States. For Singapore, cross-price elasticities indicate that the United States competes with the EU (0.4), Australia (0.9), and Japan (0.04) on the basis of price. For Indonesia cheese imports from the United States, the U.S. own-price elasticity is not significant, and the cross-price elasticities are not significant.

Appendix table 1-1

Price and expenditure elasticities for Philippine cheese imports, 2006-2016

Philippines		Own-price and cross-price elasticities						Expenditure elasticities
		Effect of 1-percent change in price per exporter						
		European Union	New Zealand	Australia	United States	Switzerland	Rest of world	
Percent change in import quantity per exporter	European Union	–0.837*** (0.212)	0.618*** (0.279)	0.247 (0.203)	0.004 (0.117)	0.002 (0.007)	–0.027 (0.113)	0.918*** (0.203)
	New Zealand	0.102** (0.046)	–0.356*** (0.114)	0.162*** (0.074)	0.076* (0.040)	0.004*** (0.001)	0.012 (0.034)	1.089*** (0.077)
	Australia	0.108 (0.088)	0.429*** (0.195)	–0.566*** (0.182)	–0.095 (0.077)	–0.003 (0.003)	0.126* (0.068)	0.991*** (0.154)
	United States	–0.003 (0.078)	0.308* (0.162	–0.145 (0.118)	–0.129 (0.100)	0.002 (0.003)	–0.030 (0.069)	0.931*** (0.074)
	Switzerland	0.109 (0.325)	1.215*** (0.441)	–0.280 (0.363)	–0.127 (0.193)	–0.814*** (0.212)	–0.103 (0.221)	0.596*** (0.301)
	Rest of world	0.040 (0.170)	0.113 (0.306)	0.433* (0.232)	–0.067 (0.134)	–0.003 (0.007)	0.436*** (0.179)	1.409*** (0.240)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. ** represent significant levels at 5percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-2

Price and expenditure elasticities for Indonesia cheese imports, 2006-2016

Indonesia		Own-price and cross-price elasticities					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.791*** (0.235)	0.290 (0.600)	0.146 (0.376)	0.426 (0.428)	–0.071 (0.169)	1.181*** (0.232)
	New Zealand	0.031 (0.065)	–0.564* (0.309)	0.368*** (0.161)	–0.081 (0.187)	0.246*** (0.070)	1.097*** (0.881)
	Australia	0.031 (0.080)	0.731*** (0.321)	–0.639*** (0.261)	0.113 0.209)	–0.237*** (0.084)	0.881*** (0.125)
	United States	0.117 (0.118)	–0.206 (0.479)	0.146 (0.270)	–0.046 (0.422)	–0.011 (0.118)	1.106*** (0.163)
	Rest of world	–0.089 (0.211)	2.849*** (0.809)	–1.381*** (0.490)	–0.048 (0.535)	–1.330*** (0.311)	–0.140 (0.346)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-3

Price and expenditure elasticities for Vietnam cheese imports, 2006-2016

Vietnam		Own-price and cross-price elasticities				Expenditure elasticities
		Effect of 1-percent change in price per exporter				
		European Union	New Zealand	Australia	Rest of world	
Percent change in import quantity per exporter	European Union	–0.339*** (0.112)	0.072 (0.096)	0.118*** (0.040)	0.149*** (0.050)	0.722*** (0.074)
	New Zealand	0.224 (0.297)	–0.539 (0.328)	0.128 (0.102)	0.187 (0.119)	0.520*** (0.168)
	Australia	1.252*** (0.426)	0.439 (0.351)	–1.623*** (0.293)	–0.068 (0.264)	0.820* (0.439)
	Rest of world	0.626*** (0.212)	0.256 (0.163)	–0.145 (0.104)	–1.855** (0.200)	2.899*** (0.275)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solutions.

Appendix table 1-4

Price and expenditure elasticities for Malaysia cheese imports, 2006-2016

Malaysia		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–1.200*** (0.161)	0.563*** (0.208)	0.471*** (0.191)	–0.031 (0.091)	0.198*** (0.083)	0.580*** (0.151)
	New Zealand	0.182*** (0.067)	–0.672*** (0.182)	0.284** (0.146)	0.114* (0.061)	0.092** (0.047)	1.445*** (0.119)
	Australia	0.130*** (0.055)	0.242** (0.125)	–0.525*** (0.129)	0.125*** (0.047)	0.028 (0.038)	0.797*** (0.093)
	United States	–0.061 (0.178)	0.690* (0.370)	0.881*** (0.328)	–1.375*** (0.229)	–0.135 (0.127)	0.686*** (0.328)
	Rest of world	0.467*** (0.197)	0.668*** (0.341)	0.235 (0.320)	–0.163 (0.154)	–1.207*** (0.196)	0.852*** (0.253)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-5

Price and expenditure elasticities for Singapore cheese imports, 2006-2016

Singapore		Own-price and cross-price elasticities for each exporter							Expenditure elasticities
		Effect of 1-percent change in price per exporter							
		European Union	New Zealand	Australia	United States	Switzerland	Japan	Rest of world	
Percent change in import quantity per exporter	European Union	–1.138*** (0.095)	0.180*** (0.069)	0.706*** (0.088)	0.094*** (0.045)	0.124*** (0.032)	–0.005 (0.005)	0.038 (0.052)	1.049*** (0.072)
	New Zealand	0.355*** (0.136)	–0.443*** (0.201)	–0.141 (0.194)	–0.032 (0.092)	0.087 (0.063)	–0.005 (0.009)	0.188 (0.180)	0.721*** (0.182)
	Australia	0.598*** (0.075)	–0.061 (0.084)	–0.744*** (0.129)	0.170*** (0.048)	0.020 (0.034)	0.005 (0.005)	0.012 (0.054)	1.115*** (0.094)
	United States	0.436*** (0.207)	–0.076 (0.217)	0.928*** (0.262)	–1.668*** (0.193)	0.002 (0.095)	0.043*** (0.015)	0.336*** (0.159)	0.839*** (0.242)
	Switzerland	2.214*** (0.565)	0.788 (0.572	0.430 (0.708)	0.008 (0.364)	–2.966*** (0.368)	0.011 (0.047)	–0.485 (0.425)	1.607*** (0.603)
	Japan	–1.032 (1.052)	–0.527 (0.971)	1.173 (1.185)	1.840*** (0.665)	0.121 (0.529)	–2.552*** (0.202)	0.978 (0.797)	–2.459*** (0.838)
	Rest of world	0.233 (0.321)	0.559* (0.321)	0.085 (0.396)	0.444*** (0.210)	–0.167 (0.146)	0.030 (0.024)	–1.184*** (0.338)	0.847*** (0.346)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. ** represent significant levels at 5percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Expenditure elasticities for imports of cheese from the United States are estimated to be inelastic for the Philippines (0.9), Malaysia (0.7), and Singapore (0.8). If the future is similar to the past, these estimates suggest that the United States would gain if imports grow but could lose market share in the cheese market for these countries over time. Indonesia shows a slightly elastic expenditure elasticity for the United States of 1.1. If Indonesia's cheese imports grow, the United States will likely gain market share, assuming prices remain constant.

Although this report emphasizes the competitive position of the United States with respect to SEA imports, some values with respect to other suppliers are noteworthy. While the U.S. own-price elasticity with respect to Singapore's cheese imports is estimated to be relatively elastic (–1.7), Singapore's cheese imports from Switzerland and Japan are estimated to be even more sensitive to changes in prices—with elasticities of –3.0 and –2.5, respectively. Since Singapore imports only small quantities of cheese from these suppliers, small changes could show up as large in percentage terms.

Whey Product Imports

In 2016, more than 91 percent of SEA whey product imports were supplied by New Zealand, the EU, the United States, and Australia (table 4). Model results relative to SEA whey product imports are presented in appendix tables 1-6 through 1-8. Three SEA countries had consistent imports of whey products from at least three exporting countries each over the study period: Malaysia, Singapore, and the Philippines. Malaysia and Singapore had four consistent suppliers of whey products over the study period: the EU, New Zealand, Australia, and the United States. For the Philippines, the list of consistent suppliers is the same, with the exception of Australia. The EU has been the greatest supplier of whey products to the region, followed by the United States (table 4).

For the Philippines and Singapore, it is notable that many of the own-price and cross-price elasticities estimates are statistically significant and relatively inelastic. This suggests that these two importers are relatively insensitive to suppliers' prices of whey products. It could also be the case that the Philippines and Singapore have well-established relationships with their suppliers of whey products and may be reluctant to substitute whey products from suppliers of other countries. Malaysia, Singapore, and the Philippines have U.S. own-price elasticity estimates for whey product imports of –1.0, –0.2, and –0.3, respectively. It is noteworthy that the EU cross-price elasticity estimate for Malaysia's imports from the United States is 0.9, about the same as the U.S. own-price elasticity. This suggests that the level of U.S. whey product exports to Malaysia is about as sensitive to the EU price as it is to the U.S. price. In the Philippines, whey products from the United States and EU are also substitutes. Given the relatively low sensitivity of SEA whey product imports to prices, other factors beyond the scope of this study may have more important roles in the decision making of SEA importers concerning whey product imports.

For all three countries, U.S. expenditure elasticities are relatively elastic (1.4 for Malaysia, 2.3 for Singapore, and 1.2 for the Philippines). Thus, if the future is similar to the period of this study, the United States can expect to gain market share for whey products as SEA import expenditures grow.

Appendix table 1-6

Price and expenditure elasticities for Philippine Whey Product Imports, 2006-2016

Philippines		Own-price and cross-price elasticities for each exporter Effect of 1-percent Change in Price per exporter				Expenditure elasticities
		European Union	New Zealand	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.279*** (0.026)	0.022*** (0.009)	0.161*** (0.021)	0.095*** (0.021)	0.943*** (0.090)
	New Zealand	0.168*** (0.067)	–0.176*** (0.052)	0.111* (0.065)	–0.103 (0.072)	0.120*** (0.260)
	United States	0.179*** (0.023)	0.016 (0.010)	–0.318*** (0.029)	0.122*** (0.022)	1.192*** (0.105)
	Rest of world	0.148*** (0.033)	–0.022 (0.015)	0.173*** (0.031)	–0.299*** (0.042)	0.997*** (0.139)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-7

Price and expenditure elasticities for Malaysia whey product imports (2011-2016)

Malaysia		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent Change in Price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.401*** (0.068)	0.040 (0.055)	0.075*** (0.018)	0.262*** (0.042)	0.023 (0.016)	0.763*** (0.119)
	New Zealand	0.095 (0.129)	–0.198 (0.149)	0.001 (0.028)	0.058 (0.071)	0.044* 0.024)	1.467*** (0.319)
	Australia	0.931*** (0.223)	0.004 (0.146)	–0.994*** (0.175)	0.043 (0.217)	0.016 (0.102)	0.634* (0.330)
	United States	0.897*** (0.144)	0.084 (0.103)	0.012 (0.060)	–1.043*** (0.148)	0.050 (0.047)	1.360*** (0.236)
	Rest of world	0.748 (0.508)	0.614* (0.332)	0.041 (0.267)	0.472 (0.444)	–1.876*** (0.305)	0.218 (0.746)

Note: Due to the U.S. limited whey products exports to Malaysia during the first several years of this data source, the estimate presented in the above table were derived using data from 2011-2016. Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-8

Price and expenditure elasticities for Singapore whey product imports, 2006-2016

Singapore		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantit per exporter	European Union	–0.061 (0.092)	–0.171*** (0.067)	0.152*** (0.064)	0.027 (0.062)	0.052 (0.051)	0.284*** (0.095)
	New Zealand	–0.255*** (0.099)	–0.018 (0.157)	0.217** (0.096)	–0.010 (0.118)	0.065 (0.086)	0.631*** (0.197)
	Australia	0.298*** (0.126)	0.286*** (0.126)	–0.567*** (0.152)	0.108 (0.119)	–0.124 (0.089)	0.602*** (0.183)
	United States	0.029 (0.064)	0.007 (0.083)	0.057 (0.063)	–0.217 (0.229)	–0.138*** (0.064)	2.311*** (0.184)
	Rest of world	0.154 (0.150)	0.129 (0.170)	–0.188 (0.135)	0.391*** (0.183)	–0.486*** (0.171)	0.728*** (0.323)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

SMP Imports

Model results relative to SEA SMP product imports are presented in appendix tables 1-9 through 1-13. All five SEA importers included in this study have been consistent importers of SMP, and these importers have consistently imported SMP from the same top four suppliers (the EU, New Zealand, Australia, and the United States). In 2016, the United States was the second largest supplier of SMP to SEA, behind New Zealand (table 4). Model results indicate that for SEA imports of SMP from the United States, the U.S. own-price response is relatively elastic for Malaysia, Indonesia, and the Philippines (–1.3, –1.2, and 1.1, respectively), but relatively inelastic for Vietnam and Singapore (–0.9, and –0.4 respectively).

The largest own-price elasticity absolute value estimate listed in the tables for SMP imports is –1.8 for Vietnam's imports of SMP from New Zealand, suggesting that these imports are very sensitive to prices. This contrasts with the U.S. own-price elasticity of –0.9 for Vietnam's imports of SMP. Since the United States has been the largest supplier of SMP to Vietnam, the inelastic demand could be the result of well-established trade relationships and the relatively large import volume (as relatively large changes in import volumes could appear small in percentage terms).

The cross-price elasticities are particularly interesting for U.S. exports to the region. For Singapore, the EU cross-price elasticity estimate for imports from the United States is 1.4, a much greater magnitude than the –0.4 own-price elasticity for the United States. This suggests that for Singapore, changes in the EU prices tend to have larger impacts on imports from the United States than changes in U.S. prices. This may be because a large proportion of Singapore's SMP imports are from the EU, while SMP imports from the United States are relatively small; even a small change in quantity imported from the United States is a large percentage change. For Malaysia, the New Zealand and Australia cross-price elasticities for SMP imports from the United States are both relatively inelastic, about 0.7. For Indonesia, the EU cross-price elasticity estimate for SMP imports from the United States is 0.8.

The expenditure elasticity estimates for SMP imports from the United States are mixed. They are relatively inelastic for Malaysia (0.7), and relatively elastic for Vietnam and Indonesia (both about 1.3). For both Singapore and the Philippines, the expenditure elasticities for SMP imports from the United States are close to unity. This means that the percentage increase or decrease in Singapore's and the Philippines' import quantities from the United States would be about the same as the percentage increase or decrease in those countries' total SMP import expenditures, all other things being equal.

Appendix table 1-9

Price and expenditure elasticities for Philippine skim milk powder imports, 2006-2016

Philippines		Own-price and cross-price elasticities					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	0.146 (0.149)	–0.355 (0.232)	0.074 (0.135)	0.109 (0.205)	0.026 (0.057)	1.355*** (0.300)
	New Zealand	–0.091 (0.438)	–0.104 (0.267)	0.158* (0.088)	0.029 (0.232)	0.008 (0.054)	1.180*** (0.115)
	Australia	0.056 (0.102)	0.463* (0.267)	–1.058*** (0.194)	0.647*** (0.245)	–0.107 (0.066)	1.448*** (0.237)
	United States	0.027 (0.051)	0.028 (0.223)	0.212*** (0.080)	–0.255 (0.236)	–0.146 (0.771)	0.996*** (0.415)
	Rest of world	0.152 (0.247)	–0.262 (0.264)	0.180 (0.116)	–0.007 (0.035)	0.268 (0.169)	0.666*** (0.228)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-10

Price and expenditure elasticities for Indonesia skim milk powder imports, 2006-2016

Indonesia		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–1.452*** (0.299)	0.804*** (0.262)	–0.232 (0.209)	1.085*** (0.346)	–0.203*** (0.083)	0.879*** (0.126)
	New Zealand	0.631*** (0.206)	–1.437*** (0.343)	0.704*** (0.211)	–0.071 (0.332)	0.172*** (0.073)	0.980*** (0.102)
	Australia	–0.254 (0.229)	0.980*** (0.292)	–1.163*** (0.323)	0.463 (0.373)	–0.026 (0.085)	0.712*** (0.118)
	United States	0.769*** (0.245)	–0.064 (0.300)	0.301 (0.242)	–1.155*** (0.480)	0.149* (0.088)	1.275*** (0.129)
	Rest of world	–1.259*** (0.527)	1.396*** (0.591)	–0.151 (0.497)	1.335* (0.788)	–1.284*** (0.308)	1.141*** (0.378)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-11

Price and expenditure elasticities for Vietnam skim milk powder imports, 2006-2016

Vietnam		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–1.415*** (0.331)	1.040*** (0.327)	–0.015 (0.212)	0.329 (0.310)	0.062 (0.066)	0.795*** (0.175)
	New Zealand	1.148*** (0.361)	–1.822*** (0.645)	–0.026 (0.317)	0.710 (0.499)	–0.026 (0.092)	1.200*** (0.165)
	Australia	–0.046 (0.054)	–0.073 (0.877)	–0.754 (0.820)	0.109*** (0.050)	–0.222 (158)	0.515*** (0.257)
	United States	0.199 (0.188)	0.389 (0.274)	0.217 (0.154)	–0.894*** (0.331)	–0.090* (0.050)	1.291*** (0.099)
	Rest of world	0.522 (0.520)	0.066 (0.706)	–0.613 (0.438)	1.258* (0.694)	–1.101*** (0.208)	0.446 (0.300)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-12

Price and expenditure elasticities for Malaysia skim milk powder imports, 2006-2016

Malaysia		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–1.443*** (0.162)	0.786*** (0.226)	0.385* (0.213)	0.003 (0.102)	0.275*** (0.076)	0.795*** (0.175)
	New Zealand	0.235*** (0.068)	–0.760*** (0.189)	0.388*** (0.156)	0.109* (0.064)	0.026 (0.043)	1.381*** (0.124)
	Australia	0.099* (0.054)	0.331*** (0.133)	–0.583*** (0.140)	0.104*** (0.050)	0.048 (0.035)	0.806*** (0.099)
	United States	0.005 (0.181)	0.652* (0.381)	0.729*** (0.350)	–1.315*** (0.237)	–0.061 (0.117)	0.723*** (0.329)
	Rest of world	0.622*** (0.172)	0.198 (0.323)	0.431 (0.306)	–0.777*** (0.148)	–1.174*** (0.150)	0.654*** (0.261)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-13

Price and expenditure elasticities for Singapore skim milk powder imports, 2006-2016

Singapore		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.616*** (0.165)	0.416*** (0.136)	0.081 (0.212)	0.032 (0.156)	0.087 (0.121)	0.930*** (0.092)
	New Zealand	0.654*** (0.215)	–0.331 (0.273)	–0.078 (0.094)	–0.043 (0.026)	–0.201 (0.203)	1.200*** (0.165)
	Australia	0.597 (0.436)	–0.368 (0.443)	–0.932*** (0.312)	0.052 (0.054)	0.651 (0.419)	0.290 (0.358)
	United States	1.426*** (0.703)	–1.236 (0.744)	0.314 (0.329)	–0.358*** (0.172)	–0.146 (0.771)	0.996*** (0.415)
	Rest of world	0.152 (0.247)	–0.262 (0.264)	0.180 (0.116)	–0.007 (0.035)	–0.089 (0.334)	1.430*** (0.150)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Lactose Imports

Model results relative to SEA lactose product imports are presented in appendix tables 1-14 through 1-17. The United States has been the leading supplier of lactose to SEA (table 4). Both the United States and the EU were consistent suppliers of lactose to the Philippines, Vietnam, and Malaysia from 2006 to 2016. In addition to the United States and the EU, New Zealand has been a consistent supplier to Indonesia. A Rotterdam model could not be formulated for Singapore because the United States was the only consistent supplier of lactose to the country from 2006 to 2016, with imports from the United States totaling $11.5 million in 2016.

For all four importing countries included in the analysis, own-price elasticity of imports from the United States estimates are relatively inelastic, ranging from –0.2 for Malaysia to –0.6 for Indonesia. Cross-price elasticity estimates for Indonesia's imports of lactose from the United States are significant for the EU and New Zealand (0.3 and 0.2, respectively). For Vietnam and the Philippines, imports of U.S. and EU lactose serve as substitutes—with cross-price elasticities of 0.3 and 0.2, respectively.

All the U.S. expenditure elasticities for lactose imports of the SEA countries analyzed are close to unity, at 1.2 for Indonesia, 1.1 for Malaysia, 0.9 for Vietnam, and 1.0 for the Philippines. This suggests that changes in lactose import expenditures for Indonesia, Malaysia, Vietnam, or the Philippines would give rise to proportionate changes in total lactose imported from the U.S. for any of the four countries.

For the most part, own-price and cross-price elasticity estimates for lactose imports of all four countries are relatively inelastic, meaning that lactose imports of SEA countries are relatively insensitive to price changes. There are some exceptions. For Indonesia, the New Zealand own-price elasticity is –1.2 and the ROW own-price elasticity is –1.0. ROW own-price elasticity estimates are also relatively elastic for Malaysia and Vietnam (–1.5 and –1.7, respectively). This suggests that minor players can gain or lose significantly in percentage terms when their lactose prices change.

Appendix table 1-14

Price and expenditure elasticities for Philippine lactose imports, 2006-2016

Philippines		Own-price and cross-price elasticities for each exporter			Expenditure elasticities
		Effect of 1-percent change in price per exporter			
		European Union	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.347* (0.201)	0.366* (0.200)	–0.019 (0.056)	1.095*** (0.119)
	United States	0.222* (0.121)	–0.317*** (0.130)	0.094*** (0.036)	1.026*** (0.077)
	Rest of world	–0.103 (0.301)	0.833*** (0.322)	–0.730*** (0.168)	0.253 (0.271)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-15

Price and expenditure elasticities for Indonesia lactose imports, 2006-2016

Indonesia		Own-price and cross-price elasticities for each exporter				Expenditure elasticities
		Effect of 1-percent change in price per exporter				
		European Union	New Zealand	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.729*** (0.152)	0.194*** (0.094)	0.439*** (0.139)	0.096* (0.056)	0.943*** (0.090)
	New Zealand	0.445*** (0.216)	–1.219*** (0.252)	0.692*** (0.259)	0.082 (0.100)	0.764*** (0.209)
	United States	0.264*** (0.083)	0.181*** (0.068)	–0.602*** (0.116)	0.158*** (0.039)	1.199*** (0.084)
	Rest of world	0.245* (0.142)	0.091 (0.110)	0.666*** (0.167)	–1.002*** (0.111)	1.054*** (0.212)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-16

Price and expenditure elasticities for Vietnam lactose imports, 2006-2016

Vietnam		Own-price and cross-price elasticitiesfor each exporter			Expenditure elasticities
		Effect of 1-percent change in price per exporter			
		European Union	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.790*** (0.144)	0.702*** (0.134)	0.088 (0.053)	0.881*** (0.106)
	United States	0.331*** (0.063)	–0.458*** (0.067)	0.128*** (0.028)	0.945*** (0.059)
	Rest of world	0.425 (0.256)	1.314*** (0.289)	–1.739*** (0.246)	2.137*** (0.475)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Appendix table 1-17

Price and expenditure elasticities for Malaysia lactose imports, 2006-2016

Malaysia		Own-price and cross-price elasticities for each exporter			Expenditure elasticities
		Effect of 1-percent change in price per exporter			
		European Union	United States	Rest of world	
Percent change in import quantity per exporter	European Union	–0.568*** (0.148)	0.240 (0.157)	0.328*** (0.108)	0.943*** (0.090)
	United States	0.073 (0.048)	–0.212*** (0.079)	0.139*** (0.059)	1.107*** (0.059)
	Rest of world	0.309*** (0.101)	0.429*** (0.182)	–1.486*** (0.682)	1.037*** (0.174)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Butterfat Product Imports

Of the five SEA countries, sufficient data were available to estimate import demand elasticities for butterfat products in Indonesia only. The own-price elasticities for butterfat products are negative for all sources, as suggested by theory. The United States was not a major exporter of butterfat products to Indonesia. Indonesia's responsiveness to changes in the price of butterfat products is strongest for products supplied by New Zealand (appendix table 1-18).

Appendix table 1-18

Price and expenditure elasticities for Indonesia butterfat product imports, 2006- 2016

Indonesia		Own-price and cross-price elasticities for each exporter			Expenditure elasticities
		Effect of 1-percent change in price per exporter			
		European Union	New Zealand	Australia	
Percent Change in Import Quantity per exporter	European Union	–0.336* (0.181)	0.849*** (0.194)	–0.513*** (0.161)	1.088*** (0.106)
	New Zealand	0.400*** (0.091)	–0.750*** (0.193)	0.033 (0.155)	0.804*** (0.055)
	Australia	–1.465*** (0.460)	2.118*** (0.940)	–0.652 (0.903)	1.937*** (0.307)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent. * represent significant levels at 10 percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.

Whole Milk Powder Imports

The United States has been a relatively small exporter of whole milk powder (WMP). In recent years, SEA has emerged as a larger WMP importer and is becoming a potential market destination for U.S. WMP. Of the five SEA countries, only one country—Singapore—had trade data from 2006 to 2016 sufficient for analysis (appendix table 1-19). In Singapore, consumers' responsiveness to changes in the price of WMP is strongest for Australia—followed by Malaysia, the EU, and then New Zealand. An implication for Singapore import demand for WMP is that Australia has a sizeable influence on WMP products, given the magnitude of its own-price elasticity and volume.

Appendix table 1-19

Price and expenditure elasticities for Singapore whole milk powder imports, 2006-2016

Singapore		Own-price and cross-price elasticities for each exporter					Expenditure elasticities
		Effect of 1-percent change in price per exporter					
		European Union	New Zealand	Australia	Malaysia	Rest of world	
Percent change in import quantity per exporter	European Union	–0.549*** (0.148)	0.329*** (0.126)	0.260*** (0.115)	–0.009 (0.042)	–0.031 (0.066)	0.652*** (0.128)
	New Zealand	0.193*** (0.073)	–0.495*** (0.104)	0.118 (0.075)	0.099*** (0.026)	0.085* (0.044)	1.364 (0.876)
	Australia	0.277*** (0.123)	0.214 (0.135)	–0.734*** (0.168)	0.127*** (0.051)	0.115* (0.067)	0.857*** (0.125)
	Malaysia	–0.020 (0.092)	0.374*** (0.100)	0.264*** (0.105)	–0.658*** (0.088)	0.039 (0.047)	0.306*** (0.081)
	Rest of world	–0.118 (0.252)	0.555*** (0.288)	0.412* (0.240)	0.068 (0.080)	–0.918*** (0.242)	1.658*** (0.404)

Note: Standard errors are in parentheses. *** represent significant levels at 1percent.

Sources: USDA, Economic Research Service calculations using data from Global Trade Atlas and World Integrated Trade Solution.