Estimated Economic Impacts of Retaliatory Tariffs by China and Mexico on U.S. Dairy Products

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Executive Summary

- U.S. dairy exports totaled $5.4 billion during 2017. Two important markets for U.S. dairy products are Mexico, the leading market for many years and importers of $1.3 billion in dairy products in 2017, and China, the number three market for U.S. dairy exports at $577 million in 2017.

- New retaliatory Mexican tariffs of up to 25% on imports of U.S. cheese and Chinese tariffs of 25% above the most favored nation (MFN) rate on a wide range of U.S. dairy products exports will impact $390 million in cheese exports to Mexico and $408 million in dairy exports to China, consisting mainly of whey, dry milk, and cheese. The impacts of the new Chinese tariffs are exacerbated by their value added tax (VAT) of 16% added on top of the tariff resulting in price increases ranging from 21.7% on liquid milk to 24.5% on whey.

- During 2017, combined U.S. cheese exports to Mexico and dairy exports to China of $798 million required an additional $2.23 billion in supporting output resulting in $3.03 billion economic output and supported 10,302 jobs.

- Scenario 1 impacts of these retaliatory tariffs involves applying elasticities for the impacted dairy product exports to determine loss of exports and additional impacts. Scenario 1 estimated losses in U.S. dairy exports total $129.7 million per year, resulting in an annual loss of $414.9 million to U.S. dairy farmers due to both lower exports and milk prices that are lower by $0.172/cwt. The economy-wide economic losses would total $990.6 million per year and 4,840 jobs would no longer needed.

- Scenario 2 impacts of the retaliatory tariffs assumes all U.S. dairy exports to China and cheese exports to Mexico are lost with competitors absorbing many of these sales. Scenario 2 estimated losses in U.S. dairy exports total $798.5 million per year, resulting in an annual loss of $2.77 billion to U.S. dairy farmers due to both lower exports and milk prices that are lower by $1.154/cwt. The economy-wide economic losses would total $6.58 billion per year and 32,233 jobs would no longer needed.

- Scenario 3 impacts of the retaliatory tariffs assumes 42% of U.S. dairy exports to China and cheese exports to Mexico are lost if post-implementation losses were to continue. Scenario 3 estimated losses in U.S. dairy exports total $335.5 million per year, resulting in an annual loss of $1.17 billion to U.S. dairy farmers due to both lower exports and milk prices that are lower by $0.485/cwt. The economy-wide economic losses would total $2.77 billion per year and 13,358 jobs would no longer needed.

- The five-year effect of Mexican tariffs on U.S. cheese undermines the potential growth of U.S. cheese exports to a rapidly increasing market. Likewise, the five-year impact of Chinese tariffs on U.S. dairy products shows a significantly lower growth probability for whey and dry milk exports and a somewhat lower growth probability for cheese exports. Five-year losses to dairy farmers range from $2.07 billion to $13.87 billion depending on which scenario materializes.

Estimated Economic Impacts of Retaliatory Tariffs by China and Mexico on U.S. Dairy Products

Introduction

During recent months, U.S. tariffs have been placed on steel, aluminum and other products from various countries, and the re-negotiation of NAFTA has ranged from productive to contentious. As a result, some countries have levied and are planning to levy retaliatory tariffs on U.S. products, including tariffs by China and Mexico on imports of U.S. dairy products. These tariffs will lead to a decrease in U.S. dairy exports which will negatively impact U.S. dairy farmers and processors.

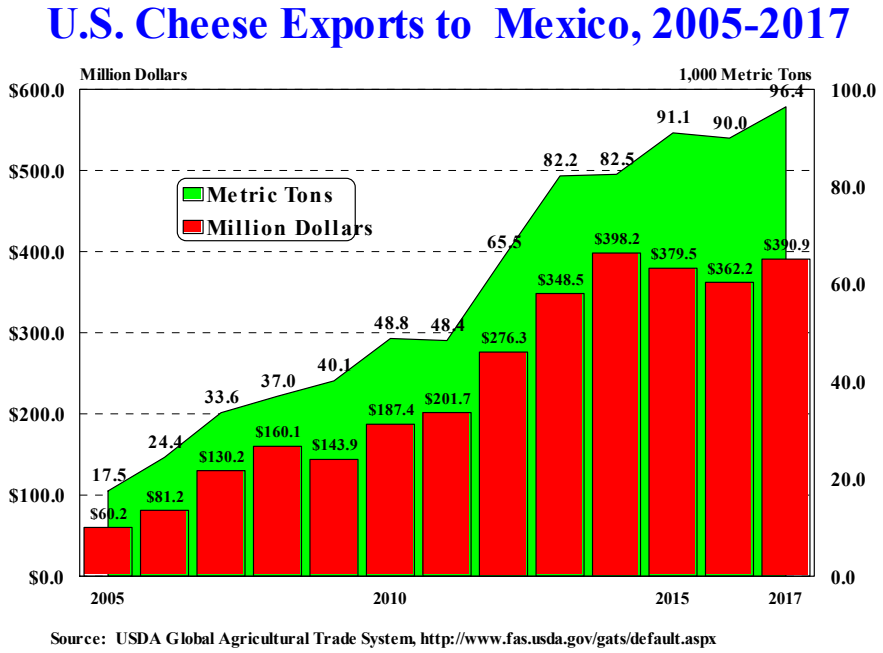
The purpose of this study was to estimate the impacts of new Mexican tariffs of up to 25 percent on fresh cheese, grated, shredded and powdered cheese, hard and semi-hard cheeses, and other cheeses, and Chinese tariffs of 25 percent over the most favored nation (MFN) rate on a wide range of U.S. dairy products including fluid and solid milk and cream, yogurt, buttermilk, whey, milk protein concentrates, butter, fats, and various cheeses. The impacts on the volume and value of U.S. dairy exports were estimated using statistical and Monte Carlo simulation modeling after it was determined that the use of partial equilibrium modeling was not appropriate for this analysis. Finally, additional economic impacts in terms of output and jobs on dairies, in dairy processing, and throughout the economy due to the decrease in U.S. dairy exports have been estimated using IMPLAN. Finally, U.S. dairy export losses through 2022 have been forecast, including consideration of a growing Chinese market and a successful Mexico-European Free Trade Agreement expected by 2020.

Background

The U.S. dairy and dairy products industries, like most other U.S. agricultural products, are heavily dependent upon international markets for profitability with about fifteen percent of dairy products production being exported. This amounted to about $5.4 billion in U.S. dairy exports during 2017. Two important markets for U.S. dairy products are Mexico, the leading market for many years and importers of $1.3 billion in dairy products in 2017, and China, the number three market for U.S. dairy exports at $577 million in 2017.

During the recent round of tariff escalation, Mexico has chosen to impose a 25 percent tariff on most U.S. cheese exports. During 2017, Mexico was the leading market for U.S. cheese exports with 96.4 thousand metric tons in purchases valued at $391 million. (Figure 1) Slightly more than $380 million of U.S. cheese exports to Mexico will be subject to the new 25 percent tariff levied July 5, 2018, while the remaining $10 million consisting of processed cheese now faces a twenty percent tariff. These new tariffs coupled with Mexico's recent trade agreement with the European Union, the leading competitor for U.S. cheese exports to Mexico, could result in both short and longer-term negative impacts on U.S. cheese exports and the U.S. dairy industry as a whole.

Figure 1.



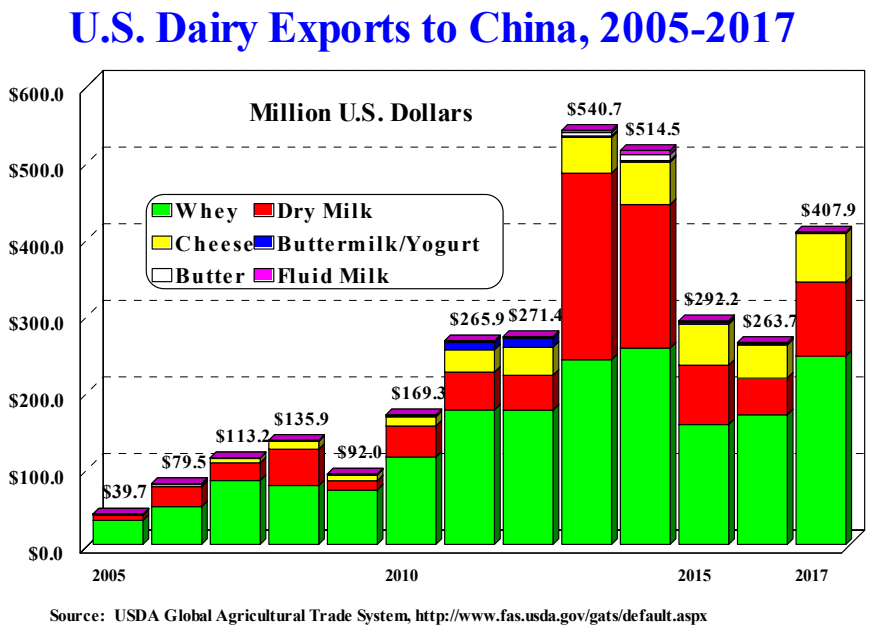
Source: USDA Global Agricultural Trade System, http://www.fas.usda.gov/gats/default.aspx

The new tariffs imposed by China could be even more problematic as they affect an entire array of U.S. dairy products exported to China valued at $407.9 million, or approximately seventy percent of the value of U.S. dairy shipments to China. (Figure 2) Not only are the tariffs increasing my 25 percent on all U.S. dairy products shipped to China, they are subject to a value added tax (VAT) of sixteen percent. This results in greater negative impacts from a tariff increase. For instance, China is the number one market for U.S. whey exports, importing $246 million in 2017. The tariff on U.S. whey increased from two percent to 27 percent on July 6. When the VAT is included, a total tax of 47.3 percent is now being levied on U.S. whey imports versus 18.3 percent before the tariff increase, or a 24.5 percent overall increase in price. Table 1 shows the impacts of each of the new tariffs including the VAT.

Table 1. Impacts Chinese VAT on the New Tariffs on U.S. Dairy Products

	Whey	Milk Powder	Cheese	Buttermilk/ Yogurt	Butter	Liquid Milk
Original Tariff (%)	2%	10%	8%	10%	10%	15%
Value Added Tax (VAT) (%)	16%	16%	16%	16%	16%	16%
Price Index with Original Tariff	1.02	1.10	1.08	1.10	1.10	1.15
Price Index with Original Tariff + VAT	1.18	1.28	1.25	1.28	1.28	1.33
New Tariff (%)	27%	35%	33%	35%	35%	40%
Price Index with New Tariff	1.27	1.35	1.33	1.35	1.35	1.40
Price Index with New Tariff + VAT	1.47	1.57	1.54	1.57	1.57	1.62
Change in Prices due to New Tariff (%)	24.5%	22.7%	23.2%	22.7%	22.7%	21.7%

Figure 2.



Using Elasticities to Estimate Impacts of Increased Tariffs

There are many ways to estimate the impacts of a tariff increase, and one of the most direct ways is to use the elasticity of demand for the product subject to the increased tariff. That is because an increase in tariff is essentially an increase in price, and the elasticity of demand for a product reveals the estimated change in quantity purchased, in this case a decrease in purchases, as a result of a change in price, here an increase in price due to increased tariff rates.

When adequate data are available, such as price and quantity for the product in question, price and quantity for substitutes and complements, income, and other variables, an elasticity of demand can be calculated for a specific set of circumstances. If those data are not available, other previously calculated elasticities are often used if a case can be made that the market for which the previously calculated elasticity was calculated has enough similarities with the market in question, in this case, Mexico and China. For the impacts of these new tariffs, a combination of newly and previously calculated elasticities was applied.

Mexico Cheese Tariffs and Estimated Impacts on U.S. Exports

On July 5, 2018, Mexico instituted a second increase in their tariff rate for U.S. cheese imports. This raised the tariff rate which was zero prior to June 5th and 15 percent for the intervening thirty days to 25 percent for most U.S. cheeses; the new tariff for processed cheese is 20 percent. After numerous attempts, it was determined that adequate data were not available to calculate a tariff specific to Mexican imports of cheese from the United States. However, it was further determined that the Mexican market for U.S. cheese imports is substantially similar to the U.S. market for cheese. Reasons for this include the fact that cheese purchased by Mexico from

the United States is dissimilar to much of the cheese produced in Mexico, that there are many substitutes, including other cheeses, for U.S. cheese in Mexico, the Mexican lifestyle is becoming more similar to the U.S. lifestyle from the types of retail outlets and restaurants to the expansion of the dual-income household, and particularly the recent high growth in U.S. cheese exports to Mexico from 2005–2014 before settling in a more narrow range.

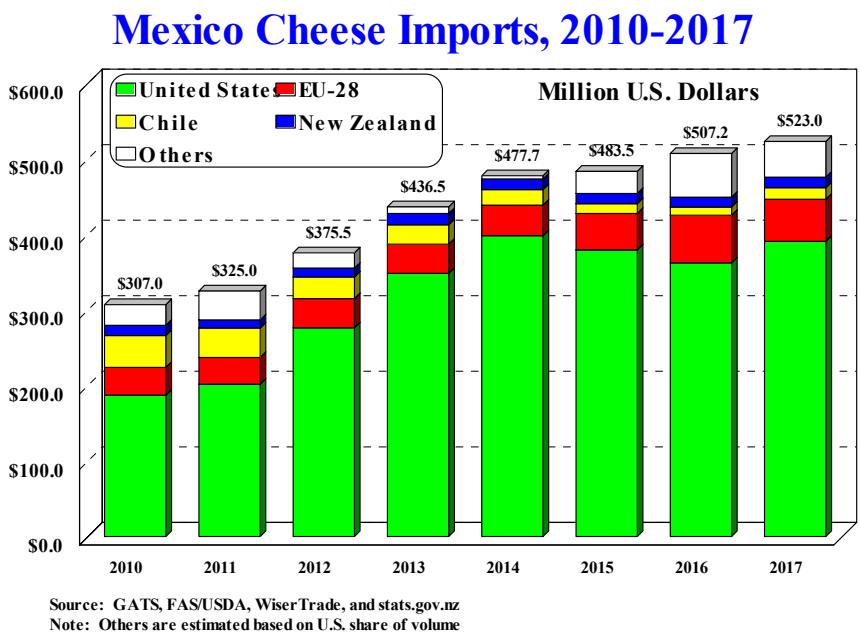
Thus, the elasticity of demand used for Mexican imports of U.S. cheese is the U.S. elasticity of demand for cheese: -0.7. What this elasticity means is that when the price of cheese increases by one percent, the quantity purchased of cheese declines by 0.7 percent. As a result, an increase in the tariff on most Mexican cheese imports from the United States from zero to 25 percent is essentially a 25 increase in the price of U.S. cheese in Mexico, and this will result in a 17.5 percent decrease in the quantity of most types of U.S. cheese purchased by Mexico. This decrease of cheese purchases is valued at $66.57 million. By the same token, a new 20 percent tariff on U.S. processed cheese exports to Mexico will result in a 14 percent decrease in purchases valued at $1.47 million. Total reductions in U.S. exports of cheese to Mexico are estimated to be $68.04 million for the first year of this tariff. Table 2 summarizes these estimates.

Table 2. Impacts of New Tariffs on U.S. Cheese Exports to Mexico

	Grated, Fresh, Non-Fresh, and Bleu Veined Cheese	**Processed Cheese**	**Total Cheese Exports to Mexico**
2017 Exports ($1,000)	$380,404	$10,490	$390,894
Original Tariff (%)	0.0%	0.0%	
Changes in Price starting July 5th (%)	25.0%	20.0%	
Changes in Quantity (%) with Import Elasticity = -0.7	-17.5%	-14.0%	
Changes in U.S. Export Values ($1,000) with Import Elasticity = -0.7	-$66,571	-$1,469	-$68,039

An important question is how long will these annualized losses in sales persist, and the fact is there are no easy answers to this question. One could posit that as long as the tariffs remain in place, the decrease in sales will continue. That may seem far-fetched to some because the market typically adjusts over longer periods, but given the fact that U.S. cheese is not the only cheese imported by Mexico, there is potential for Mexican cheese importers to switch to non-U.S. suppliers, and that would likely lead to long-term losses in sales. Figure 3 reveals that while U.S. cheese captures around three-quarters of the Mexican import market, there are competitors in the European Union (EU-28), Chile, and New Zealand. Uruguay is also a competitor in Mexico, but their data were unavailable. Mexico and EU-28 are nearing the implementation of a trade agreement, and this would grant EU-28 cheese exporters the increased market access that the United States previously enjoyed; this could have long-term implications particularly as the EU-28 share of the Mexican cheese import market has recently grown.

Figure 3.



Chinese Dairy Tariffs and Estimated Impacts on U.S. Exports

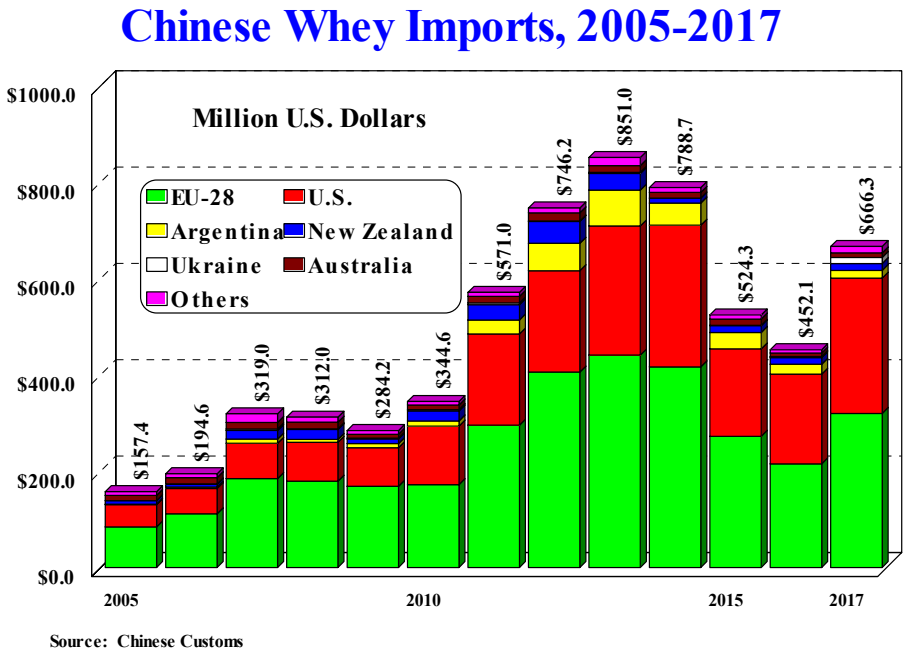
On July 6, 2018, China instituted an array of increased tariffs on U.S. dairy imports that, when coupled with their 16 percent VAT as shown above in Table 1, has recently led to significant increases in the prices paid by Chinese importers. These increases in prices paid range from 21.7 percent for liquid milk to 24.5 percent for whey. It was determined that there were adequate data to calculate the Chinese elasticity of demand for U.S. milk powder imports, which is estimated at -0.19. Though no other elasticities for Chinese imports of other U.S. dairy products could be calculated, previously published elasticities of demand for U.S. dairy products were available. Thus, the same proportional differences for U.S. dairy products as compared to the elasticity of demand in the United States for milk powder were applied to the Chinese elasticity of demand for U.S. milk powder. For instance, elasticity for milk powder in the United States is -0.3 and the U.S. elasticity for cheese is -0.7, or 2.33-times that of dry milk. As a result, the elasticity of demand for Chinese imports of U.S. cheese is estimated as 2.33*-0.19, or -0.44. This process was used for all U.S. dairy products exports to China impacted by the new tariffs and can be found in Table 3. This proportional approach seemed plausible because Chinese consumption many dairy products is growing and becoming more Western with the introduction of many restaurant chains; however, there are still significant differences in Chinese and U.S. consumption patterns and so U.S. elasticities would not directly apply.

Table 3. Chinese Elasticities of Demand for Imports of U.S. Dairy Products

Milk Powder – Calculated from Chinese Data	-0.19
Whey – Proportional based on U.S. Elasticity	-0.63
Cheese – Proportional based on U.S. Elasticity	-0.44
Butter – Proportional based on U.S. Elasticity	-0.54
Fluid Milk – Proportional based on U.S. Elasticity	-0.20

To calculate the impacts of these new tariffs in combination with the elasticities, Chinese Customs data were used as the baseline. The reason for this is that the Chinese market for dairy products is growing and fiercely competitive. The only source that could provide consistent data for Chinese imports by source was Chinese Customs. As a result, the dollar values for dairy imports from the United States from Chinese Customs were used to estimate the impacts of the increased tariffs. The Chinese data are similar but not identical to those noted above for which GATS, the FAS/U.S.DA agricultural trade database, was used. For the big three U.S. dairy exports to China, the Chinese source was 14 percent above the GATS value for whey, 14 percent below the GATS value for milk powder, and 4.6 percent lower than the GATS value for cheese. When considering these are vastly different sources, those differences are very small and nearly a wash in terms of combined value. Figures 4–9 show Chinese dairy imports by origin, which also include modest markets for butter, buttermilk/yogurt, and fluid milk.

Figure 4.



Source: Chinese Customs

Figure 5.

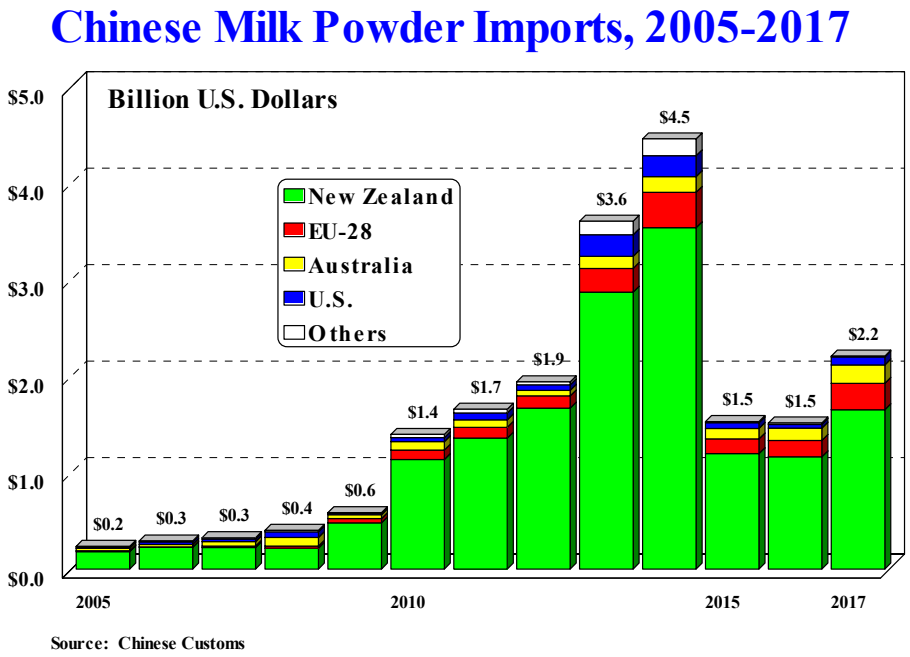


Figure 6.

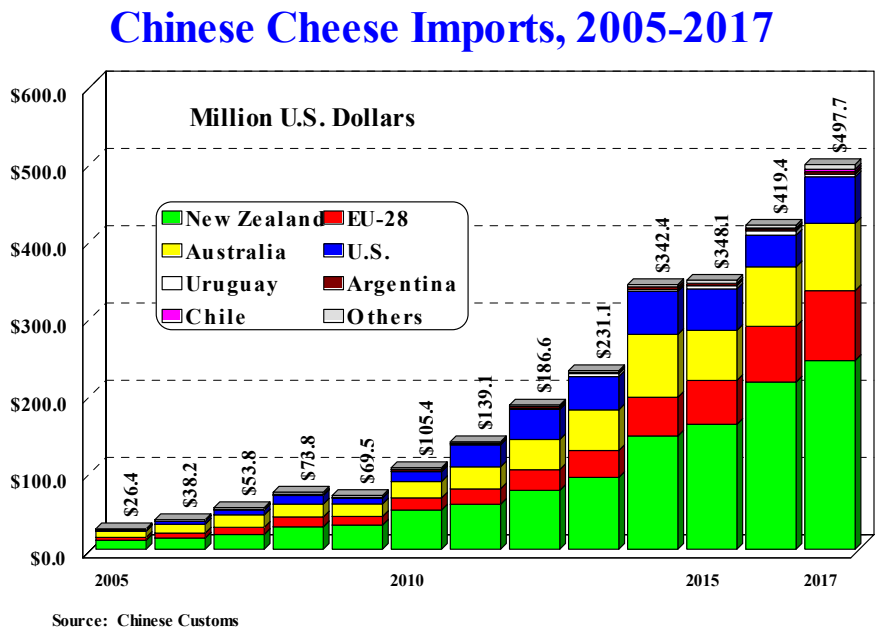


Figure 7.

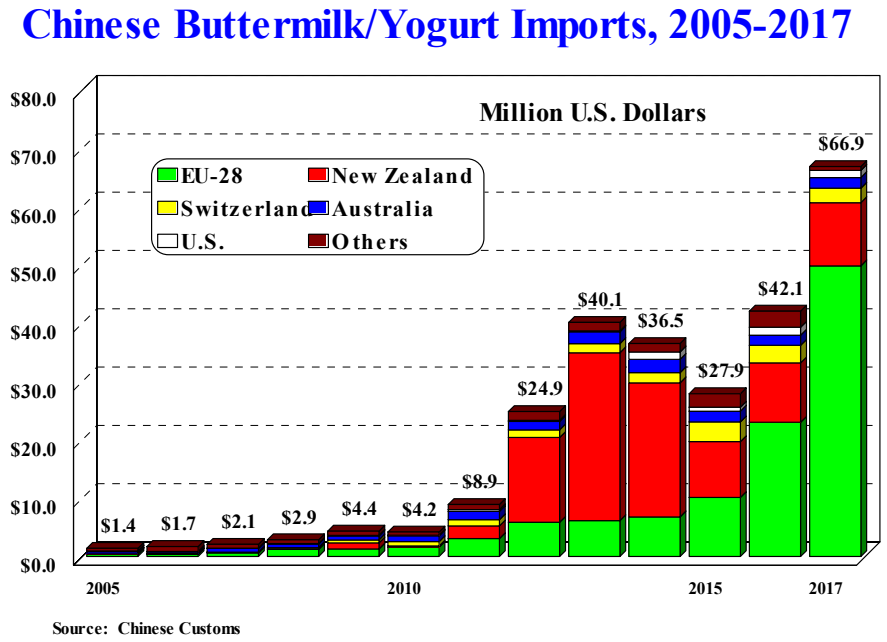


Figure 8.

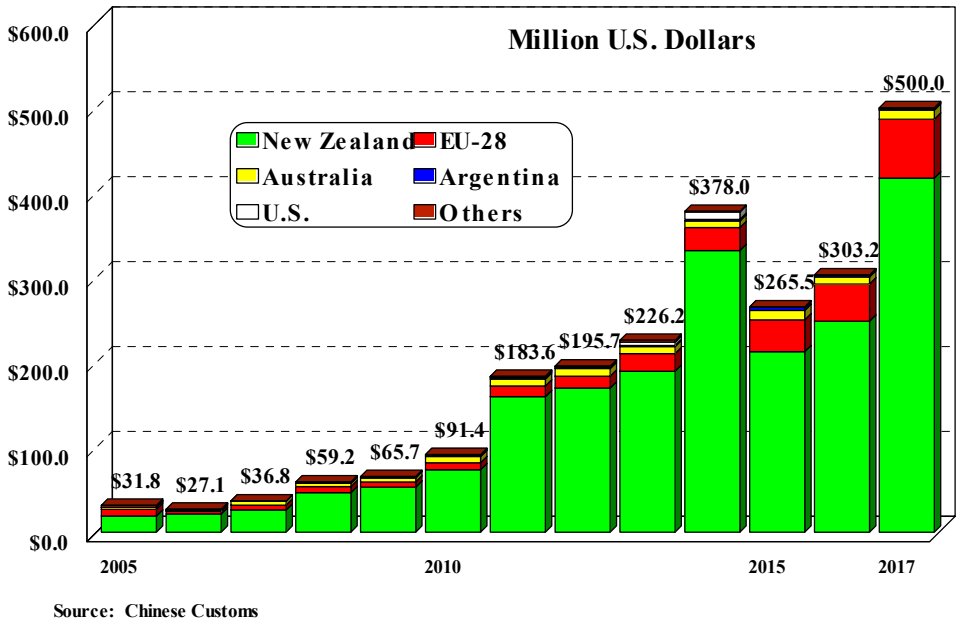
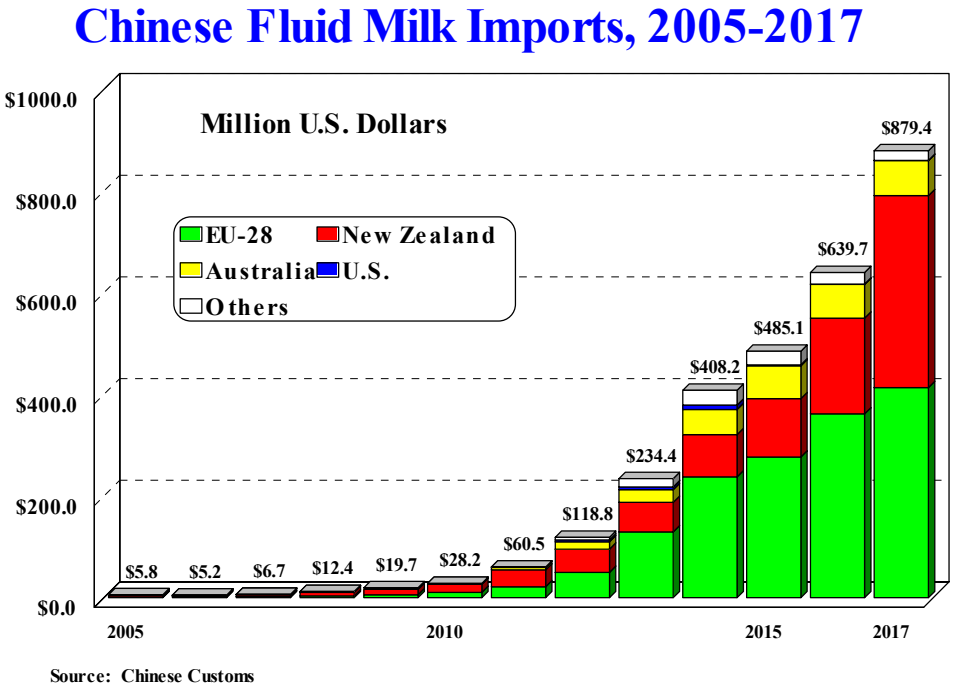


Figure 9.



As the new Chinese tariffs impact six U.S. dairy export categories, and each new tariff is different and started at non-zero levels, there is a bit more complexity but the process remains the same as with Mexico. It is estimated that the new tariffs will result in lost exports to China valued at $53.37 million, led by whey at $43.35 million less in exports, cheese ($6.18 million less), and dry milk ($3.59 million less). (Table 4) Buttermilk, yogurt, butter, and fluid milk combine for about $150,000 in export decreases to China.

Table 4. Impacts of New Tariffs on U.S. Dairy Exports to China

	Whey	Milk Powder	Cheese	Yogurt	Butter	Liquid Milk
Original tariff (%)	2%	10%	8%	10%	10%	15%
Price Index with Original Tariff	1.02	1.10	1.08	1.10	1.10	1.15
Price Index with Original Tariff and 16% VAT	1.18	1.28	1.25	1.28	1.28	1.33
New tariff (%)	27%	35%	33%	35%	35%	40%
Price Index with New Tariff	1.27	1.35	1.33	1.35	1.35	1.40
Price Index with New Tariff and 16% VAT	1.47	1.57	1.54	1.57	1.57	1.62
Changes in prices (%)	24.51%	22.73%	23.15%	22.73%	22.73%	21.74%
Elasticity of Demand for Imports from U.S.	-0.630	-0.190	-0.443	-0.538	-0.538	-0.196
Changes in Quantity (%)	-15.4%	-4.3%	-10.3%	-12.2%	-12.2%	-4.3%
2017 U.S. Export Value ($1,000)	$280,726	$83,147	$60,235	$650	$478	$276
Changes in U.S. Export Value ($1,000)	-$43,347	-$3,590	-$6,181	-$80	-$58	-$12

It should be noted that it is assumed that the changes in quantity of exports to China as a result of new import tariffs are valued at the same price as before the tariff increase. While over the longer term, prices may adjust downward and thus return some of the dairy exports to China, it should be noted that all units of dairy products would be sold at the lower price, resulting in a longer term loss in value of U.S. dairy exports to China. Further, U.S. dairy exports to China face intense competition from other exporters. For whey, EU-28 stand ready to take market share from the United States, while in milk powder and cheese, New Zealand, Australia, and EU-28 are fierce competitors. Thus, U.S. dairy exports to China could suffer continuous losses as competitors who enjoy better market access replace U.S. exports.

Scenario 1: Economic Impacts of Decreased U.S. Dairy Exports to Mexico and China under Elasticity Analysis

The loss of cheese exports to Mexico and dairy exports to China due to retaliatory tariffs calculated above used elasticity analysis and are of great concern to the U.S. dairy industry. However, the losses would not stop there. In this case, the value of the exports is referred to as the direct impact. However, for every dollar of cheese, whey, or other dairy product sold, whether that be domestic or to foreign markets, the product requires a wide array of inputs to make the sale happen, and the production and sale of those inputs require additional inputs. These are typically referred to as indirect impacts. Further, once employees and taxes are paid, whether that be by the dairy product processor or the supporting industries, those payrolls and taxes are expended throughout the economy. The results of these expenditures are typically referred to as induced impacts. When the direct, indirect, and induced impacts are combined, the total economic impact of these lost exports can be calculated, and they can be calculated for output, i.e. – the products being sold or supporting the sale of the products, or employment, payrolls, and gross domestic product. Using IMPLAN, an input/output model, the economic impacts of current and reduced exports of cheese to Mexico and dairy products to China were estimated. These impacts are discussed in the following section.

Economic Impacts of U.S. Cheese Exports to Mexico

During 2017, $390.9 million worth of U.S. cheese was exported to Mexico. These exports required an additional $805.4 million in indirect output and another $318.8 million in consumer and tax expenditures occurred for a total economic impact of $1.52 billion. While cheese accumulated a lot of these economic impacts, dairy cattle and milk production as well as other processed dairy sectors involved in the production of cheese also benefitted, as did a wide array of additional support sectors such as wholesale and warehousing, agricultural and food processing, business services, transportation and healthcare. Further, while cheese production required 404 jobs to support these exports, 4,901 additional jobs through the economy were required to support the $390.9 million in U.S. cheese exports to Mexico.

Table 5. Economic Impact of 2017 U.S. Cheese Exports to Mexico

Impact	Direct	Indirect	Induced	Total
Total Output *($1,000)*	**$390,894**	**$805,449**	**$318,766**	**$1,515,109**
Cheese	$380,404	$100,059	$627	$481,090
Processed Cheese	$10,490	$2,759	$17	$13,267
Supporting Dairy Sectors				
Dairy Cattle and Milk Production	N/A	$161,033	$451	$161,484
Other Dairy Industry Sectors	N/A	$47,782	$989	$48,771
Employment *(Jobs)*	**404**	**2,945**	**1,956**	**5,305**

The estimated loss of $68.04 million in U.S. cheese exports to Mexico also causes losses throughout the economy. For this section, a more detailed discussion will be provided. Table 6 illustrates that the estimated decrease in cheese exports to Mexico will result in a total of $263.7 million in output losses and 923 jobs throughout the U.S. economy. The direct losses will occur in cheese and processed cheese production; however, dairy cattle and milk production will lose $28.1 million in output and 93 jobs while other dairy sectors combine for $8.5 million in output losses and 9 fewer jobs.

The larger impacts come in other supporting industries. Wholesale and warehousing loses $21.2 million in output, followed by agricultural and food processing (-$13.7 million), business services (-$13.4 million), and transportation (-$11.0 million). These losses are mostly concentrated in the indirect impact category as cheese manufacturers typically use these inputs and services for production. However, induced impacts resulting from household income and tax expenditures occur primarily in real estate (-$10.1 million), financial services (-$9.2 million), health care (-$6.0 million), retail stores (-$3.5 million), and food and drinking businesses (-$3.3 million). Other supporting industries with significant job impacts include business services with a loss of 109 jobs, other agriculture (-96 jobs), wholesale and warehousing (-91 jobs), transportation (-63 jobs), healthcare (-56 jobs), and food and drink establishments (-51 jobs).

Table 6. Economic Impacts of Decreased U.S. Cheese Exports to Mexico

Impact	Direct	Indirect	Induced	Total	Jobs
Total Output *($1,000)*	**-$68,039**	**-$140,197**	**-$55,485**	**-$263,721**	**-923**
Cheese	-$66,571	-$17,040	-$107	-$81,931	-85
Processed Cheese	-$1,469	-$10	$0	-$50	0
Dairy Supporting Sectors					
Dairy Cattle and Milk Production	N/A	-$28,030	-$78	-$28,108	-93
Other Dairy Sectors	N/A	-$8,317	-$172	-$8,489	-9
Other Supporting Sectors					
Wholesale and Warehousing	N/A	-$18,620	-$2,605	-$21,225	-91
Ag and Food Processing	N/A	-$11,328	-$2,400	-$13,728	-13
Business Services	N/A	-$8,405	-$5,011	-$13,417	-109
Transportation	N/A	-$9,367	-$1,649	-$11,016	-63
Real Estate	N/A	-$2,326	-$7,736	-$10,062	-26
Financial Services	N/A	-$3,294	-$5,932	-$9,227	-35
Other Agriculture	N/A	-$7,830	-$673	-$8,502	-96
Healthcare	N/A	-$43	-$5,996	-$6,040	-56
Other Retail	N/A	-$401	-$3,084	-$3,485	-39
Paper and Printing	N/A	-$2,834	-$521	-$3,355	-8
Food and Beverage	N/A	-$446	-$2,826	-$3,272	-51
Household Services	N/A	-$791	-$1,934	-$2,725	-38
Government Services	N/A	-$1,162	-$959	-$2,121	-10

Economic Impacts of U.S. Dairy Exports to China

During 2017, $407.9 million worth of U.S. dairy products were exported to China. These exports required an additional $797.5 million in indirect output and another $311.1 million in consumer and tax expenditures occurred for a total economic impact of $1.52 billion. (Table 7) While whey, dry milk, and cheese exports accounted for the vast majority of the direct economic impacts, many supporting industries accumulated the indirect and induced economic impacts. Dairy cattle and milk production benefitted significantly as none of the dairy products exported to China can be produced without milk first being produced on the dairy farm. A wide array of additional support sectors such as wholesale and warehousing, agricultural and food processing, business services, transportation and healthcare also shared in the economic impacts. Further, while the production of the exported dairy products required 299 jobs to support these exports, 4,708 additional jobs through the economy were required to support the $407.9 million in U.S. cheese exports to Mexico.

Table 7. Economic Impact of 2017 U.S. Dairy Exports to China

Impact	Direct	Indirect	Induced	Total
Total Output *($1,000)*	**$407,936**	**$797,530**	**$311,127**	**$1,516,593**
Whey	$246,074	$41,531	$196	$287,801
Dry Milk	$96,642	$16,311	$77	$113,030
Cheese	$63,162	$29,057	$629	$92,848
Buttermilk/Yogurt	$1,053	$2,126	$30	$3,209
Butter	$761	$1,536	$22	$2,319
Fluid Milk	$244	$28,884	$532	$29,660
Supporting Dairy Sectors				
Dairy Cattle and Milk Production	N/A	$125,813	$440	$126,253
Employment *(Jobs)*	**299**	**2,799**	**1,909**	**5,007**

The estimated loss of $53.3 million in U.S. dairy exports to China also causes losses throughout the economy. Again, a more detailed discussion of these losses is provided. Table 8 illustrates that the estimated decrease in dairy exports to China will result in a total of $197.7 million in output losses and 651 jobs throughout the U.S. economy. The direct losses will occur primarily in whey, dry milk, and cheese production; however, dairy cattle and milk production will lose $16.2 million in output and 54 jobs.

As with losses due to decreased cheese exports to Mexico, the larger impacts occur in other supporting industries. For output, wholesale and warehousing are estimated to lose $12.9 million, followed by agricultural and food processing (-$12.7 million), business services (-$10.4 million), and transportation (-$7.8 million). These losses are mostly concentrated in the indirect impact category as manufacturers of dairy products typically use these inputs and services for their production. However, induced impacts resulting from household income and tax expenditures occur primarily in real estate (-$7.3 million), financial services (-$7.0 million), health care (-$4.4 million), retail stores (-$2.65 million), and food and drinking businesses (-$2.4 million).

Other supporting industries with significant job losses include business services shedding 84 jobs, other agriculture (-65 jobs), wholesale and warehousing (-63 jobs), transportation (-43 jobs), healthcare (-41 jobs), and food and drink establishments (-37 jobs).

Price Impacts of Lost Exports due to Increased Tariffs

When taken together, the loss of $68.0 million in cheese exports to Mexico and $53.3 million in dairy exports to China total to a reduction in demand for $121.6 of U.S. dairy products. When this reduction is put in milk equivalents, there is a decrease in demand for 1.58 billion pounds of milk, or 0.73 percent of U.S. milk production. Using the U.S. price flexibility for milk of -1.32, and multiplying the flexibility by a loss of 0.73 percent in demand for milk, the result is a 0.97 percent decrease in the price of milk.

Table 8. Economic Impacts of Decreased U.S. Dairy Exports to China

Impact	Direct	Indirect	Induced	Total	Jobs
Total Output *($1,000)*	**-$53,269**	**-$103,882**	**-$40,499**	**-$197,651**	**-651**
Whey	-$43,347	-$7,207	-$33	-$50,587	-34
Cheese	-$6,181	-$3,327	-$82	-$9,590	-10
Dry Milk	-$3,590	-$597	-$3	-$4,190	-3
Butter/Buttermilk/Yogurt	-$138	-$480	-$7	-$625	0
Fluid Milk	-$12	-$3,731	-$69	-$3,812	-5
Dairy Supporting Sectors					
Dairy Cattle and Milk Production	N/A	-$16,181	-$57	-$16,239	-54
Other Supporting Sectors					
Wholesale and Warehousing	N/A	-$12,854	-$1,902	-$14,755	-63
Ag and Food Processing	N/A	-$10,897	-$1,767	-$12,663	-12
Business Services	N/A	-$6,702	-$3,657	-$10,359	-84
Transportation	N/A	-$6,604	-$1,203	-$7,807	-43
Real Estate	N/A	-$1,674	-$5,645	-$7,319	-19
Financial Services	N/A	-$2,704	-$4,331	-$7,035	-27
Other Agriculture	N/A	-$5,923	-$491	-$6,414	-65
Healthcare	N/A	-$39	-$4,378	-$4,417	-41
Paper and Printing	N/A	-$4,023	-$380	-$4,403	-10
Other Retail	N/A	-$346	-$2,251	-$2,598	-29
Food and Beverage	N/A	-$328	-$2,063	-$2,390	-37
Household Services	N/A	-$646	-$1,412	-$2,058	-28
Government Services	N/A	-$941	-$700	-$1,641	-7

The reduction of 0.97 percent in the price of milk would apply to all milk production going forward. Thus, instead of receiving the FAPRI forecast 2018 price of $17.73 per hundredweight (cwt), dairy farmers would receive only $17.56 per cwt. With 215.5 billion pounds of milk production in the most recent year, that equates to a loss in dairy farmer income of $370.6 million. This loss of farmer income would lead to an additional loss of $529.2 million in economic output and an estimated 3,266 jobs. This is a dynamic impact that results from a loss in demand for milk, and this impact is much more severe than the losses directly attributable to the loss in exports.

Estimated Combined and Ongoing Impacts of Scenario 1

Under Scenario 1, the estimated loss of U.S. dairy exports to China and decreased cheese exports to Mexico amount to a $129.7 million decrease in sales by dairy products manufacturers and another $44.3 million reduction in milk sales by dairy farmers. Other supporting sectors lose a total of $287.4 million in economic output. Further, a total of 1,474 jobs which previously supported these lost exports to China and Mexico are no longer needed.

The secondary, dynamic impact of these lost exports is a loss of demand of milk, which leads to decreases in the price dairy farmers receive for their milk. In this case, the price decrease is 0.97 percent, from $17.73 per cwt to $17.56 per cwt, which when applied to all milk production going forward result in an annual loss of dairy income of $370.6 million, income which supported $529.2 million in output throughout the economy and 3,266 jobs. This dynamic impact resulting from a loss in demand for milk is much higher than the impacts due solely to the loss of exports.

When combined with the direct losses, the reduction of $129.7 million in exports due to retaliatory tariffs leads to total losses in economic output of $990.6 million annually and a loss in employment of 4,740 jobs. If this persisted over the next five years, output losses would total $4.95 billion. As many of the losses accrue outside of the dairy and dairy products industry, these lost exports should be of concern throughout the economy.

Scenario 2: Total Loss of Mexican Cheese and Chinese Dairy Export Markets

There is a case to be made that, as a result of the retaliatory tariffs, all U.S. exports of cheese to Mexico and dairy products to China would cease, and that, depending on the product and market, some or all of these shipments would be absorbed my competitors. The reasoning is that a 20–25 percent price increase would be too much for the Mexican and Chinese importers to pay, and too much for U.S. exporters to absorb through lower prices.

If Scenario 2 were to materialize, the impacts would be a loss of exports and supporting economic activity, including jobs, identical to the baseline export impacts as shown in Tables 5 and 7. That is, U.S. cheese exports to Mexico would drop by $390.9 million while U.S. dairy exports to China would drop by $407.9 million for a total loss of $798.8 million in U.S. dairy exports. Additional losses in economic output would total $2.23 billion, which includes $287.8 million in milk sales supporting those lost exports. Thus, the total loss in output would total $3.03 billion annually and 10,312 jobs.

When the loss of the Mexican cheese and Chinese dairy markets is put in milk equivalents, there is a decrease in demand for 10.66 billion pounds of milk, or 4.95 percent of U.S. milk production. Once the U.S. price flexibility is applied to the decrease in milk demand, a 6.51 percent decrease in the price of milk would result. When this price decrease, from $17.73 per cwt to $16.58 per cwt, is applied to all future sales of milk, dairy farmers would lose approximately $2.49 billion per year. This loss of farmer income would lead to an additional loss of $3.55 billion in economic output and an estimated 21,921 jobs.

When combined with the direct losses due to export reductions, the loss of all exports of cheese to Mexico and dairy products to China due to retaliatory tariffs leads to total losses in economic output of $6.58 billion per year and 32,233 jobs. If this persisted over the next five years, output losses would total $32.9 billion.

Scenario 3: Loss of 42 Percent of the Chinese Dairy and Mexican Cheese Export Markets

In the months immediately following the implementation of retaliatory tariffs by China, U.S. exports of dairy products to China decreased by approximately 42 percent – much more than the decreases estimated in Scenario 1 by using elasticity analysis but much less than total loss of the market as assumed in Scenario 2. Further, the U.S. cheese exports to Mexico decreased by a similar proportion. Thus, Scenario 3 assumes there is a longer term loss of 42 percent of U.S. exports of dairy products to China and cheese exports to Mexico.

If Scenario 3 were to materialize, the impacts would be a loss of 42 percent of exports and supporting economic activity, including jobs, which would be the same as a 42 percent decline in Scenario 2 and as shown Tables 5 and 7. That is, U.S. cheese exports to Mexico would drop by $164.2 million while U.S. dairy exports to China would drop by $171.3 million for a total loss of $335.5 million in U.S. dairy exports. Additional losses in economic output would total $936.6 million, including $120.9 million in milk sales previously supporting . Thus, the total loss in output would total $1.27 billion annually and 4,331 jobs.

When the loss of 42 percent of the Mexican cheese and Chinese dairy markets is put in milk equivalents, there is a decrease in demand for 4.48 billion pounds of milk, or 2.08 percent of U.S. milk production. Once the U.S. price flexibility is applied to the decrease in milk demand, a 2.73 percent decrease in the price of milk would result. When this price decrease of $0.485 per cwt is applied, milk price drops from $17.73 per cwt to $17.25 per cwt and, when applied to all future sales of milk, dairy farmers would lose approximately $1.04 billion per year in income. This loss of farmer income would lead to an additional loss of $1.49 billion in economic output and an estimated 9,207 jobs.

When combined with the direct losses due to export reductions, the loss of all exports of cheese to Mexico and dairy products to China due to retaliatory tariffs leads to total losses in economic output of $2.77 billion per year and 13,538 jobs. If this persisted over the next five years, output losses would total $13.8 billion.

Table 9. Economic Impacts of U.S. Dairy Export Losses due to Retaliatory Tariffs by Scenario

Impact	**Scenario 1**	**Scenario 2**	**Scenario 3**
Annual Dairy Exports *(Million $)*	-$129.7	-$798.5	-$335.5
Drop in Milk Prices *($/cwt)*	-$0.172	-$1.154	-$0.485
Dairy Farm Sales/Income			
Annual Losses *(Million $)*	-$414.9	-$2,774.8	-$1,165.5
5-Year Losses *(Million $)*	-$2,074.5	-$13,874	-$5,827.5
Economy-wide Economic Output *(Million $)*			
Annual Losses *(Million $)*	-$990.6	-$6,583.7	-$2,765.2
5-Year Losses *(Million $)*	-$4,953.1	-$32,918.3	-$13,825.9
Employment *(Jobs)*	-4,840	-32,233	-13,538

Note: Scenario 1 is from elasticity analysis of lost dairy exports to China and Mexico;
Scenario 2 assumes total loss of dairy exports to China and cheese exports to Mexico;
Scenario 3 assumes 42% loss of dairy exports to China and cheese exports to Mexico.

Trade Simulation Results

In order to analyze Mexican cheese import trends and Chinese dairy import trends, a risk-based simulation model for each commodity was developed based on 2008–2017 data. The model defined, parameterized, simulated, and validated relevant risky variables; in this case dairy product imports. These stochastic (random) values were then used to forecast future volumes imported. First the stochastic variables were de-trended and a multivariate empirical (MVE) distribution was used to estimate the parameters. A MVE distribution has been shown to appropriately correlate random variables based on their historical correlation. The results were probability distributions of forecasted variables that were used as stochastic baselines of future import volumes and values.

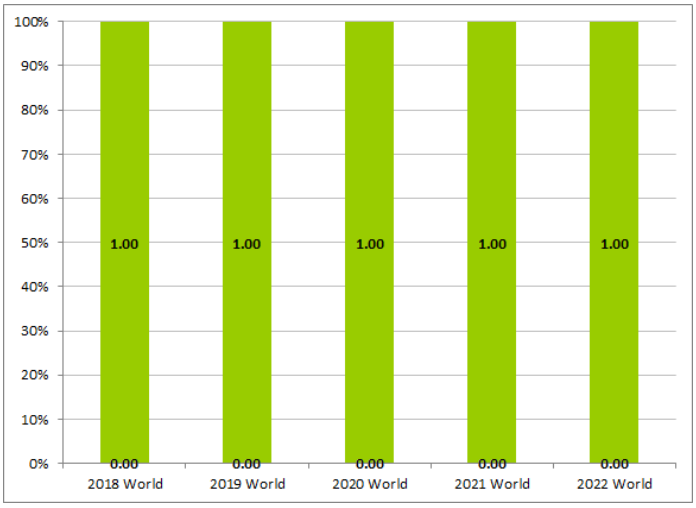
The results were summarized in stoplight charts for each dairy product imported into Mexico and China. The red portion of the chart shows the probability of the value of the imported product to be below a lower target value. The yellow portion of the chart is the probability of being between a lower and upper target value. Finally, the green portion is the probability of being above an upper target value. The lower and upper target values are set as the average and maximum product imported values, respectively, during 2013–2017.

These analyses were performed for each dairy product imported into Mexico and China that are affected by the new tariff structure. Included are Mexican cheese imports and Chinese imports of whey, buttermilk/yogurt, milk powder, liquid milk, cheese and butter.

Mexico Cheese Imports

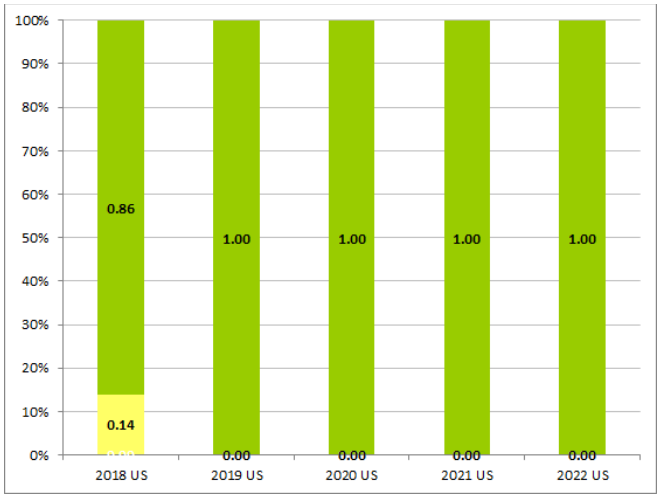
Mexico cheese imports have increased greatly, from $307 million on 2010 to $523 million in 2017. This trend is predicted to increase over the next five years as seen in Figure 10. The probability of the value of Mexican cheese imports has 100 percent change to be higher than $523 million (maximum value of the last five years). Thus shows the tremendous opportunities that the Mexican cheese market present to cheese exporters.

Figure 10. Probabilities of Total Mexico Cheese Imports being < $429.4 Million and > $523 Million



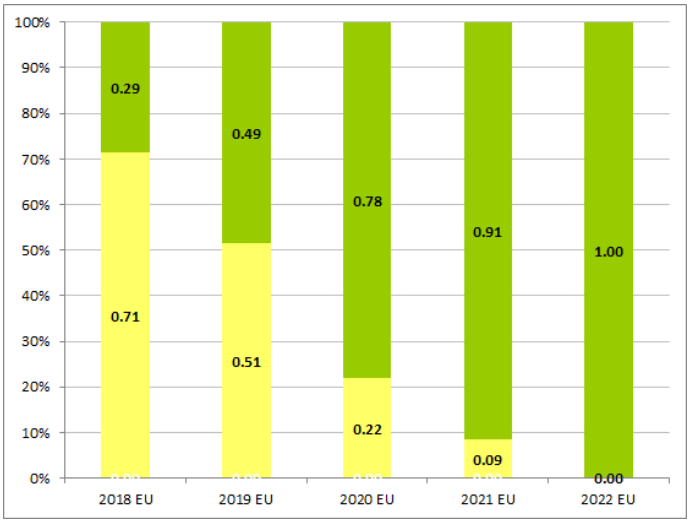
The U.S. is the largest cheese exporter to Mexico accounting for 75 percent of the Mexican market. Assuming no tariff disruption, forecast for Mexico cheese imports from U.S. look very promising (Figure 11). In 2018, there is zero percent chance of having exports below $318.1 million (average of the last five years), 14 percent change of imports being between $318.1 and $398.2 million (yellow segment), and 86 percent chance of imports from the U.S. to be higher than $398.2 million (green segment). By 2019 and throughout the forecasted period, Mexican cheese imports from U.S. are expected to be above $398.2 million.

Figure 11. Probabilities of Mexico Cheese Imports from U.S. being < $318.1 Million and > $398.2 Million



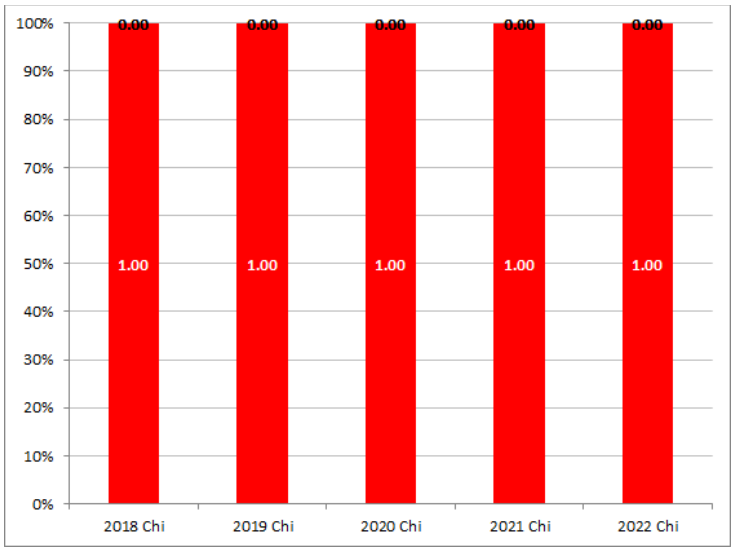
Mexico cheese imports from the EU-28 are experiencing a positive trend (Figure 12). As a result, in 2018 there is a 71 percent chance of cheese imports from the EU-28 be between the lower and higher target value and a 29 percent chance of being above the maximum target value ($63.2 million). By 2022, Mexico cheese imports from the EU-28 have a 100 percent chance of being above the higher target value.

Figure 12. Probabilities of Mexico Cheese Imports from EU-28 being < $44.6 Million and > $63.2 Million



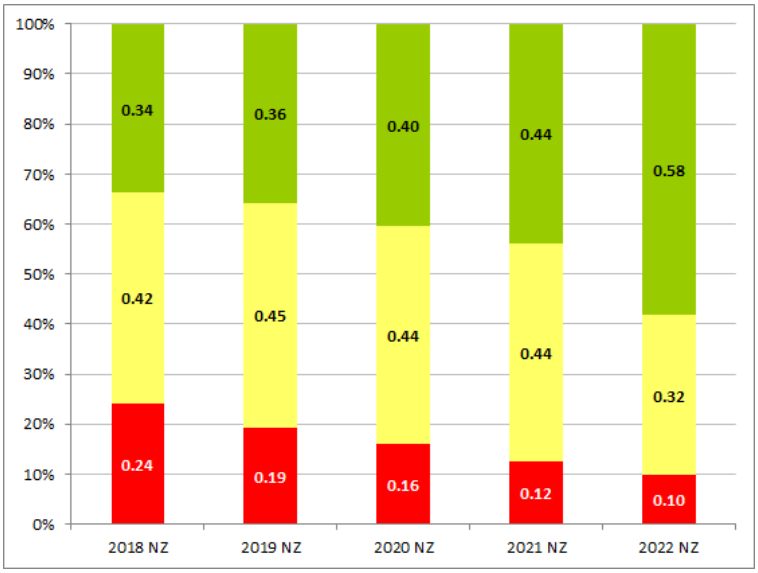
Mexico cheese imports from Chile on the other hand, has a 100 percent chance of being below the lower target value of $24.4 million through the forecasted period (Figure 13).

Figure 13. Probabilities of Mexico Cheese Imports from Chile being < $24.4 Million and > $42.3 Million



Finally, Mexico cheese imports from New Zealand are experiencing a positive trend as well (Figure 14). The probability of imports being below the lower target value decreases from 24 to 10 percent, while the probability of imports being above the higher target value increases from 34 to 58 percent.

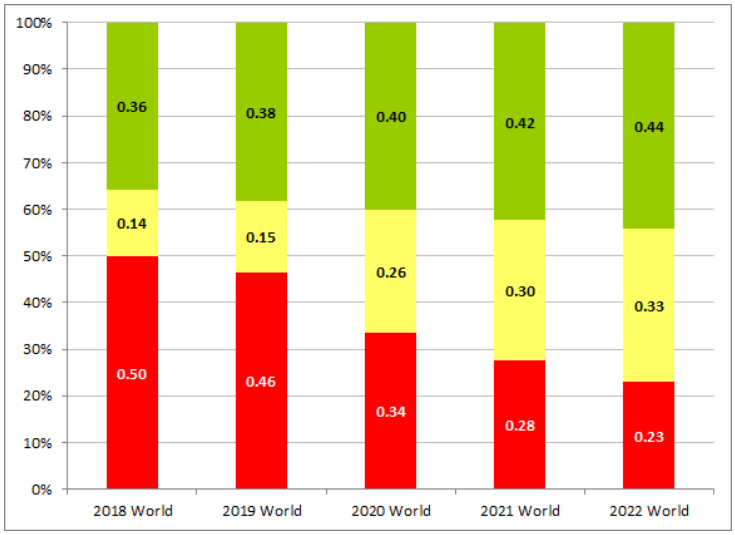
Figure 14. Probabilities of Mexico Cheese Imports from New Zealand being < $13.2 Million and > $14.9 Million



China Whey Imports

Total China whey imports are expected to increase in the next five years (Figure 15). The probabilities of whey imports to China to be greater than the lower target value go down from 50 to 23 percent by 2022 while the probability of imports above the $851 million increases from 36 to 44 percent over the same forecasted period.

Figure 15. Probabilities of Total China Whey Imports being < $656.4 Million and > $851 Million



China whey imports from EU-28 and U.S. are expected to increase over the next five years (Figures 16 and 17), while imports from Argentina and Ukraine are fairly flat (Figures 18 and 20), and imports from New Zealand and Australia are expected to decline (Figures 19 and 21).

Figure 16. Probabilities of China Whey Imports from EU-28 being < $332.9 Million and > $440.8 Million

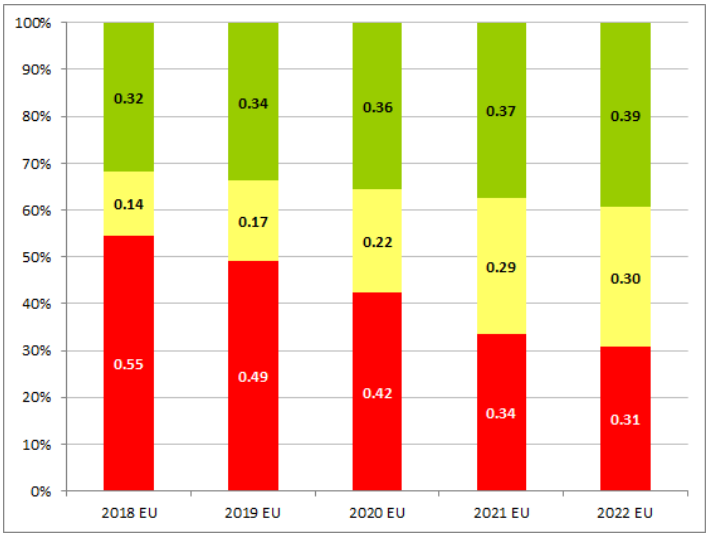


Figure 17. Probabilities of China Whey Imports from U.S. being < $242.2 Million and > $294.1 Million

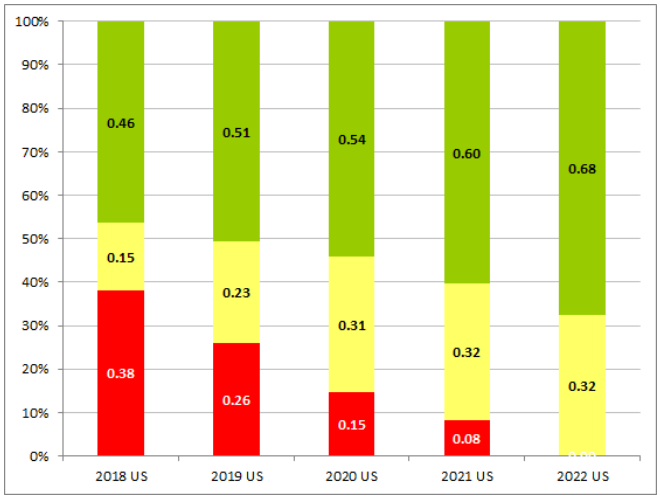


Figure 18. Probabilities of China Whey Imports from Argentina being < $38.2 Million and > $74.3 Million

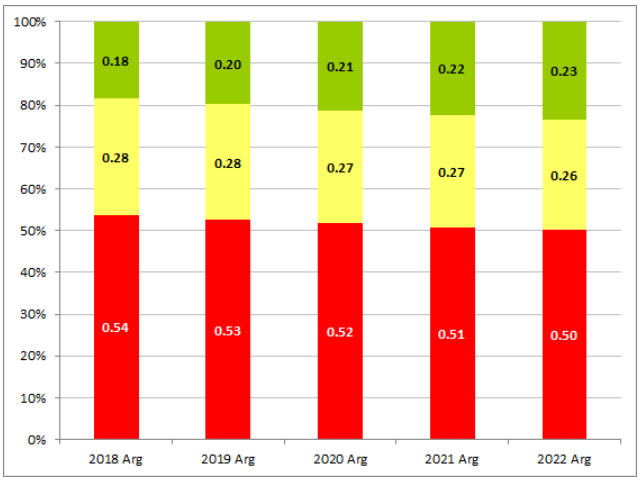


Figure 19. Probabilities of China Whey Imports from New Zealand being < $17.4 Million and > $34.7 Million

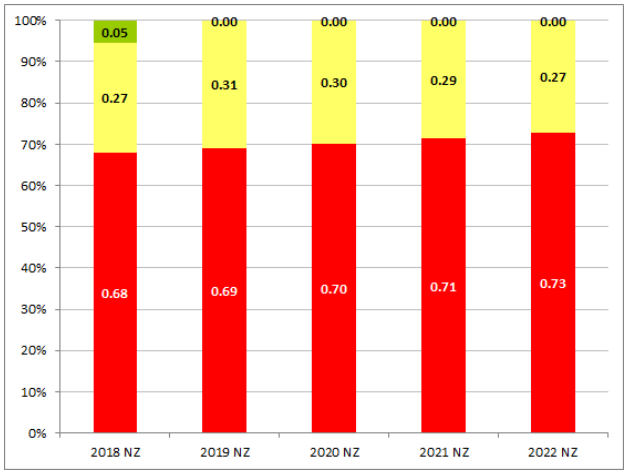


Figure 20. Probabilities of China Whey Imports from Ukraine being < $3.5 Million and > $12.5 Million

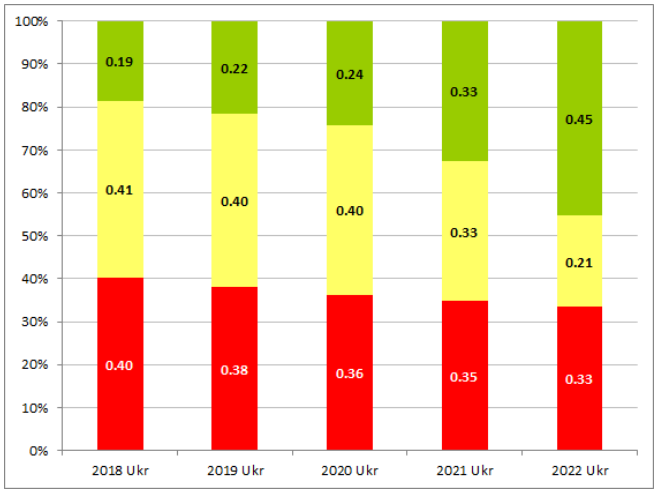
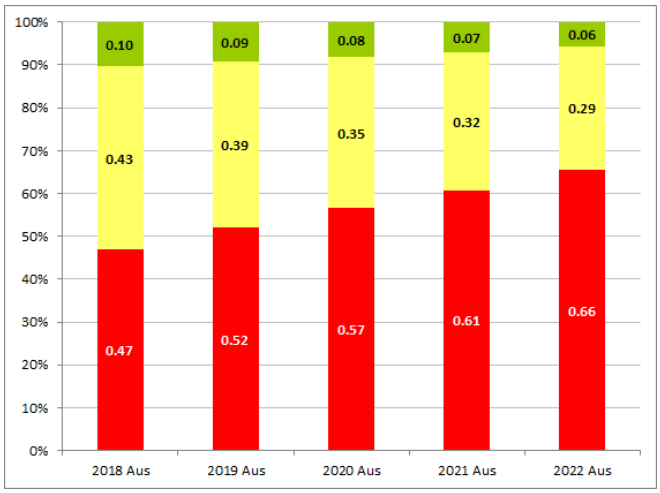


Figure 21. Probabilities of China Whey Imports from Australia being < $11.1 Million and > $13.9 Million



China Buttermilk/Yogurt Imports

Total China buttermilk/yogurt imports are expected to increase in the next five years (Figure 22). Figures 23 to 27 show the forecast of Chinese imports from major suppliers. The EU-28 and New Zealand buttermilk/yogurt exports to China seems very flat while exports from Switzerland and Australia are expected to experience a rapid growth and exports from U.S. are expected a more moderate growth.

Figure 22. Probabilities of Total China Buttermilk/Yogurt Imports being < $25.9 Million and > $66.9 Million

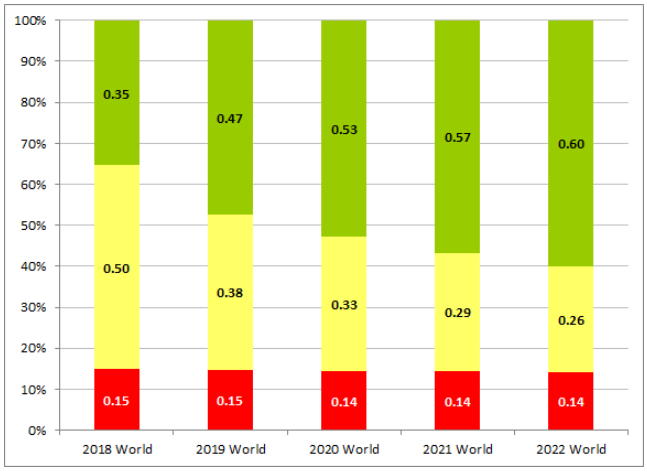


Figure 23. Probabilities of China Buttermilk/Yogurt Imports from EU-28 being < $10.9 Million and > $49.8 Million

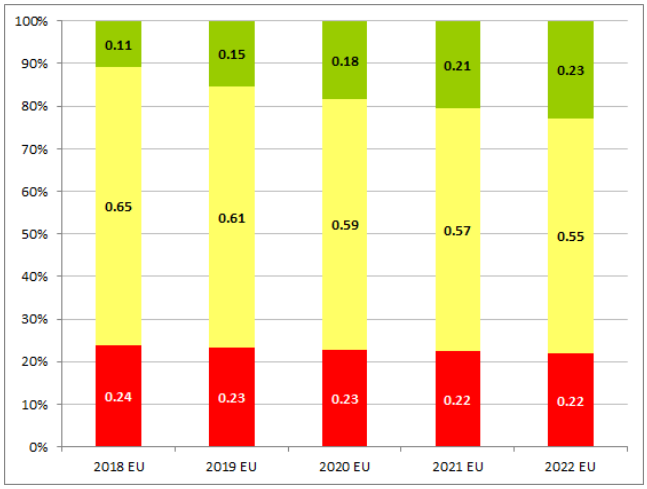


Figure 24. Probabilities of China Buttermilk/Yogurt Imports from New Zealand being < $10 Million and > $28.8 Million

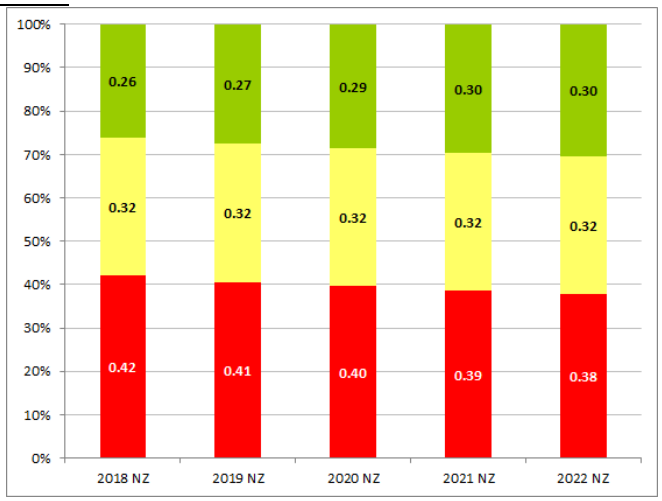


Figure 25. Probabilities of China Buttermilk/Yogurt Imports from Switzerland being < $1.6 Million and > $3.4 Million

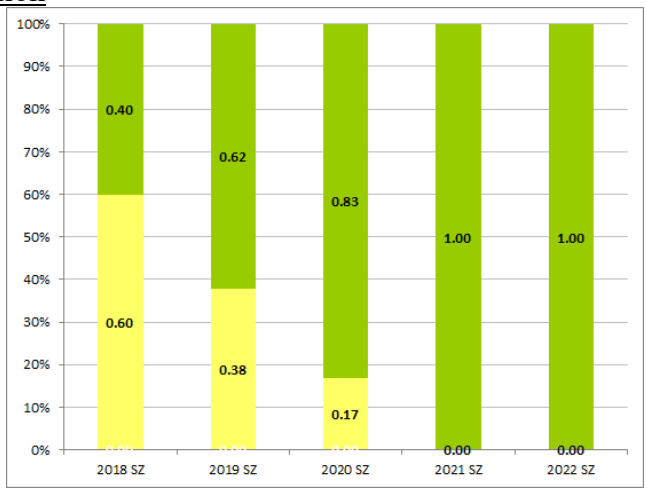


Figure 26. Probabilities of China Buttermilk/Yogurt Imports from Australia being < $1.5 Million and > $2.3 Million

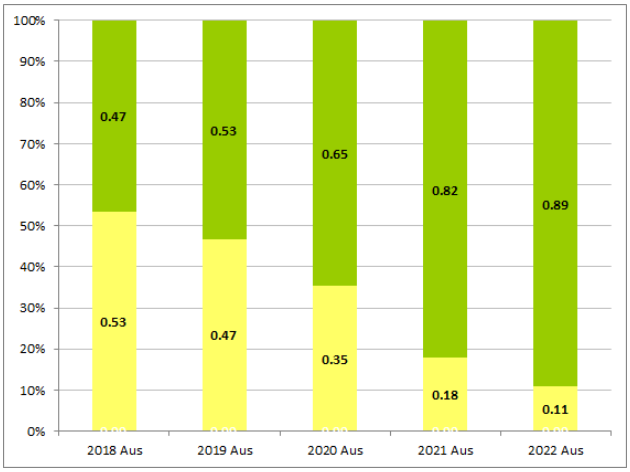
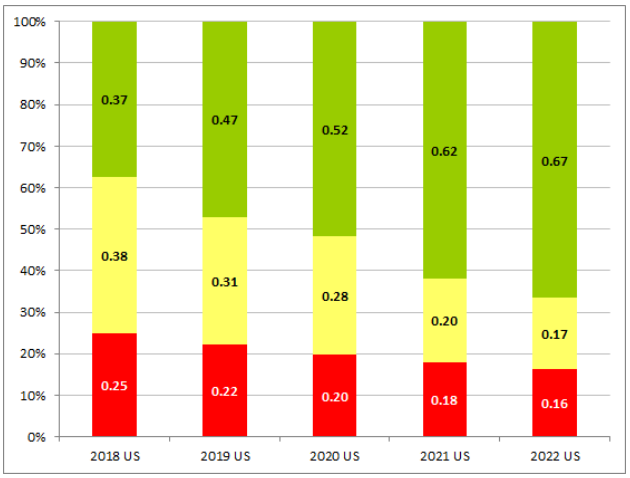


Figure 27. Probabilities of China Buttermilk/Yogurt Imports from U.S. being < $547.7 Thousand and > $1.4 Million



China Milk Powder Imports

Total China milk powder imports are expected to grow moderately over the next five years (Figure 28). Main milk powder suppliers to China are expected to growth as well with growth in EU-28 and Australia expected to be over the lower target value by 2022 (Figures 29 to 32).

Figure 28. Probabilities of Total China Milk Powder Imports being < $1.9 Billion and > $4.4 Billion

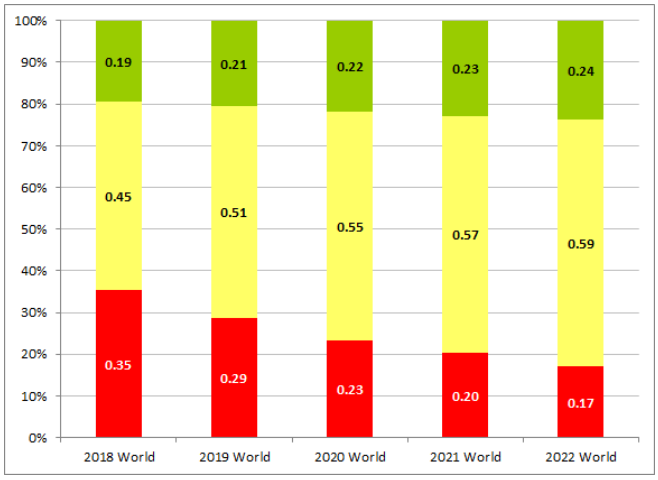


Figure 29. Probabilities of China Milk Powder Imports from New Zealand being < $1.5 Billion and > $3.5 Billion

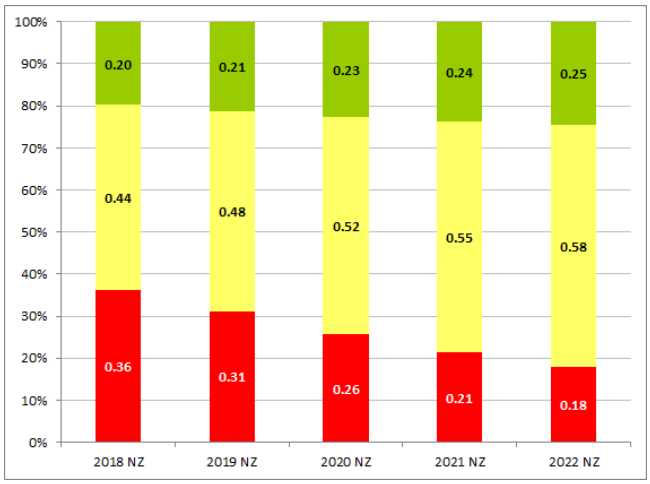


Figure 30. Probabilities of China Milk Powder Imports from EU-28 being < $161.2 Million and > $367.3 Million

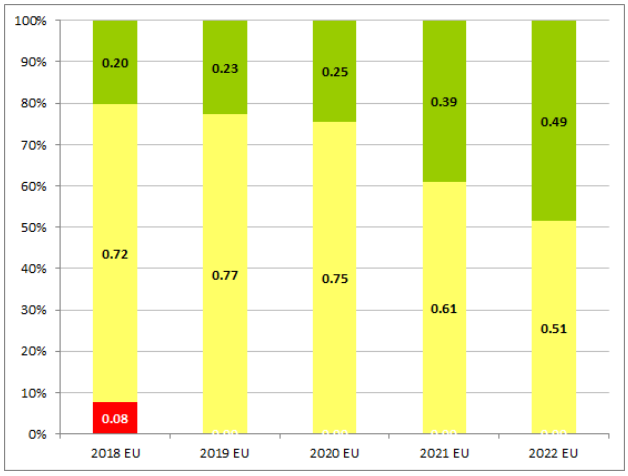


Figure 31. Probabilities of China Milk Powder Imports from Australia being < $106.8 Million and > $191.3 Million

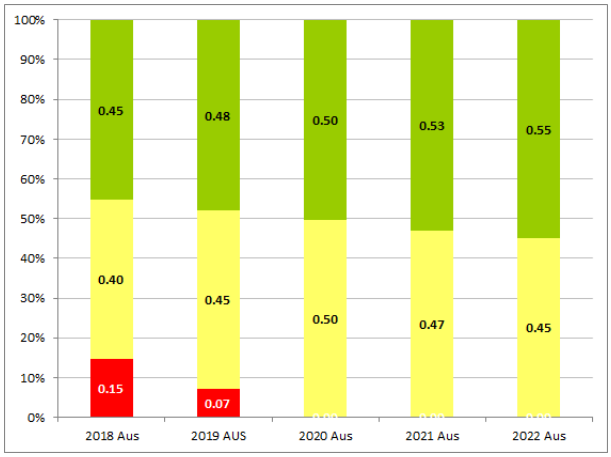
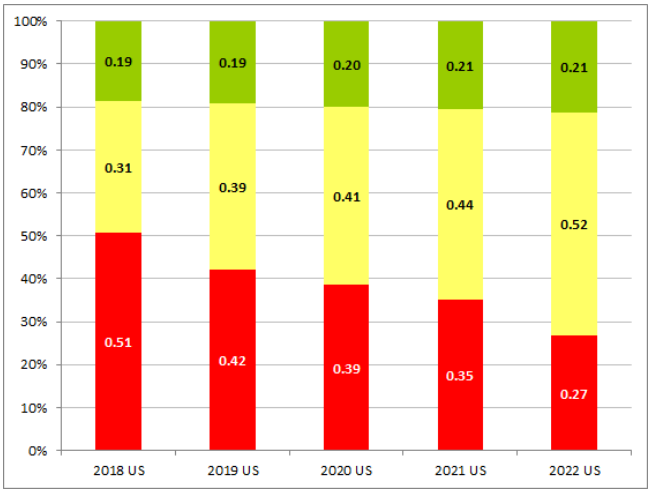


Figure 32. Probabilities of China Milk Powder Imports from U.S. being < $86.7 Million and > $223.6 Million



China Fluid Milk

Total China liquid powder imports are expected to grow moderately over the next five years (Figure 33). Main liquid milk suppliers to China are expected to growth slowly (Figures 34 to 37).

Figure 33. Probabilities of Total China Fluid Milk Imports being < $288.6 Million and > $879.3 Million

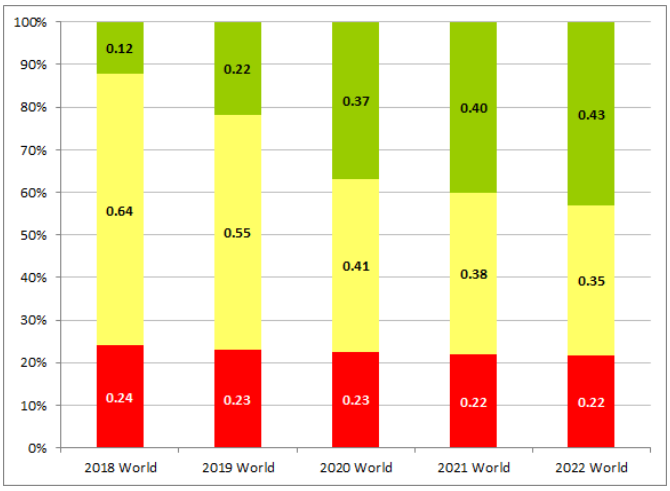


Figure 34. Probabilities of China Fluid Milk Imports from EU-28 being < $151.1 Million and > $413.4 Million

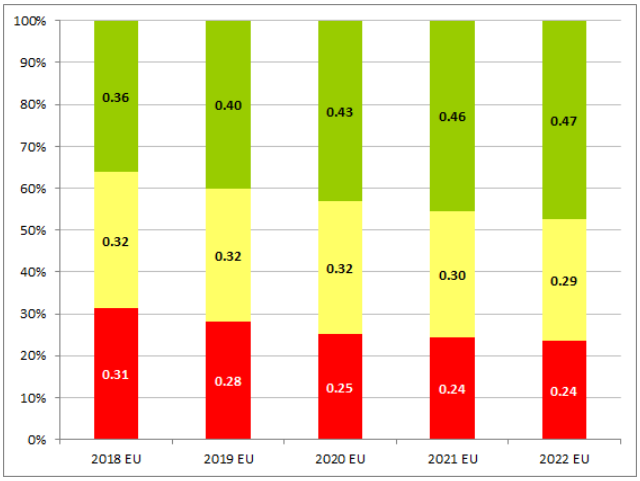


Figure 35. Probabilities of China Fluid Milk Imports from New Zealand being < $93.4 Million and > $377.6 Million

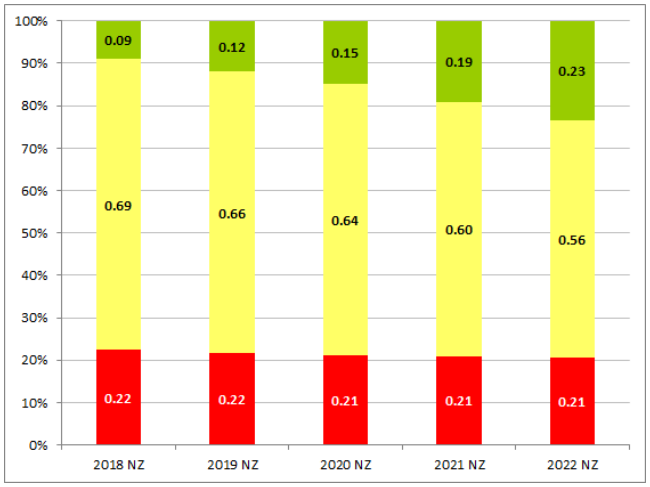


Figure 36. Probabilities of China Fluid Milk Imports from Australia being < $29.8 Million and > $69.1 Million

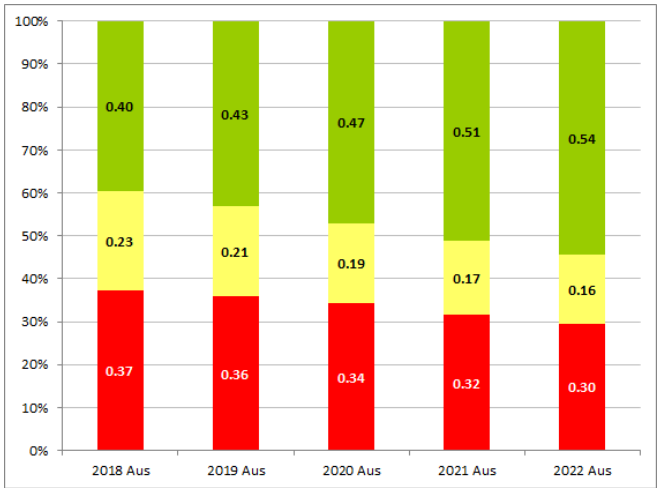
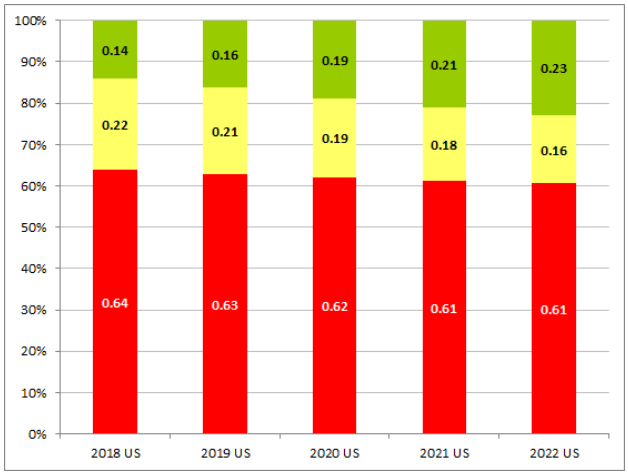


Figure 37. Probabilities of China Fluid Milk Imports from U.S. being < $2.1 Million and > $8.8 Million



China Cheese Imports

Total China cheese imports are expected to grow dramatically over the next five years (Figure 38). Main cheese suppliers to China are expected to growth as well with growth in EU-28, Australia and Argentina expected to be over the lower target value by 2022 (Figures 39 to 44).

Figure 38. Probabilities of Total China Cheese Imports being < $367.7 Million and > $497.7 Million

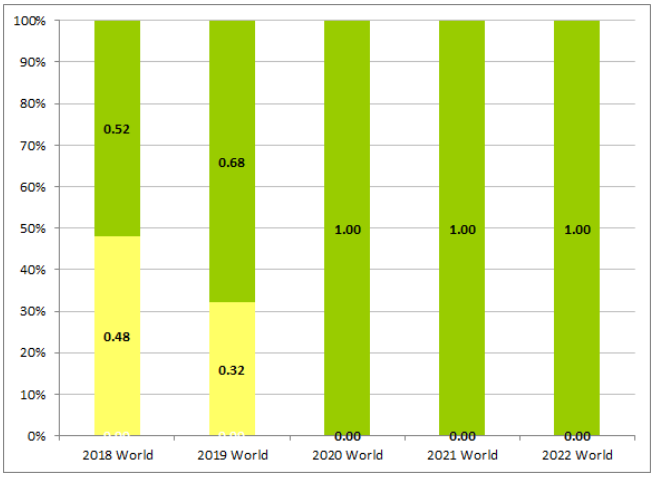


Figure 39. Probabilities of China Cheese Imports from New Zealand being < $172.4 Million and > $244.2 Million

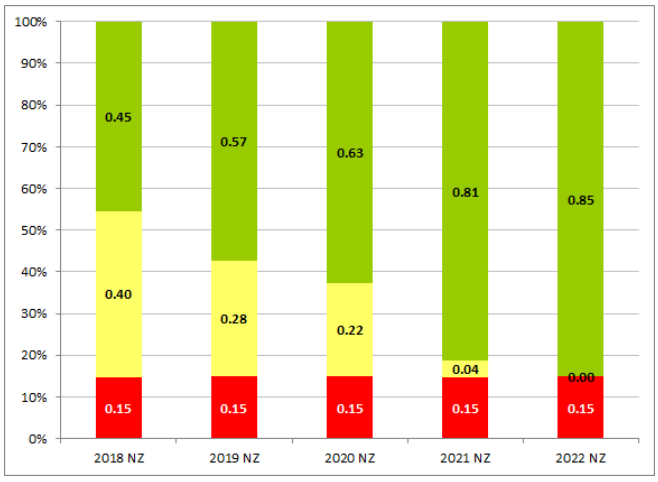


Figure 40. Probabilities of China Cheese Imports from EU-28 being < $60.8 Million and > $90.3 Million

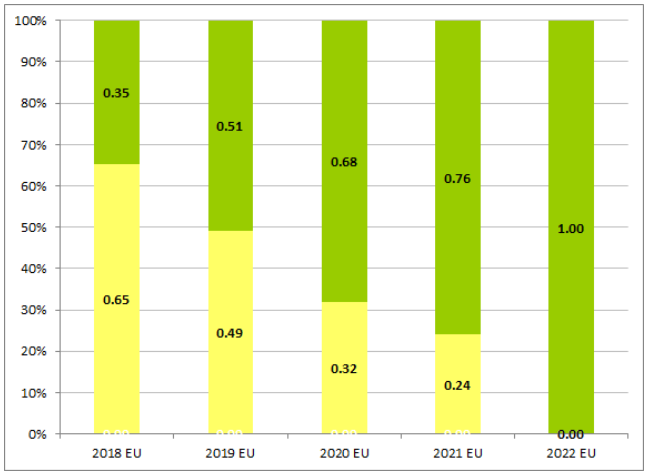


Figure 41. Probabilities of China Cheese Imports from Australia being < $72.6 Million and > $87.2 Million

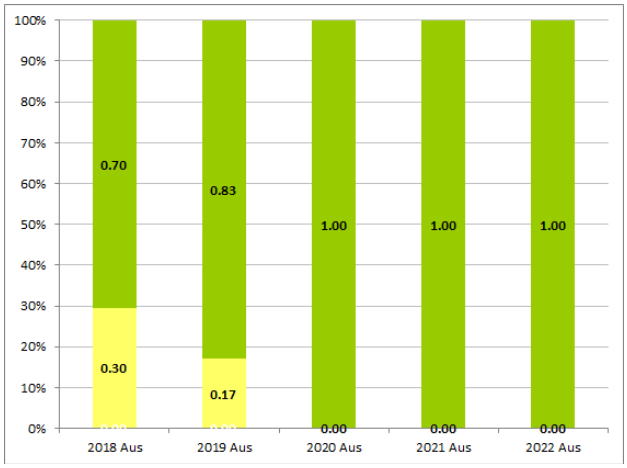


Figure 42. Probabilities of China Cheese Imports from U.S. being < $50.7 Million and > $60.2 Million

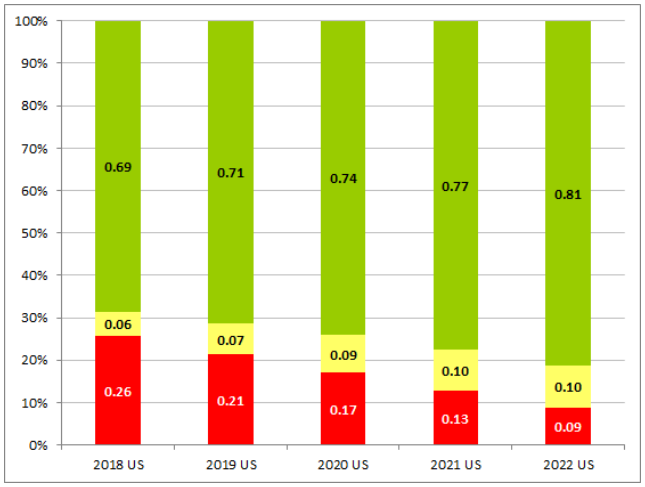


Figure 43. Probabilities of China Cheese Imports from Uruguay being < $3.8 Million and > $5.6 Million

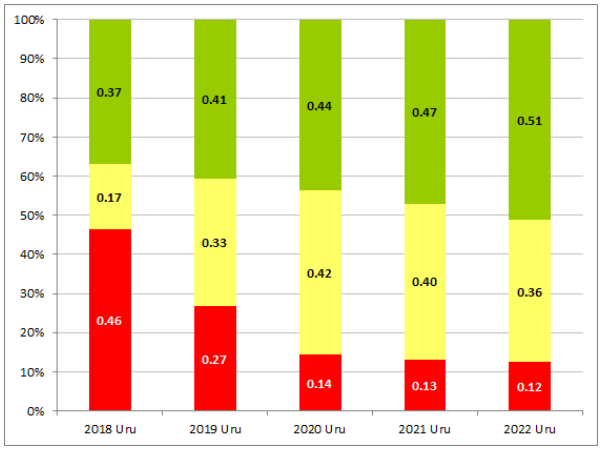
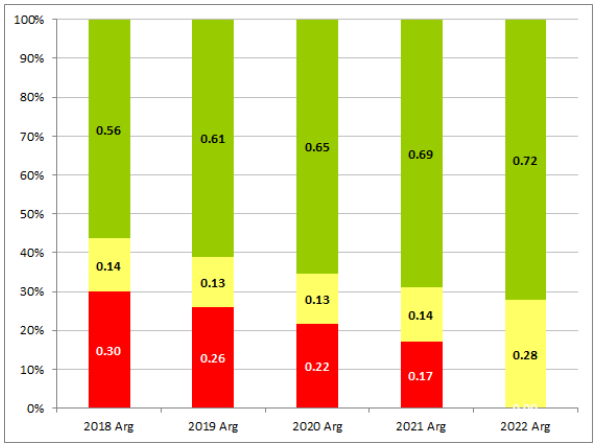


Figure 44. Probabilities of China Cheese Imports from Argentina being < $2.8 Million and > $3.5 Million



China Butter Imports

Total China butter imports are expected to grow considerably over the next five years (Figure 45). Main butter suppliers to China are expected to growth as well except for the U.S. that remains flat over the forecasted period (Figures 46 to 50).

Figure 45. Probabilities of Total China Butter Imports being < $334.6 Million and > $500 Million

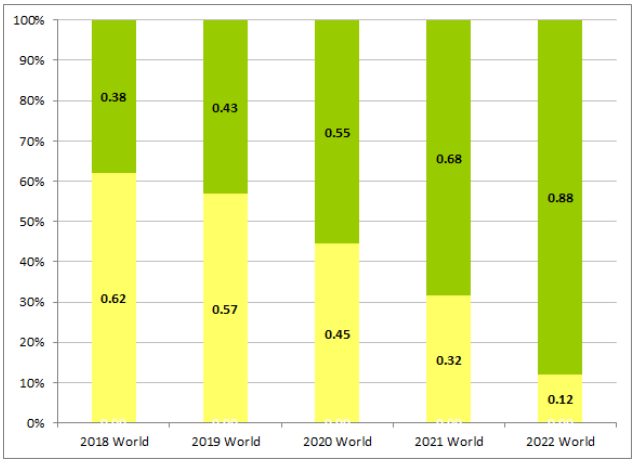


Figure 46. Probabilities of China Butter Imports from New Zealand being < $279.9 Million and > $417.1 Million

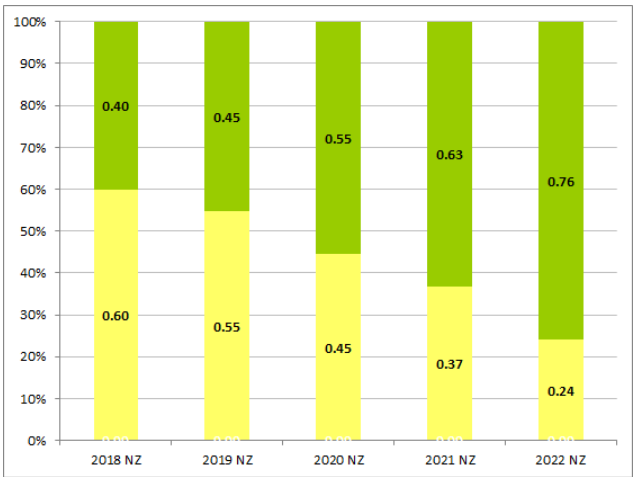


Figure 47. Probabilities of China Butter Imports from EU-28 being < $39.7 Million and > $69.3 Million

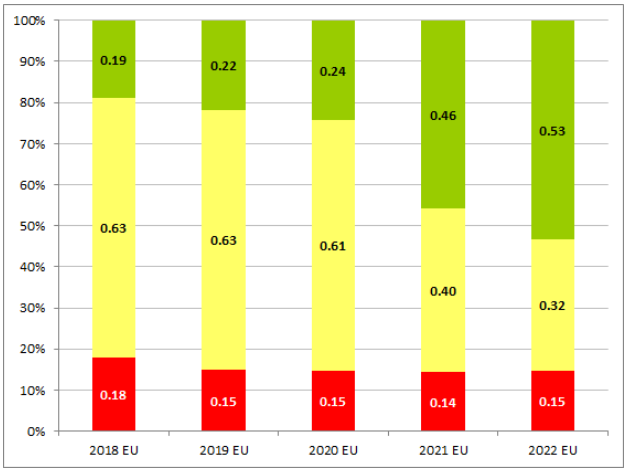


Figure 48. Probabilities of China Butter Imports from Australia being < $9.2 Million and > $11.1 Million

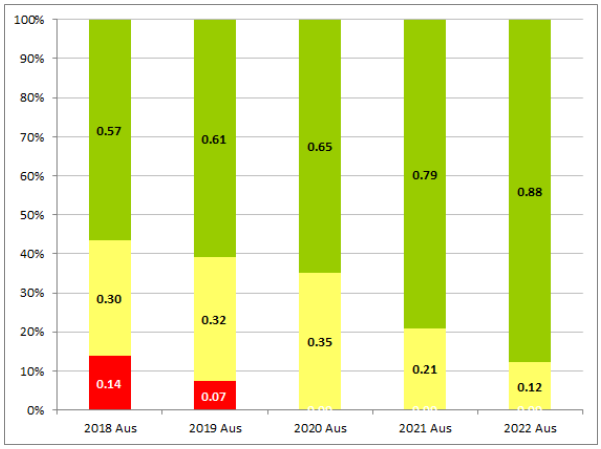


Figure 49. Probabilities of China Butter Imports from Argentina being < $2 Million and > $3.8 Million

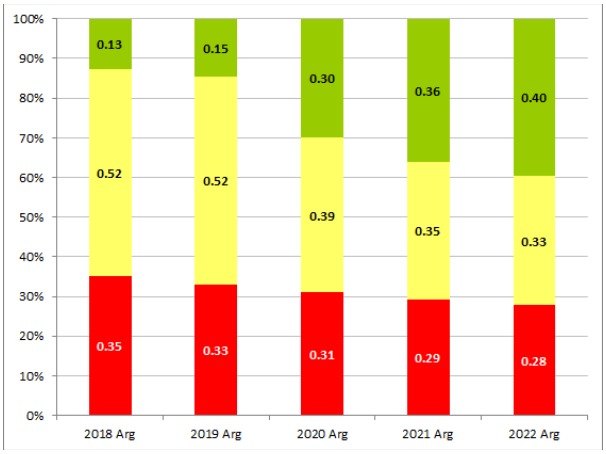
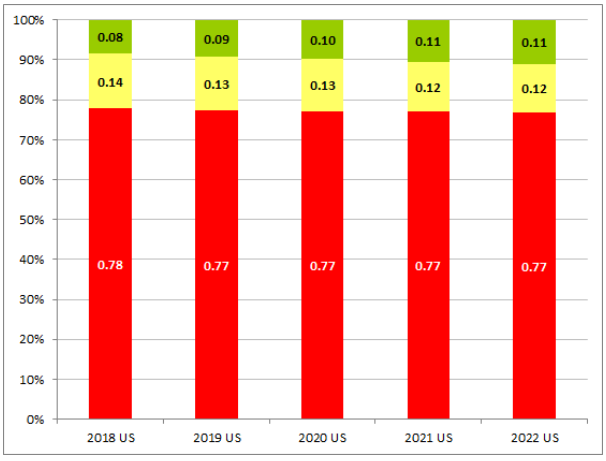


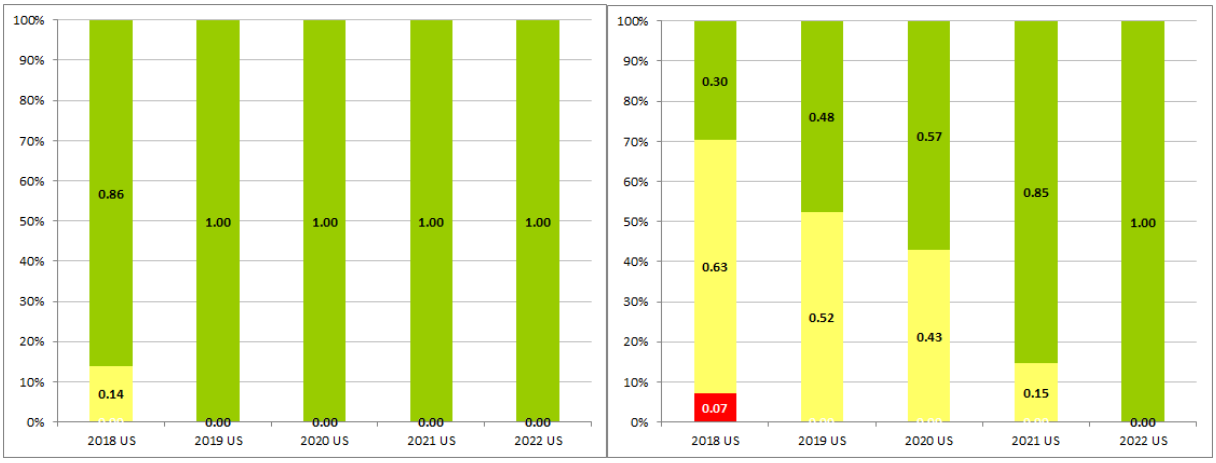
Figure 50. Probabilities of China Butter Imports from U.S. being < $2.7 Million and > $8.8 Million



Potential Market Losses Due to Mexican and Chinese Tariffs on Selected U.S. Dairy Products

The five-year effect of Mexican tariffs on U.S. cheese can be seen in Figure 51. The effect of the tariff delays the probability of U.S. exports to exceed $398.2 million by three years reaching it by 2022 as oppose to 2019. In addition, it increases the chance to be below $318.1 million from zero to seven percent in 2019. Overall, it undermines the potential growth of U.S. cheese exports to a rapidly increasing market.

Figure 51. Probabilities of Mexico Cheese Imports from U.S. being < $318.1 Million and > $398.2 Million Before and After New Tariffs



The effects of the Chinese tariff on U.S. whey can be seen in Figure 52. The probability of exports exceeding $242.2 went from 38 to zero without the tariff to 52 and 26 percent after the tariff for 2019 and 2022, respectively. Moreover, the tariffs reduced the chances of exports being above $294.1 million from 68 percent before the tariff to 51 percent in 2022 after the tariff.

Figure 52. Probabilities of China Whey Imports from U.S. being < $242.2 Million and > $294.1 Million Before and After New Tariffs

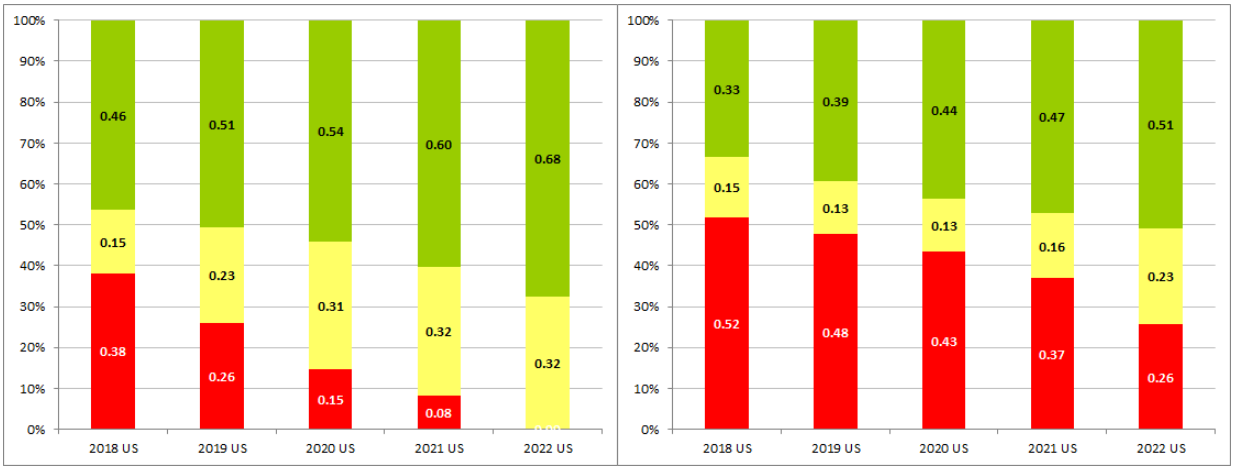
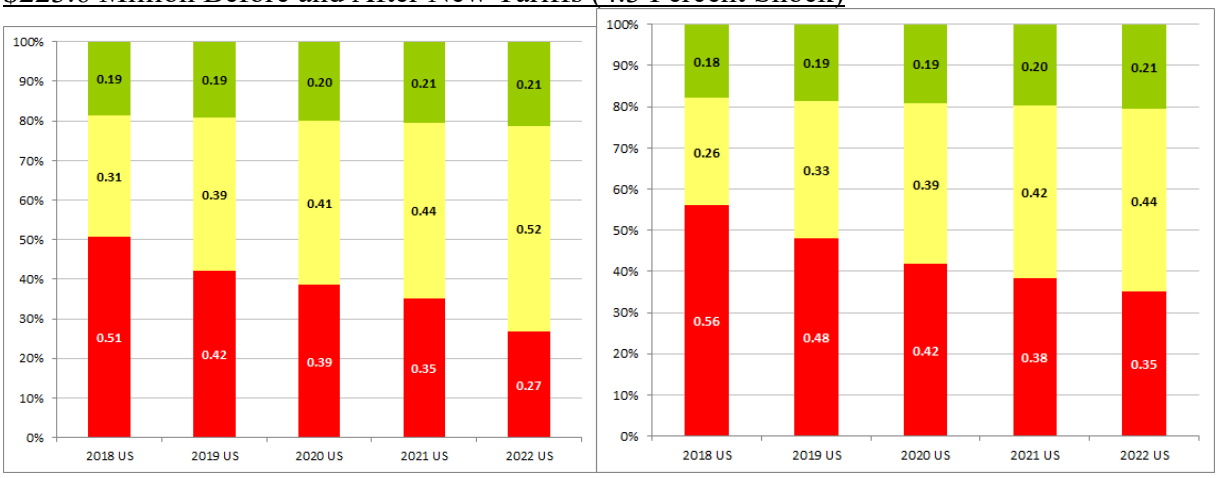


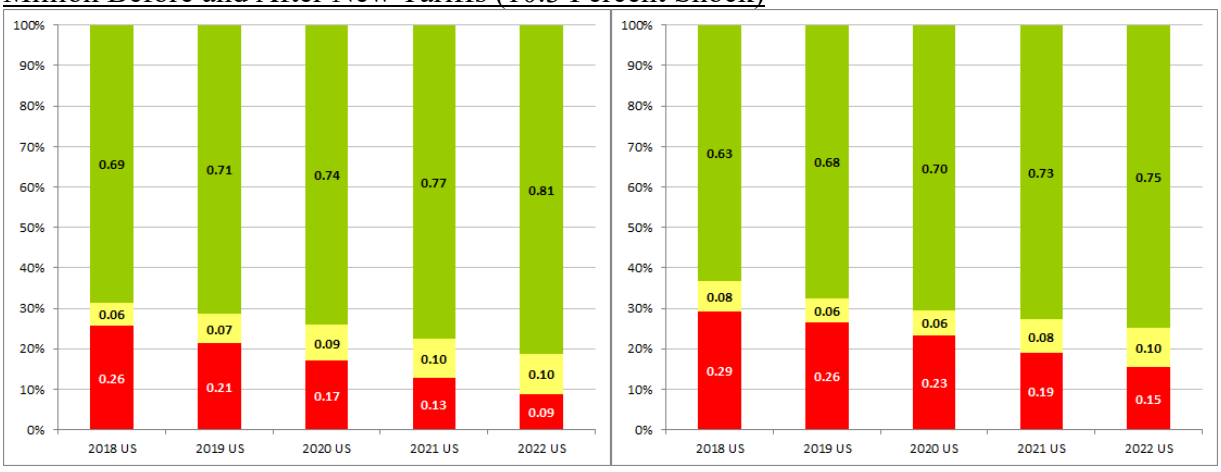
Figure 52 shows the effect of the Chinese tariff on U.S. milk powder. Although green and yellow segments of the graphs don't change much, the tariff increases the probability of the red segment which is the chance of exports being below $86.7 million.

Figure 52. Probabilities of China Milk Powder Imports from U.S. being < $86.7 Million and > $223.6 Million Before and After New Tariffs (4.3 Percent Shock)



Finally, the effects of Chinese tariffs on U.S. cheese are shown in Figure 53. As with the other products, the tariffs reduce chances of increasing exports and increase chances of loosing market shares. By 2022 U.S. exports of cheese could have an 81 percent probability of being over $60.2 million, but after the tariff the probability was reduced to 75 percent.

Figure 53. Probabilities of China Cheese Imports from U.S. being < $50.7 Million and > $60.2 Million Before and After New Tariffs (10.3 Percent Shock)



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