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Dairy Export Markets: Changing the Structure of US Dairy Demand

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Abstract

The role of the United States in international milk and dairy product markets has changed significantly in recent years. Although it seemed unexpected, the foundation for that change was laid following the 1994 signing of the Uruguay Round of GATT. The first decade of the 21st century also saw some important changes in the United States and in major dairy exporting areas around the world. Exploratory statistical analysis is undertaken to support assertions. There is at least some evidence that pre- and post-Uruguay round implementation periods are significantly different with respect to trade indicators. These preliminary findings suggest several avenues for further analysis.

Keywords: dairy trade, milk, supply and demand, international trade, trade agreements

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Introduction

A major dairy industry storyline in 2014 was the changed role of the United States in international milk and dairy product trade. The US had become the third largest supplier of milk and dairy products to international markets with a 14% share. New Zealand held the top position with a 38% share and the European Union (EU) was in second place holding a 32% share (Dairy Australia 2015). Although it had the feel of an overnight development, the foundations for changes in the US dairy industry's approach to international marketing were laid in the late 1990s and the first decade of the 21st century.

In the five years prior to 2000, the exported share of US milk production (on a total milk solids basis) was relatively stable at about 3.1%. The share rose to about 4% from 2000 to 2003 before growing to 15.2% in 2014. There has been only one major downturn in the export growth since 2004, the 2008–2009 period coinciding with the global recession. The more remarkable fact to note is how quickly exports rebounded to even higher levels after the downturn (Figure 1). It is clear that dairy businesses and companies in the United States have more actively delivered their products for commercial export.

A second thing to note in Figure 1 is that US dairy imports have been a smaller share of production since 2003. After rising to about 4% in 2005, imports declined to shares representing between 2–3% of production since 2010. However, the United States is still an inviting market for exporters of milk and dairy products around the world, particularly for cheeses.

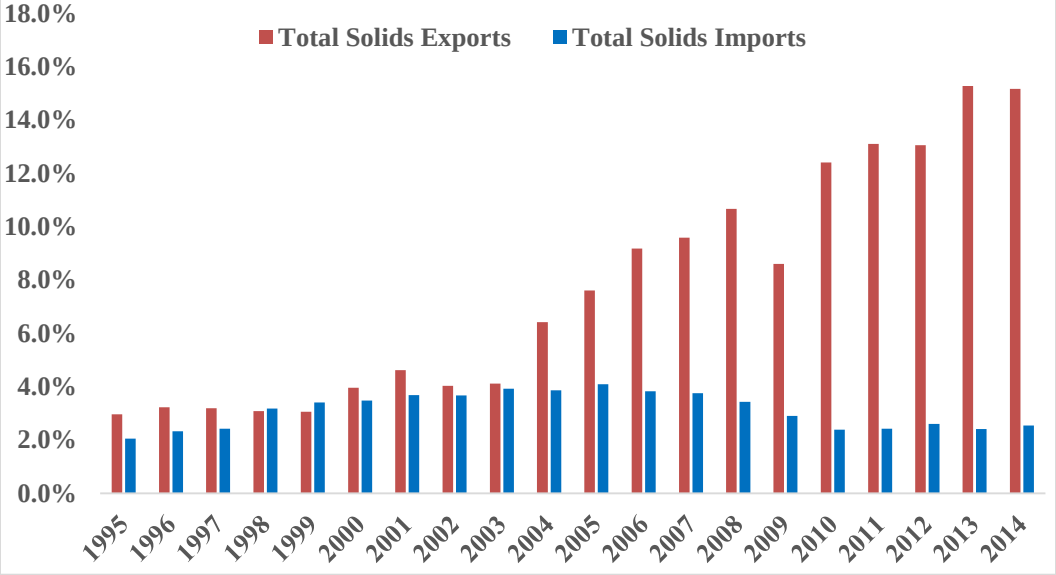

Figure 1. Annual export and import of total solids as share of total solids production, US.

The aggregate demand for milk and dairy products in the United States, and in dairy trading nations worldwide, is comprised of two components: domestic demand and demand for exports. The growth in the export component in the United States suggests there has been a structural change in aggregate US dairy demand. That is, the interactions between or among the US domestic dairy product market demands and dairy product export demands have changed. But

demands for US milk and dairy products are only half of the story; milk production and supply factors must be considered also. A short digression examining the US milk supply and use, sets the stage for the demand relationships that are examined later. This quick diversion to supply issues also provides the opportunity to explain the framework for calculating demand estimates such as those shown in Figure 1 and others to be considered in following sections.

Milk Supply and Use in the United States

Dairy farm operations in the US have grown larger, production costs have come down and productivity (milk per cow) has increased over time. Technological advances on the farm have been major drivers of these changes, but so too have forces beyond the farm gate. Among those forces are changes in US domestic dairy policies and programs, evolving environmental regulations, consumer evaluations of milk and dairy products related to diet and health, and changing agricultural trade policies.

Milk production and use estimates are provided by USDA based on accounting frameworks known as Supply and Use (S & U) and Commercial Disappearance and the units of measure are milk equivalents, or milk components.

Milk equivalents define the elements of S&U or commercial disappearance in the units matching the farm milk production, commonly reported in volume-based terms like hundredweights (cwt) or pounds. Milk components are the two solid components in milk; milkfat and solids not fat (SNF). The two solids constitute about 13% of each 100 pounds (cwt) of milk produced. Solid contents are determined by testing milk produced. The solids do vary by dairy cattle breed, across regions of the country and seasonally.

Annual commercial disappearance data for the 1995–2014 period in terms of milk equivalent, fat basis is shown in Table A1 (see Appendix). Milk production is shown growing by almost 33% from 1995 to 2014 as commercial exports grew by over 300%. The production change is similar to the 36% production change derived using the total solids as in Figure 1 but there is a significant difference in the commercial export changes (300 compared to 600%). The take-home point of this exercise is that the units of measurement, despite being different, are describing the same underlying situation.

About 56% of US milk production in 2014 was manufactured into cheese and cheese-products. This product share, and others like it, is derived using product milk equivalent factors to convert the products to fluid form that are then compared to the total milk production. Cheese manufacturing generates a co-product that has become more economically important in its own right, liquid whey. Liquid whey can be processed into differentiated products with functional properties meeting the needs of many product producers, including food producers. Those products include dry whey, whey protein concentrates, modified whey, and lactose.

Fluid milk products processing and packaging absorbed the second largest share, about 25%. The quantities of milk used in fluid milks (also called beverage milks) has declined steadily over the last several years. The remaining 19% of production is used to produce all of the other milk and

dairy products supplied. A relatively recent trend among these other products has been growing yogurt production.

Domestic US Dairy Product Demands

Milk equivalents and milk components can be used for analysis of dairy demands but a third possibility, and one more understood by the general populace, is to examine individual manufactured or processed dairy products. Consumers, especially individuals or in households, are more likely to grasp demand issues as they affect specific products they have in their homes. Also, analyses of food demand often focus on income, which is commonly reported in per capita or per household form, as a key demand determinant.

As Table 1 shows, US per capita domestic demand for all dairy products measured on a milk equivalent, fat basis has grown about 4% from 2000 to 2014. The demand trends for the selected individual products vary but in the US, cheese product demands have been a driving force behind overall dairy demand growth for many years.

Per capita natural cheese consumption increased from 30.4 pounds in 2000 to about 34.1 pounds in 2014, about 12.2%. A USDA report in 2010 (Davis et al. 2010) suggested that cheese demand might be slowing as population characteristics in the US changed. The annual percentage change in per capita cheese consumption did slow from 1.4% between 2009 and 2010 to 0.4 % between 2012 and 2013. However, the growth rate then rebounded markedly from 2013 to 2014 (1.6 %).

The per capita consumption of fluid milk, based on estimated sales, declined from 196 pounds to about 159 pounds (slightly over 19%) from 2000–2014. The fluid beverage milks include whole, reduced fat milks, flavored milks, buttermilk and a miscellaneous, each having different consumption trends over time. Total beverage milk consumption has declined for many years, but the year-over-year changes in more recent years have increased (from -0.6 % from 2009 to 2010 to -3.7 % from 2013 to 2014).

Reduced fat ice cream has been relatively steady since 2000 but regular ice cream demands have declined, perhaps an indication of changing health concerns. In general, ice cream is a product that is popular regardless of any other existing conditions or demand factors. Butter demand actually increased somewhat but has steadied in recent years and the demand for nonfat dry milk, not a major consumer product, has moved up and down but at generally low levels.

A product not shown in Table 1 that has gained importance for the US dairy industry is yogurt. Its production and consumption growth in recent years suggests that yogurt will be an important factor in the US domestic dairy market going forward. Nutritional and health benefits are an important component of efforts to increase demand for yogurt products. There have been some recent efforts to examine demand for yogurts and those efforts will only improve as both production and demand data for the various products become available.

Table 1. Selected dairy products: Per capita consumption in pounds, United States, 2000–2014 [1]

Year	All products [2]	Fluid milk and cream[3]	Butter	American cheese	Other cheese	Regular ice cream	Reduced fat ice cream	Nonfat dry milk
2000	590	196	4.5	13.5	16.9	15.6	6.0	2.7
2001	586	193	4.3	13.6	17.0	15.3	6.0	3.3
2002	589	191	4.4	13.6	17.4	15.7	5.3	3.4
2003	596	189	4.5	13.2	17.7	15.4	6.2	3.3
2004	595	186	4.5	13.5	18.1	14.1	5.9	4.7
2005	603	185	4.5	12.8	18.7	14.6	5.5	4.0
2006	612	184	4.7	13.2	19.1	14.8	5.7	2.8
2007	612	181	4.7	12.9	19.9	14.3	5.7	2.8
2008	607	179	5.0	13.3	19.1	13.8	5.7	3.0
2009	607	178	5.0	13.4	18.9	13.5	5.9	4.0
2010	603	177	4.9	13.9	19.4	13.5	6.0	3.2
2011	603	174	5.4	13.7	20.0	12.8	6.0	3.0
2012	613	170	5.5	13.3	20.2	12.8	6.6	3.7
2013	605	165	5.5	13.4	20.3	12.8	5.9	3.0
2014 [4]	614	159	5.4	13.5	20.6	12.3	6.1	3.1

Sources. USDA , U.S. Department of Commerce Bureau of the Census, California Department of Food and Agriculture.
[1] Based on total population except for fluid products (resident population), July 1 estimate.
[2] Milk equivalent, milkfat basis
[3] Product weight of beverage milks: whole, reduced fat, low fat, skim, flavored, buttermilk and miscellaneous.
[4] Preliminary

Dairy Export Demands Grow

Several key events from 2000 to 2014 period have played a role in propelling the United States toward pursuing opportunities as a commercial dairy exporting nation:

- Final implementation of Uruguay Round Agricultural Agreement (URAA) commitments by the US and other major dairy trading nations (2000);
- China's accession to the WTO (2001);
- A "perfect storm" of drought in Australia and New Zealand in 2006/2007 that coincided with reductions in subsidized exports from the EU;
- The last North America Free Trade Agreement (NAFTA) transitional agricultural trade restrictions were removed (2008);
- Relatively quick recovery of US commercial dairy exports after the 2008–2009 global recession; and
- On-going participation in bi-lateral and multi-country trade talks such as the Korea–US Free Trade Agreement (KORUS), the Trans-Pacific Partnership (TPP) and the Transatlantic Trade and Investment Partnership (T-TIP).

The URAA for the first time put national dairy import rules on a relatively common, and more transparent, tariff-based system. The individual tariff rate quota (TRQ) systems that evolved and were added to already existing tariffs created issues for some trade negotiators, but they remain

in place (Skully ERS 2001). Further, part of the URAA commitments were reductions in subsidized exports and increasing imported product access to domestic consumer markets (Peterson 2015).

The accession of China to the WTO in 2001 changed the accessibility for all agricultural product exporters to a huge market. The Chinese initially focused on implementing domestic policy changes that had been under way since the 1980s while committing to reduce agricultural tariffs, eliminate export subsidies, limit potentially trade distorting domestic crop supports, and address sanitary and phyto-sanitary regulations based on sound science (Conklin 2002; Gale, Hansen and Jewison 2015). A central element of China's WTO commitments was to put in place a system of TRQs for many major agricultural commodities.

When concerns related to melamine contamination of infant formula arose in 2008, Chinese dairy product imports rose substantially. China became, and remains today, an important market for dairy product exporters as income growth in the country has changed consumers' food demands. The United States was the second largest exporter of dairy products to China over 2012–2013 with a 10% share valued at $4.2 billion (Gale, Hansen and Jewison 2015). However, the recent slowing of China's economic growth has reduced the flow of dairy imports.

Prior to the middle of 2006, the EU and Oceania (New Zealand and Australia combined) dominated international commercial dairy product markets. Australian dairy policy was significantly reformed in 2000, and during 2006–2007 both Australia and New Zealand endured severe weather conditions that significantly reduced milk production in both countries. At the same time, budgetary pressures in the EU, but not policy changes, were reducing the EU's ability to subsidize dairy product exports. Taken together, the two events reduced quantities of dairy products available to international markets. Buyers that normally obtained EU or Oceania dairy products were likely forced to find alternative sources to meet their immediate needs; and the United States was able to respond.

The United States had supplied international dairy markets before and had, after the immediate need for products was met, usually lost interest in them. The 1994 signing of NAFTA and the finalization of its rules in 2008 brought agricultural product markets in the US, Mexico and Canada into closer alignment, but not for all product sectors.

Mexico has been and still is a major market for nonfat dry milk (NFDM). Prior to 2006, Liconsa, a government enterprise that provides nutritional assistance to low-income Mexican households, was the primary buyer of US–NFDM. However, it has changed its emphasis to purchasing and distributing domestically produced fluid milk products (Zahniser et al. 2015). There have also been consistent exports of consumer products from the United States to Mexico of fluid milk, butter and cheese as well.

Canada, which under the NAFTA structure has maintained its use of a milk supply management policy and the associated protections in place to minimize domestic industry impacts from dairy imports, is not a major dairy importing nation from any country. However, there have been US exports of milk ingredients such as whey and casein and consumer products like fluid milk and cream to the country over time.

The global recession of 2008–2009 provided a first test of the US dairy industry's resolve to remain engaged in commercial exporting of milk and dairy products. Export volume fell from 2.52 billion pounds (total solids) to 2.03 billion but rebounded in 2010 to 2.98 billion. The annual value of dairy exports fell from about $3.8 billion in 2008 to $2.2 billion in 2009 (a 42% decline) then rebounded to almost $3.7 billion in 2010, essentially fully recovering the previous loss. The dairy export volumes and values have continued to increase since, although they did slow in the latter half of 2014.

The continued US participation in bi-and multi-lateral trade agreements has also been a basis for interest in dairy export opportunities. The United States has finalized, or is currently in negotiations of, sixteen free trade or trade promotion agreements that include twenty individual countries in all parts of the world (Office of the United States Trade Representative, https://ustr.gov/). Only three (3) of these agreements were concluded prior to 2000, with Israel (1985), Canada (1988), and Mexico under NAFTA (1994). The Korea–US Free Trade Agreement (KORUS) is a recent example of how these efforts have had important impacts on the US dairy industry. By adjusting tariffs and other restrictions under KORUS, the value of US dairy product exports to Korea grew to $417 million. Fresh cheese exports alone accounted for $199 million— up 575% from the pre-KORUS base level ($30 million).

Export data for selected dairy products in Table 2 also illustrate the growth of the United States as a major dairy exporting nation. US exports for most of the products declined from 2008 to 2009, the end of the Great Recession. Butter exports had spiked in 2008 so the fall was large (85%) and the smallest decline was about 9% for the other-than-American cheese category. The recovery of dairy exports seen in 2010, by 259% in butter, 116% in American cheese, 82% in nonfat dry milk, 46% in other than American cheese, and 30% in whey products were indicative the US industry's continued interest in exporting.

Table 2. Selected dairy product exports, in million pounds, US 2000–2014 [2]

Year	Milk in all products [1]	Butter	American cheese	Other cheese	Nonfat dry milk [2]	Whey products
2000	1,876	1.4	18.1	76.1	43.9	414.8
2001	2,571	3.3	18.3	92.1	40.9	376.2
2002	2,283	3.0	24.4	92.4	1.0	397.3
2003	2,113	0.3	23.3	85.5	5.0	363.9
2004	3,137	13.0	30.8	98.1	262.1	444.0
2005	2,791	9.7	33.0	94.4	486.6	593.2
2006	3,080	18.5	32.2	124.4	631.8	741.7
2007	5,433	72.6	61.9	157.6	568.6	936.6
2008	8,782	175.4	89.0	200.2	862.2	772.6
2009	4,329	26.1	53.3	182.7	464.3	790.3
2010	8,452	93.6	115.2	266.6	845.8	1023.2
2011	9,389	115.1	160.9	335.3	959.2	1020.2
2012	8,810	95.5	163.2	410.0	980.1	1077.2
2013	12,353	178.3	200.0	497.2	1223.1	1149.5
2014 [3]	12,469	130.2	222.1	590.8	1203.6	1148.9

Note. [1] Milk equivalent, milkfat basis [2] For human consumption, after 2004 production includes Skim Milk Powder [3]Preliminary

Sources. USDA-FAS and UDA-ERS calculations.

In addition to identifying the products that are exported, it is also important to identify major export destinations when assessing the current US trade strategy. The top five (5) export destinations in 2000 and in 2014 for dairy product categories as defined by USDA's Foreign Agricultural Service (FAS 2016) are shown in Table 3.

Table 3. Top five US dairy export markets for dairy products, 2014 and 2000

2014					
Butter & Milkfat	Saudi Arabia	Iran	Morocco	Mexico	Egypt
Casein	Mexico	Canada	China	Germany	Brazil
Cheese & Curd	Mexico	South Korea	Japan	Australia	Canada
Condensed & Evaporated Milk	Mexico	China	Vietnam	South Korea	Malaysia
Dry Whole Milk & Cream	Vietnam	Mexico	China	Algeria	Colombia
Fluid Milk & Cream	Canada	Mexico	Taiwan	China	Hong Kong
Ice Cream	Mexico	Saudi Arabia	United Arab Emirates	Canada	Australia
Non-Fat Dry Milk	Mexico	Philippines	Indonesia	China	Vietnam
Other Dairy Products	Canada	China	Mexico	New Zealand	Japan
Whey	China	Mexico	Canada	Japan	Philippines
Yogurt & Other Fermented Products	Mexico	Philippines	Australia	Trinidad & Tobago	Canada
2000					
Butter and Milkfat	Mexico	Canada	Dominican Republic	Nigeria	Israel
Casein	Argentina	Canada	Brazil	Mexico	Chile
Cheese and Curd	Canada	Mexico	Japan	South Korea	Venezuela
Condensed and Evaporated Milk	Mexico	Venezuela	Australia	Canada	Argentina
Dry Whole Milk and Cream	Russia	Algeria	Yemen	Haiti	Tajikistan
Fluid Milk and Cream	Mexico	Hong Kong	Taiwan	Palau	Malaysia
Ice Cream	Japan	Mexico	United Kingdom	Canada	Hong Kong
Non-Fat Dry Milk	Mexico	Russia	Philippines	Dominican Republic	Indonesia
Other Dairy Products	Canada	Taiwan	Japan	Philippines	Mexico
Whey	Canada	Mexico	Japan	Philippines	China
Yogurt & Other Fermented Products	Mexico	Canada	Denmark	Australia	United Kingdom

Source. USDA–FAS

The previously mentioned importance of Mexico and Canada as destinations for US dairy products is seen in the table. Mexico appears as an export market for all eleven product categories in both 2014 and 2000 with one exception (Dry Whole Milk and Cream in 2000). Canada is also a market for several product categories in both years. Focusing on markets other than Mexico and Canada, we see that in today's (2014) global markets, US dairy export interests have shifted toward not only China, but also to other countries in Asia and the Pacific region There has also been recent interest by countries in North Africa and the Middle-east importing US dairy products.

US Domestic and International Dairy Market Linkages

The US dairy market is large but mature. Mature markets often exhibit only relatively slow growth in population and, as the characteristics and dynamics of that population change, supply and demand relationships among dairy products change as well. The continuing steady growth of US milk production suggests that additional dairy product markets, including international ones, need to be established and nurtured. Otherwise, milk price and industry supply chain issues may appear in the US. Export sales help support US producer milk prices when the domestic

economy itself may be sluggish and affect dairy product stocks and their potential impacts on domestic prices.

In general, export markets carry benefits and risks beyond US control. Macroeconomic factors that affect currency exchange rates are a fundamental issue to consider. US dairy exporters need to be cognizant of the strength or weakness of the US dollar relative to a competing exporting country's currency and to the currency in a potential export market. A weaker dollar is advantageous for exporting US produced products. For an extended period, from 2003 to 2012, the US dollar was, in general, steadily depreciating relative to other currencies. That depreciation provided support for increased US agricultural exports, including milk and dairy products (Cooke et al. 2016). When the dollar is strong, the US becomes more attractive to exporters so US milk and dairy product imports may increase. While clearly important, exchange rate conditions are not the only important factor affecting trade.

The ban on some imports of dairy products imposed by Russia that has been extended for some time illustrates such a risk. Along with China, Russia has become a key market for traded agricultural products as its food economy has been buffeted by several factors (Liefert and Liefert 2015). Since US dairy product exports to Russia were not large, the direct effects of the ban are small. However, significant indirect effects may be seen as other dairy product exporters banned from sales to Russia, in this case mainly EU countries, redirect exports into markets where they will more directly compete with existing US imports. What had been essentially a seller's market is transformed into a buyer's market as alternative product supplies appear. Unique events such as import bans are not the only sources of risk in export markets.

There is seasonality that affects supplies since the major exporters of dairy products are located in both the Northern and Southern hemispheres. Unexpected or more severe than usual weather conditions can also significantly alter milk production, as can other natural disasters. Transportation issues involving ports are also potentially disruptive for dairy trade as the recent actions at the Ports of Los Angeles and Long Beach highlighted.

Even though the World Trade Organization (WTO) has made agricultural trade more transparent by establishing tariff-based regulations, heated agricultural trade debates have not been eliminated. The political power of agricultural organizations to influence trade policy is still strong in many countries. Sanitary and phyto-sanitary regulations are often cast in terms of food quality and safety issues but as non-tariff based regulations they can hide elements of economic protectionism.

The release of the Bain Report (Innovation Center for U.S. Dairy 2009) may have had a role in determining the US industry response to commercial exporting opportunities since its publication. Four potential US dairy trade strategies were outlined in the report: "Fortress USA", Status Quo, Consistent Exporter and Global Dairy Player. The Innovation Center Board of Directors recommended following the Consistent Exporter strategy that included six (6) components:

1. commitment to global opportunities,
2. broad efforts to improve commercial focus and align product portfolios,

3. collective efforts to reform US dairy policy/programs,
4. efforts to improve forward contracts, futures markets,
5. maintaining a strong domestic market as the basis for trade, and
6. joint efforts in the industry to build insight/capabilities.

The question is, how is this strategy working for the US dairy industry? Our answer is, we believe "Quite well." There have been notable results achieved for all of the elements but here we consider only elements 1, 2 and 6 since they are those where greater changes in industry perspectives would likely have been required.

International dairy market participants must balance changing demand conditions in local markets with competing for reliable supplies of milk and dairy products from international market sources. The US dairy industry is an attractive target for foreign investment of various kinds (Blayney et al. 2006). Joint ventures and agreements with major international trading organizations such as Fonterra (New Zealand) and Glanbia (Ireland) have marked US dairy industry efforts to build the insights and capabilities to become more engaged in exporting. Such agreements linked the large, relatively stable supplies of US dairy products with international trading expertise. The US "side" of several of these agreements has been Dairy Farmers of America (DFA), the largest farmer-owned dairy cooperative in the country.

Proprietary US dairy companies have also made major commitments to this effort. Both Hilmar Cheese Co. and Leprino Foods made major investments in building dairy product capacity after 2000. Hilmar and Leprino have extensive cheese manufacturing capacity which also brings with it large quantities of whey that can be further processed. A look at the websites of these companies shows how they have developed an extensive range of whey and dry products that can meet customers' specifications.

Dairigold, another US farmer-owned dairy cooperative, added dry whole milk production capabilities to its operations during renovation of its manufacturing facilities in 2013. The action illustrates a commitment to bring back production of a product that had shown demand growth in international markets. DFA followed suit by constructing a state of the art dry milk plant in Nevada to supply Chinese dry whole milk demands and has also announced plans for a joint venture with a Chinese dairy cooperative for a plant in western Kansas. It is clear that US dairy businesses have been making broad efforts to improve commercial focus and align product portfolios to meet the demands of international customers. These efforts also strengthen the US domestic dairy product markets as changing consumer tastes and preferences appear.

Can We Find Empirical Evidence for Claims?

The narrative of how the US dairy industry has changed from a sporadic to a consistent supplier to international markets is well-documented. But if the structure of total domestic US demand for milk and dairy products has been changed due to more involvement in export markets, does industry data offer any empirical clues to support that claim?

Major empirical modeling is not the purpose here. Instead, some basic exploratory analysis of selected aggregate data is provided. Given the apparent changing role of the US in commercial

exports of dairy products, a method of assessing various indicators of changing trade polices (Diakosavvas 2001) is used for the analysis. The four indicators suggested by Diakosavvas were calculated using the aggregate milk equivalent, fat basis data previously shown in Table 1.

Each indicator is defined as a ratio. Trade Openness is the ratio of imports plus exports to production, Import Penetration is the ratio of imports to consumption, Export Performance is the ratio of exports to production, and Net Trade Performance is the ratio of the difference between exports and import to the sum of the two. The trade indicators are examined in a before and after framework as in the study by Jones and Blayney (2004) that focused on three particular dairy products and eight countries.

The before and after framework lends itself to nonparametric statistical analysis. As a general statement, nonparametric tests are not as powerful as parametric tests that depend on distributional assumptions. The before (Pre-WTO) period is 1995 to 2000 and the after (Post-WTO) period is 2001 to 2014. Such a framework permits analysis (tests) of means, medians, and variances across subsamples of a single data series. The tests are based on the assumption that the subsamples are independent. Table 4 shows the average values and the difference between them of aggregate production, consumption, imports, exports, and the calculated Trade Policy Indexes.

Table 4. Mean and median summary of data and trade indicators for pre- and post-WTO time frames

	Pre-WTO	**Post-WTO**		**Pre-WTO**	**Post-WTO**	
Data (Million pounds)	Average		Difference	Median		Difference
Production	19,642.4	23,152.4	3,510.0	19,384.8	23,338.0	3,953.2
Commercial Disappearance	18,908.7	21,253.5	2,344.8	18,780.1	21,496.9	2,716.8
Exports	638.4	2,275.4	1,637.0	614.9	2,148.0	1,533.1
Imports	554.3	742.7	188.4	543.3	765.2	221.9
Indexes						
Trade Openness	0.060	0.128	0.068	0.059	0.132	0.072
Import Penetration	0.029	0.035	0.006	0.029	0.038	0.009
Export Performance	0.032	0.096	0.063	0.031	0.094	0.063
Net Trade Performance	0.079	0.433	0.354	0.101	0.467	0.366

The nonparametric test results for the four trade indexes are reported in Table 5. The null hypothesis being tested for each index is the means of the two subsamples and the medians of the two subsamples are equal against the alternative in each case that they are not equal. As a practical matter, analysts may choose any single test to report but in this case all of the tests available in the chosen statistical package (E-Views 8) are shown.

Table 5. Tests for equality of the means and medians of dairy trade indicators

	Trade Openness		Import Penetration		Export Performance		Net Trade Performance	
Means								
Method	Value	Probability	Value	Probability	Value	Probability	Value	Probability
t-test	4.7774	0.0002	1.9601	0.0657	3.8991	0.0011	3.2839	0.0041
Satterthwaite-Welch	6.9964	0.0000	1.8834	0.0932	6.0002	0.0000	4.5085	0.0003
Anova F-test	22.8237	0.0002	3.8420	0.0657	15.2029	0.0011	10.7843	0.0041
Welch F-test	48.9498	0.0000	3.5472	0.0932	36.0022	0.0000	20.3261	0.0003
Medians								
Method	Value	Probability	Value	Probability	Value	Probability	Value	Probability
Wilcoxon/Mann-Whitney	3.4229	0.0006	1.9382	0.0526	3.4229	0.0006	2.5156	0.0119
Wilcoxon/Mann-Whitney (tie-adjusted)	3.4229	0.0006	1.9382	0.0526	3.4229	0.0006	2.5156	0.0119
Median Chi-square	8.5714	0.0034	0.9524	0.3291	8.5714	0.0034	8.5714	0.0034
Adjustd Median Chi-sq.	5.9524	0.0147	0.2381	0.6256	5.9524	0.0147	5.9524	0.0147
Kruskall-Wallis	12.0000	0.0005	3.9184	0.0478	12.0000	0.0005	6.5374	0.0106
Kruskall-Wallis (tie-adjusted)	12.0000	0.0005	3.9184	0.0478	12.0000	0.0005	6.5374	0.0106
van der Waerden	11.5211	0.0007	4.4780	0.0343	11.5211	0.0007	6.3530	0.0117

Note. Estimates calculated using E-views 8 statistical software.

The probabilities indicate relatively strong rejections (5% or less) of the null hypotheses in most cases except for the Import Penetration indicator. The tests tend to support the notion that growing commercial export opportunities for the US after 2000 have changed the dairy export situation of the United States.

The nonparametric analysis does offer some interesting glimpses at the changing export position of the United States in what has been called the Post-WTO period. However, that analysis is based on a milk equivalent basis. It has been suggested that many interested readers might better follow discussions cast in terms of specific products. There is no specific statistical testing of the product data that follows.

It has been suggested that exchange rate for various dairy products are important for exporters to be aware of. The following table, Table 6 is a reprise of the previous Table 2. Included are annual real trade-weighted values for the US dollar (defined as an index) for the 2000–2014 period.

Table 6. Selected dairy product exports and trade-weighted US dollar exchange rate, 2000–2014 [2]

Year	Milk in all products [1]	Butter	American cheese	Other cheese	Nonfat dry milk [2]	Whey products	Real trade-weighted dollar exchange rate index [3]
	million pounds						
2000	1,876.0	1.4	18.1	76.1	43.9	414.8	116
2001	2,571.0	3.3	18.3	92.1	40.9	376.2	123
2002	2,283.0	3.0	24.4	92.4	1.0	397.3	124
2003	2,113.0	0.3	23.3	85.5	5.0	363.9	121
2004	3,137.0	13.0	30.8	98.1	262.1	444.0	117
2005	2,791.0	9.7	33.0	94.4	486.6	593.2	114
2006	3,080.0	18.5	32.2	124.4	631.8	741.7	112
2007	5,433.0	72.6	61.9	157.6	568.6	936.6	108
2008	8,782.0	175.4	89.0	200.2	862.2	772.6	103
2009	4,329.0	26.1	53.3	182.7	464.3	790.3	106
2010	8,452.0	93.6	115.2	266.6	845.8	1,023.2	100
2011	9,389.0	115.1	160.9	335.3	959.2	1,020.2	96
2012	8,810.0	95.5	163.2	410.0	980.1	1,077.2	97
2013	12,353.0	178.3	200.0	497.2	1,223.1	1,149.5	98
2014 [4]	12,469.0	130.2	222.1	590.8	1,203.6	1,148.9	100

Note. [1] Milk equivalent, milkfat basis
[2] For human consumption, includes skim milk powder after 2004
[3] 2009 dollars, base year 2010 = 100
[4] Preliminary
Sources. USDA-FAS and USDA-ERS

Analyzing the correlation between each product's quantity of exports and the trade-weighted dollar index shows the relationship that is expected. The estimated correlation coefficients range from a high of -0.95 for whey products to a low of -0.81 for the other than American cheese style products. The negative correlation implies that as the US dollar weakens (depreciates) there is a positive effect on exports. Likewise the appreciation of the US dollar results in a negative trade effect. The trade-weighted index in this case is for all agricultural products, not just dairy products but the results are as expected. A more sophisticated empirical model would be able to cast the results in terms of elasticity measures. Also, a dairy-trade weighted index could be employed to gain further insights.

A Pre- and Post WTO classification has also been implemented to examine alternative statistical measures associated with the quantities and values of US dairy products. The two following tables, Table 7 and Table 8 contain summary data on specific product exports.

From 1995 to 2000, some dairy exports such as whey grew 60% in value, compared to a 45% increase in cheese and curds, and 19% increase in non-fat dry milk. Whey exports were the US largest dairy market followed by nonfat dry milk. On average, the US exported 10,941 metric ton of whey over six years at an average value of $10.4 million. While some dairy products grew at a very moderate rate, other dairy products like dry whole milk, butter and milk-fat experienced declines in exports over the observed period. During this period, dry whole milk declined 61% in volume and 63% in value. Butter and milk-fat were hardest hit dropping 79% in volume and 89% in value from 1995 through 2000.

After the URAA was fully implemented, a new trade regime was established which helped bring forth waves of US dairy trade flows. Over the past fourteen years, US dairy exports have increased more than seven-fold. Whey continues to be the US largest dairy market averaging over 29,253 metric ton and $40.62 million in export value (Table 8). In March of 2014, whey exports totaled 53,224 metric tons compared with only 19,081 metric tons before 2001. March 2014 is the largest US whey trade recorded.

Table 7. US Dairy Exports, Pre-Implementation of the Uruguay Round (UR) Agreement (1995–2000)

Variable	Mean	SD	Max	Min
Quantity metric tons				
Whey	10,940.94	2,726.47	19,081.60	5,848.90
Nonfat dry milk	6,088.82	4,332.01	18,554.00	245.80
Dry whole milk	3,102.98	2,438.74	9,296.80	450.80
Butter and milk fat	1,538.95	2,461.44	17,073.40	57.80
Cheese and curd	3,089.14	618.37	4,795.40	1,809.10
Value ($1000)				
Whey	10,413.08	1,973.01	17,144.00	6,005.00
Nonfat dry milk	9,856.54	6,438.14	27,826.00	291.00
Dry whole milk	4,563.83	4,115.70	14,316.00	465.00
Butter & milk fat	2,226.25	2,918.33	1,478.00	85.00
Cheese & Curd	9,808.88	1,890.24	14,311.40	5,645.00

Source. USDA-FAS dairy export data for selected years. Descriptive statistics were calculated by the authors.

The United States is the second largest, in terms of volume, dairy market in nonfat dry milk. From 2001 through 2014, the US average monthly export of nonfat dry milk totaled 25,834

metric tons at a value of $76.16 million (Table 8). A record setting shipment (60,710 metric tons) of US nonfat dry milk was achieved in June 2014. The growth in nonfat dry milk exports is tremendous when June 2014 volume is compared to February 2002 volume of 1,515 metric tons.

Of the five dairy products, butter and milk-fat experienced the greatest increase in volume (almost eighteen-fold) and value (over fifty-fold), followed by cheese and curd, nonfat dry milk, whey, and dry whole milk. Dry whole milk has grown the least of the dairy products due to society increasing demand for healthier foods.

Table 8. US Dairy Exports, Post-Implementation of the Uruguay Round (UR) Agreement (2001–2014).

Variable	Mean	SD	Max	Min
Quantity metric tons				
Whey	29,253.17	11,342.76	53,224.60	10,927.40
Nonfat dry milk	25,834.59	14,083.98	60,709.80	1,515.40
Dry whole milk	2,729.09	2,081.16	16,194.40	312.60
Butter and milk fat	3,218.43	3,095.60	12,413.70	129.80
Cheese and curd	12,088.99	8,809.28	36,163.30	3,437.50
Value ($1000)				
Whey	40,617.05	26,041.87	104,646.00	7,829.00
Nonfat dry milk	76,159.12	57,623.39	231,589.00	2,566.00
Dry whole milk	5,947.15	4,890.50	21,151.00	426.00
Butter & milk fat	10,802.31	11,701.80	49,302.00	242.00
Cheese & Curd	49,587.51	41,134.06	162,933.40	10,334.00

Source. USDA-FAS dairy export data for selected years. Descriptive statistics were calculated by the authors.

Conclusions

The US dairy industry has grasped the opportunity to increase its footprint in international export markets during the last decade by following the strategy to be a consistent exporter. Industry-wide and individual dairy business efforts required to maintain the strategy have been made and appear to be expanding to meet future trade opportunities as they arise. There have been some commentaries that suggest the United States can respond quickly to export opportunities but may not have a long-term willingness to maintain efforts or even expand them to keep them. The reported investments by US companies since about 2005 to meet the recommendation to remain a consistent exporter of high-quality and desired products suggest otherwise.

The preliminary analyses provide insights for more detailed and complete analysis of the assertion that the growth in US commercial exports has altered the domestic dairy demand in the country. As one reviewer mentioned to the authors, such an analysis would likely be more useful for specific product rather than aggregate measures of milk. The export data indicates that the US has directed major efforts toward exporting dry products such as nonfat dry milk, whole milk powder and dry whey products. These are the products the US has focused on manufacturing and exporting for some time. However, opportunities may exist for more exports of the other traditional products like cheese and butter as well as new export markets emerge.

The decline seen in US dairy exports in 2014 has continued into 2015 and several concerns have been raised in that regard. The changing dairy product import demands of China and Russia is one factor but there has also been a surge in world-wide milk production. These supplies and demands must be balanced. It has been noted that the general decline observed for the aggregate measures of milk and dairy products do not translate into consistent declines among individual products. There are many unknowns in both domestic and export markets for dairy, and indeed for all, food products. As issues such as climate change, the use of agricultural technologies, including biotechnology, and food safety, security, and availability are debated and, hopefully resolved, dairy and other agricultural trade relationships will face adjustments.

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Appendix

Table A1. Annual commercial disappearance, milk in all products, milk-equivalent milk-fat basis, 1995–current (millions of pounds)

Table A1. Annual commercial disappearance, milk in all products, milk-equivalent milk-fat basis, 1995–current (Millions of pounds)

Year	Beginning commercial stocks [A]	Farm Milk Supply: Production	Farm Milk Supply: Farm use	Farm Milk Supply: Marketing [B]	Imports [C]	Total supply [A+B+C]	USDA net removals [1]	Commercial Use: Domestic commercial disappearance	Commercial Use: Commercial exports [2]	Commercial Use: Total commercial disappearance	Ending commercial stocks [3]
1995	4,164	155,292	1,556	153,736	2,293	160,193	2,096	151,005	3,059	154,064	4,033
1996	4,033	154,006	1,476	152,530	2,651	159,214	87	151,782	2,682	154,464	4,663
1997	4,663	156,091	1,394	154,697	2,918	162,278	1,092	154,531	1,833	156,364	4,822
1998	4,822	157,262	1,377	155,885	4,868	165,575	367	158,180	1,831	160,011	5,197
1999	5,197	162,589	1,326	161,263	4,948	171,409	346	163,463	1,532	164,996	6,067
2000	6,067	167,393	1,307	166,086	4,502	176,655	846	167,149	1,876	169,025	6,784
2001	6,784	165,332	1,209	164,123	6,491	177,398	145	167,707	2,571	170,278	6,976
2002	6,976	170,063	1,119	168,944	6,151	182,070	327	169,662	2,283	171,945	9,799
2003	9,799	170,348	1,127	169,221	6,172	185,192	1,161	173,650	2,113	175,763	8,268
2004	8,268	170,832	1,115	169,717	7,028	185,013	-72	174,860	3,137	177,997	7,088
2005	7,088	176,931	1,095	175,836	7,425	190,349	-40	179,669	2,791	182,460	7,929
2006	7,929	181,782	1,081	180,701	7,489	196,119	14	183,578	3,080	186,658	9,447
2007	9,447	185,654	1,089	184,565	7,180	201,191	0	185,456	5,433	190,889	10,302
2008	10,302	189,978	1,068	188,910	5,264	204,476	24	185,679	8,782	194,461	9,991
2009	9,991	189,202	1,013	188,189	5,562	203,742	917	187,258	4,329	191,586	11,238
2010	11,238	192,877	980	191,897	4,055	207,190	262	187,661	8,452	196,113	10,816
2011	10,816	196,255	965	195,290	3,510	209,616	0	189,361	9,351	198,712	10,904
2012	10,904	200,642	956	199,686	4,078	214,668	0	193,663	8,810	202,473	12,195
2013	12,195	201,231	977	200,254	3,722	216,171	0	192,639	12,359	204,998	11,173
2014	11,173	206,054	964	205,090	4,315	220,579	0	196,911	12,444	209,355	11,224
2015	11,224	208,633	969	207,664	5,685	224,572	0	202,498	8,761	211,259	13,313

Notes. [1] The Dairy Products Price Support Program and the Dairy Export Incentive Program were repealed by the Agricultural Act of 2014. USDA net removals = price support purchases + Dairy Export Incentive Program exports - unrestricted sales of stocks held by USDA Commodity Credit Corporation (CCC). USDA conducted a barter program in 2009 and 2010; Government stocks of nonfat dry milk were exchanged for products containing substantial dairy content. Although barters are different from USDA net removals, the net transfer of milk-equivalent milk fat from the commercial market to the Government was added to USDA net removals in this table.

[2] Commercial exports = total exports - Dairy Export Incentive Exports - Government donations to foreign countries.

[3] Includes commercial stocks of butter, American cheese, other-than-American cheese, nonfat dry milk, and dry whole milk.

Sources. USDA National Agricultural Statistics Service, USDA Farm Service Agency, USDA Foreign Agriculture Service, U.S. Department of Commerce Bureau of the Census, USDA Economic Research Service calculations.