China's Dairy Industry: Current Situation and Long-Term Projections

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Abstract

Production costs, structural conditions, feedstuffs availabilities, and related policy aspects for China that will impact trade potential in milk and its products are examined. It is concluded that China, with direct (meaning out-of-pocket) costs ranging between a low of $US 0.11 and $US 0.19 per kg of milk in eight major cities, and $US 0.16 per kg on a medium size modern farm analyzed in Jilin Province, a major maize growing area, is internationally competitive in milk production. It is also concluded that feedstuffs availabilities will not be a limiting factor to expansion of China's dairy industry. Comparisons are made with Japan, which stands in stark contrast with China due to its extremely high national average production cost—$US 0.62 per kg of milk—and production cost in the US which is $US 0.24 per kg on medium size farms. Globalization of dairy products through partnerships and deals by global oriented milk product companies are also examined.

Key words: China, cost, cows, dairy, dairy farms, feedstuffs, Japan, milk, Non-trade Concerns, production, projections, United States, USA

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Problem and Objectives

Milk product consumption in Asia has been growing, and there is expectation in the international community that this region represents considerable export market potential—and thus the powerful dairy producing countries would like very much to expand milk product exports to them (Dong, 2005). Complicating the situation is that dairy products are one of the main commodities under discussion in the current round of international trade negotiations. China's entry into the WTO (World Trade Organization) has resulted in the nation lowering barriers to imports of agricultural commodities adding to speculation about the possibility of increased imports by it. The sheer size of China, its rapid economic growth, relatively low per capita consumption of milk products, yet very high growth rate in the past half decade, all lead to questions about the extent to which it can meet projected demand for milk products as well as other livestock commodities. The approach taken is to focus on a structural perspective that includes milk production cost and feedstuffs availabilities, and related policy aspects that will impact trade potential. This paper is heavily supply side and policy oriented, focusing mainly on production conditions rather than the demand side, since costs and structure will be among the predominant factors in determining how, and to what extent, China negotiates in this Doha Round of WTO trade negotiations.

It is difficult to examine just one country in isolation in a highly charged global atmosphere such as the current round of trade negotiations just as it is almost overwhelming to study the entire current round of WTO negotiations. Consequently, apart from providing an in-depth study of China's dairy industry, another major objective is to examine and compare the competativeness of the dairy industries in three countries; China, Japan and the United States including import tariffs. In addition, relationships between countries are very important in the negotiating process to help support their positions, and ultimately the outcomes in this round. Grouping China, Japan and the United States together is particularly interesting from a global conflict standpoint given the widely publicized concerns among them regarding trade and security matters. Greater detail on the demand, supply and trade sides of the three countries is available in Simpson (2005a).

Milk Product Consumption and Production in China

Milk Consumption in China

China has witnessed tremendous growth in demand for dairy products in the past few years due to a rapid rise in income, changes in urban lifestyles, promotion of the dairy industry by the government, and improved marketing channels (Fuller, Jikun Huang, Hengyun Ma, and Scott Rozelle, 2005). Milk consumption per capita (including all products on a whole milk basis) tripled in the 15 years from 1985 to 2000 (Table 1). Then it really took off, doubling again in just 4 years. Analysts disagree on the extent to which growth will continue, with some arguing that the exceptionally large increases have already taken place, while others believe that strong demand for milk products will continue. Projections by three authors are also included in Table 1. The shortest length is by FAPRI, which projects that per capita consumption will increase from 17 Kg in 2005, to 20 kg in 2010, and 23 kg by 2014. Fangquan has made long-term projections of 24 kg in 2020, and 35 kg in 2030. Simpson's projections are for 30 kg in 2020, and 40 kg in 2030. As a comparison, the expectations for 2005 are 64 kg in Japan, and 264 kg in the United States (Table 2).

Table 1. Comparison of studies and data sources on milk consumption and production in China, 1984-86 to 2005, and projections to 2030

Item	1985	1990	1995	2000	2004	2005	2010	2014	2020	2030
Consumption per capita (Kg)										
FAO	2.4	3.8	5.0	7.0	14.3					
Fangquan, Mei (1998)				8.0			16.0		24.0	35.0
FAPRI, November, 2005 (1)			7.0	9.0		17.0	20.0	23.0		
Simpson, December 2005	2.4	3.8	5.0	7.0			18.0		30.0	40.0
Production, total (Million tons)										
FAO	2.6	3.8	5.0	8.9	18.9					
Fangquan, Mei (1998)				10.0			22.0		36.0	56.0
FAPRI, November, 2005			6.1	8.6		20.0	25.0	29.1		
Simpson, December 2005	2.6	4.4	6.1	8.9			24.7		43.1	58.4
Yield per dairy cow (Kg)										
FAO	1,541	1,568	1,533	1,749	2,680					
Fangquan, Mei (1998)										
FAPRI, November, 2005			1,533	1,749		2,824	3,282	3,647		
Simpson, December 2005	1,541	1,562	1,545	1,807	2,543		3,300		5,000	6,500
Number of dairy cows (Millions)										
FAO	1.8	2.8	3.9	4.9	7.0					
Fangquan, Mei (1998)										
FAPRI, November, 2005			4.0	5.0		7.1	7.6	8.0		
Simpson, December 2005	1.7	2.8	3.9	4.9			7.5		8.6	9.0

Sources: FAO from: FAOSTAT Database collections. Available at http://faostat.fao.org/. Fangquan, Mei (1998), see references.
FAPRI: http://www.fapri.org/outlook2005/tables/15_Dairy.xls and Tables 3 and 4.
Simpson projections are unpublished data. See Simpson and Ou Li (2004) and Simpson (2003) for a description of the model.

Analysis of Chinese, as well as worldwide, milk consumption patterns is problematical by the multitude of commodities produced by the dairy industry. Even milk for drinking is complicated by numerous products such as non-processed fresh milk, processed milk, UHT products with long shelf life, and milk produced from milk powder. There are also an abundance of manufactured products such as cheeses (many of which have different tariff rates), dried and processed milk products used in production of human food, and use as livestock feedstuffs. Longer term projections are also complicated by changing demographics such as rural/urban populations, aging, and per capita income growth.

Table 2. Milk consumption, China, Japan and the United States, 1995-2014

Item	Units	1995	2000	2005	2010	2014
Fluid Milk Consumption						
China	1,000 MT	1,967	4,401	10,445	13,449	15,475
Japan	1,000 MT	5,143	4,971	4,967	5,069	5,120
United States	1,000 MT	26,677	26,890	26,764	26,869	27,105
Manufacturing and other uses						
China	1,000 MT	7,080	7,444	12,641	14,426	16,438
Japan	1,000 MT	3,106	3,421	3,268	3,231	3,209
United States	1,000 MT	43,762	49,038	52,355	56,164	58,507
Total milk consumption (1)						
China	1,000 MT	9,047	11,844	23,086	27,875	31,913
Japan	1,000 MT	8,249	8,392	8,234	8,299	8,329
United States	1,000 MT	70,439	75,928	79,119	83,033	85,612
Total population (2)						
China	1,000	1,226,030	1,282,472	1,329,927	1,372,903	1,410,650
Japan	1,000	125,472	127,034	127,914	127,998	127,230
United States	1,000	269,945	285,003	300,038	314,921	239,650
Consumption per capita						
China	Kg	7	9	17	20	23
Japan	Kg	66	66	64	65	65
United States	Kg	261	266	264	264	357

Source: http://www.fapri.org/outlook2005/tables/15_Dairy.xls
(1) Includes milk products on a milk equivalent basis.
(2) Source: FAOSTAT Database collections. Available at http://faostat.fao.org/.
2014 interpolated.

Population growth in China is slowing and projections by FAO (2005), based on United Nations data, are that its total will only grow from 1.33 million people in 2005 to 1.46 billion in 2030 (a 10 percent increase in 25 years), much less than had been projected just a decade ago. In fact, by 2030 the growth rate is calculated at just 0.2 percent annually, significantly lower than the 0.7 percent annually between 2000 and 2010 (Table 3). Another factor is that the aged, a group that either is not accustomed to milk products, or is not interested in consuming them in large quantities, will constitute a growing proportion of the population.

Table 3. Population and per capita income in China, 1984-86 to 2005 and projections to 2030

Item	1985	1990	1995	2000	2005	2010	2020	2030
Population of China (Millions)	1,076	1,161	1,226	1,282	1,329	1,373	1,438	1,460
Annual growth rate from the previous year		1.5	1.1	0.9	0.7	0.7	0.5	0.2
Per capita income, PPP basis ($US)				3,938	6,223	8,506	14,530	22,564
Annual growth rate from the previous year					8.0	8.0	5.5	4.5

Source: Base year (2000) PPP per capita is from World Development Indicators in *World Resources 2002-2004* published by the World Resources Institute (2003). The ppp per capita in 2004 was $5,600 in China, $29,400 in Japan, and $ 40,100 in the USA according to the CIA Factbook for 2005. Available at http://www.odci.gov/cia/publications/factbook/fields/2004.html. Projections are by Simpson, unpublished data. See Simpson and Ou Li (2004) and Simpson (2003) for a description of the model.

Per capita income, and income growth, are important factors because numerous studies indicate a strong relation between income and milk product consumption (e.g. Dong, 2005; Ma and Rae, 2003). Annual growth rates from 2000 to 2030, used by Simpson in his modeling (Simpson and Ou, 2004; Simpson, 2003), presented in Table 3, show that with a growth rate of 8.0 percent annually between 2000 and 2010, and 5.5 percent in the next decade, and 4.5 percent annually between 2020 and 2030, that the per capita income—on a PPP (Purchasing Power Parity) basis—will lead to an average per capita GNI (Gross National Income) of $22,564 in 25 more years (United States dollars are used throughout this article). It was $5,600 in 2004 (CIA Factbook, 2005). As a comparison, it was $29,400 in Japan and $40,100 in the United States that year.

An important point, apart from usefulness of the data for analysis of milk consumption projections, is that if China continues on a “moderate to good” growth rate its per capita income will begin to rival that of Japan even if the latter’s economy is able to grow somewhat on a longer term basis. Given that China’s population will then be more than 10 times that of Japan by 2030, and considering the deep historical divisions between the countries, it is clear that potential for conflicts abound. In addition, even if only the great trade imbalance between the countries is taken into consideration, the rapidly narrowing per capita income gap that is likely between China and the United States also serves as a harbinger for conflicts Those aspects alone can affect trade in all commodities—even a seemingly lowly one like milk products.

Milk Production in China

China’s total production of milk is projected by FAPRI to be 29.1 million tons in 2014 while total consumption (whole milk equivalent basis) is 31.9 million tons (Tables 2 and 4). In effect, net imports of 2.8 million tons, or 9 percent of total consumption, will be required. The proportion has been continually declining, and is substantially lower than in previous years (Table 4).

Table 4. Milk cows and production, China, Japan and the United States, 1995-2014

Item	Units	1995	2000	2005	2010	2014
Milk Cow Numbers						
China	1,000 head	3,968	4,936	7,095	7,611	7,990
Japan	1,000 head	1,034	992	931	910	892
United States	1,000 head	9,466	9,199	8,991	8,885	8,762
Milk Production per Cow						
China	Kilograms	1,533	1,749	2,824	3,282	3,647
Japan	Kilograms	8,106	8,566	8,935	9,212	9,431
United States	Kilograms	7,441	8,254	8,800	9,345	9,771
Total Cow Milk Production						
China	1,000 MT	6,082	8,632	20,036	24,981	29,138
Japan	1,000 MT	8,382	8,497	8,319	8,382	8,410
United States	1,000 MT	70,439	75,928	79,119	83,033	85,612
Total population (1)						
China	1,000	1,226,030	1,282,472	1,329,927	1,372,903	1,410,650
Japan	1,000	125,472	127,034	127,914	127,998	127,230
United States	1,000	269,945	285,003	300,038	314,921	239,650
Cow milk production per capita						
China	Kg	5	7	15	18	21
Japan	Kg	67	67	65	65	66
United States	Kg	261	266	264	264	357
Difference, Production and consumption						
China	1,000 MT	2,965	3,212	3,050	2,895	2,776
Difference as a percent of Consumption						
China	Percent	33	27	13	10	9

Source: http://www.fapri.org/outlook2005/tables/15_Dairy.xls
(1) Source: FAOSTAT Database collections. Available at http://faostat.fao.org/.
2014 interpolated.

One reason for the decline in imports is that in the early years after the opening of China in 1978 there was very little movement of commodities between prefectures, partly due to policies aimed at prefectural self-sufficiency, and partly due to very poor transportation, storage, processing and marketing infrastructure. Also, nearly all cattle were kept for work purposes and there were very few dairy farms (Simpson, Cheng and Miyazaki, 1994). Then, as attention turned to dietary improvements, and international agencies became involved with milk consumption programs, the country began to import substantial amounts of export subsidized milk powder that was then recombined with water to make drinking milk and for manufacturing purposes. By the mid 1990s the prefectural self-sufficiency policies were abandoned in favor of economic efficiency and regional competativeness. The improvement of infrastructure as well as policy changes in China are apparent in the percentage of net imports falling to 27 percent in 2000 from 33 percent in 1995 (Table 4). Very dramatic declines to 13 percent in 2005 and 9 percent in 2014 are forecast.

The next big question that naturally evolves is the extent to which the dairy industry will evolve so that China's milk production might essentially meet its consumption requirements. In effect, to what extent will China really be the potential market envisioned by many analysts and hoped for by milk product exporting countries? In the medium term, very little (Appendix 1) and, as discussed next, also very little in the longer run.

Milk Production Structure and Costs in China

There are four main types of cow milk production systems in China. The first, and most rudimentary, is part of grassland animal production systems in which milk is produced for suckling calves and herder families. The second is a low-input, low-cost operation based on crossbred cows that are found in urbanized areas. This system, with most of the milk sold for nearby urban dweller's consumption as fresh product, is based on grazing and cut-and-carry of feedstuffs by small size producers. The third system is traditional medium to large-scale operations that were originally state farms. They are in a period of flux regarding ownership, management and modernization. The fourth system, and the type that will form the core of a modern dairy industry, is made up of operations owned by individuals, partnerships and private or semi-public corporations. Most of these type farms are characterized by a desire to improve management, size and economic efficiency. Experience in other countries indicates that this type system will become the dominant one in China.

Some detail is now provided on characteristics, and costs and returns, of a medium size modern dairy farm in China because, to this author's knowledge, this type of information is not readily available, at least outside China. In addition, it permits the reader to understand why China is very competitive in milk production. The farm from which these data were obtained (in 2004), was a sole proprietorship with 166 cows in lactation (310 day lactation period), 191 total milking cows, and 245 total inventory (other than calves), located in Gongzhuling, Jilin Province, which is a major maize growing area in North-east China (Simpson, Qi, Su, and Li, 2005). Most of the cows were at least ¾ purebred Holstein (American), none less than ½ purebred Holstein, and all were artificially inseminated. All milk was sold to a dairy.

Milk production averaged 17.4 kg per day per cow in inventory resulting in an annual milk yield of 5,266 kg per cow in inventory. As a comparison, milk yield per cow in lactation in 2003 averaged 6,909 kg in Japan, 8,647 in the United States and 10,400 kg in Israel (FAOSTATS, 2005). The average yield that year in China was very low, 2,680 kg, because a substantial portion of cows considered as milking cows were still in the three other types of production systems. In fact, most of the tremendous growth in cow numbers and total production has come from the second type system as females with low production genetics were just saved for milk production rather than being fattened for slaughter. As a comparison, average milk yields among eight cities in China ranged from a low of 4,745 kg per cow in the city of Hohhot, to a high of 5,930 kg in Taiyuan (Government of China, 2002).

The example farm was a silage based confinement system (no grazing) and all feedstuffs were purchased. Milking was done by machine rather than by hand. The owner was in the process of doubling the size of operation at the time of the interview in 2004. He used considerable labor because it was inexpensive, $63 per month per person including benefits (Appendix 2). Land in China is owned by the government and leased out on a long-term basis. The rental charge was very low, $843 annually, thus accounting for just 0.3 percent of direct (meaning cash or out-of-pocket) expenses.

Annual net income, only taking direct costs into account, was $48,367, which amounted to about a 6 percent return on his investment of $803,916. Net income, taking ownership costs as well as direct costs into account, was $27,680 per year. Sensitivity analysis revealed that with just a 10 percent increase in milk yield—to 5,793 kg—net income above direct costs would increase 44 percent from the current level. Milk was sold at $0.20 per kg. As a comparison, the price received by farmers in 2002 among eight cities in China varied from a low of $0.14 in Xian to a high of $0.24 in Qingdao (Government of China, 2002) .

Annual net income per cow in inventory was $253 when only direct production costs were taken into account. It was $122 when ownership costs and family labor were included. As a comparison, the Government of China (2002) study revealed that “profits” reported in the eight cities varied from $67 per cow in Chongqing to $496 in Qingdao.

Cost per kg of milk produced was $0.16 when direct costs only were taken into consideration. It grew slightly to $0.18 when ownership cost and family labor were included. As a comparison, average production cost per kg in 2002 among the eight cities in China ranged from a low of $0.11 per kg in two cities (Shenyang and Xian), to a high of $0.19 per kg in Chongqing (Government of China, 2002).

China's Feedstuffs Supply and Demand Related to its Dairy Industry

A major question is whether China can provide sufficient feedstuffs for its bourgeoning dairy industry. Long-term projections of China's requirements of feedstuffs, and availabilities of them (Simpson, 2003), are now presented since feed accounts for at least two thirds of milk production costs. Calculations for dairy cattle are based on per capita milk production of 18 kg in 2010, 30 kg in 2020 and 40 kg in 2030, compared with a base of 7 kg in 2000 (Table 1). Total milk production (equivalent to total consumption with all products on a fluid milk basis) was projected to be 24.7 million tons in 2010, 43.1 million tons in 2020, and 58.4 million tons in 2030. Milk production per head of milk cows in inventory was projected to be 3,300 kg in 2010, 5,000 kg in 2020 and 6,500 kg in 2030 compared with 1,807 kg in 2000. These projections of milk production per cow are extremely conservative considering that as China develops, there will be a commensurate shift to modern dairy farms. In addition, China will benefit from genetic and management advances worldwide, as well as from domestic research and propagation of results in national breeding programs. The upshot is that while the number of milk cows has grown very rapidly from the base of 4.9 million head in 2000 (and 1.8 million head in 1985), they will only have to grow from 7.5 million head in 2010 to 8.6 million head in 2020 and 9.0 million head in 2030 to meet all of China's milk product requirements (Table 1).

Dairy cattle are actually a small proportion of all animals in China, accounting for just 2.3 percent on an animal unit (AU) basis in 2000 (unpublished projections by Simpson, December, 2005).[1] That proportion is projected to increase moderately, to 4.3 percent by 2030 even though actual dairy cow numbers exhibit almost no increase. That is because the number of most other animals will actually decrease by then despite growth in per capita consumption of livestock products. The reason is great adoption of technology, improved management, and structural changes will take place in livestock production.

[1] Animal units are calculated by assigning a standard equivalent to each species (except poultry).

Animal feedstuffs are measured on an energy and protein basis. The latest projections by Simpson (unpublished, December 2005), as with previous ones extending back to 1990, reveal that protein based feedstuffs will increasingly have to be imported (explanation of the model and the last published projections are provided in Simpson and Li, 2004). Part of the additional imports will go to feeding dairy cattle. But the proportion of all animal requirements is relatively small, and will grow only 29 percent between 2010 and 2030, from 2.8 percent of the total to 3.6 percent. Total demand for protein will increase 63 percent over that period but, like the proportion of all animals, will still be just 3.6 percent in 2030.

Projections of energy based feedstuffs, on the other hand, reveal supplies will be sufficiently abundant that imports will not be required, even in 2030 despite significant increases in per capita consumption of animal products. Dairy cattle accounted for 1.5 percent of all China's animal and fish metabolizable energy (ME) requirements in 2000. Their proportion of the total is projected to increase to 2.4 percent by 2010, but then increase relatively slowly, to 3.5 percent of the total in 2030, which is a 45 percent total increase. The number of dairy cows is projected to only increase marginally because the size of dairy cows and their milk output increase dramatically. As a result, total ME requirements by dairy cattle are projected to increase 23 percent in the two decades between 2010 and 2030, from 47 million Mcal (one Mcal is one million calories) to 79 million Mcal. The total sounds large, but is relatively small within all requirements and will have little impact on China's ability to feed its animals.

Feedstuffs in the populous southern areas will be more expensive than in the maize and oilseed growing areas of the north-east, and some feedstuffs will be imported due to transportation cost differentials. However, domestically produced feedstuffs availabilities will not be a limiting factor in dairy production for the foreseeable future. By-products, non-conventional feeds and forages will continue to constitute a substantial portion of feedstuffs for dairy cows in much of China over the next decade, especially in the less populated areas. In brief, *technically* China can largely meet its energy based animal feed requirements without additional imports mainly due to a substantial proportion of ruminant feedstuffs derived from crop residues such as treated and untreated maize stalks, straw and other fodders.

It can be concluded that while drinking milk requirements can easily be met, and from a technical standpoint China could produce all it milk products, it will likely continue to be an importer of some processed products. For example, it is the biggest U.S. whey market by volume due to reduced tariffs from joining the WTO (Levitt, 2004). Some pundits such as Wesselink (2005) have even forecast the China might become the world's largest importer of whole milk powder, although that is questionable because, as Lu (2004) observed, processing infrastructure will improve and grow with "re-entry" of multinational corporations. FAPRI projects declines in imports (Appendix 1). That has indeed happened for, by early December 2005, New Zealand dairy exporter Fonterra announced that it had bought 43 percent of China's Shijaizhuang Sanlu Group dairy company (Japan Times, December 2, 2005). That is the largest investment ever by a foreign dairy company in China. It is particularly significant because Fonterra, the biggest marketer of dairy ingredients in the world is also the largest exporter of dairy products to China.

It is relatively easy to be carried away by news reports and short-term changes in production, infrastructure and demand. This section on China has focused on the fundamentals of production and longer term prospects to avoid that potential pitfall as they are the keys to determine the extent to which China can and will be able to compete internationally in dairy products. Those fundamentals are particularly critical to determining how China views its position on resolving conflicts regarding milk and other trade issues in the WTO negotiations—and how they feel about their food security over the longer term.

Structure and Production Cost of Milk in Japan and the United States

Japan's milk consumption and production situation is very different from that of China. Apart from slight increases in consumption of cheese, Japan's per capita consumption of dairy products has leveled off now that the aged make up a larger proportion, and children a smaller proportion, of the nation's population. In addition, total consumption of both fluid milk and manufacturing milk is flat now that the population has stabilized (Table 2). On the trade side, there has been very little growth in butter and cheese imports and none of other products (Appendix 1).

Japan, a very mountainous country with just 14 percent of its land designated as agricultural (compared with 59 percent in China and 45 percent in the United States) (FAOSTATS, 2005), has little comparative advantage in dairy production. One reason is its very high population density per ha of arable land (29 persons) compared to China (9 persons) and the United States (2 persons). These rates can be placed in perspective by relating them to the UK (10 persons) and the Netherlands (18 persons). Another reason is that Japan has little grazing land (298 persons per ha of permanent pasture) compared to 3 persons in China and 1 person in the United States.

Most of Japan's population is located on land suitable for agriculture. As a result, dairy farms have mainly evolved from total confinement operations located in areas that have increasingly urbanized, thus leaving producers with a myriad of environmental problems and little chance to expand farm size. Hokkaido, the northernmost island, and the center of milk production, has a relatively low population density, but its climate is quite cold necessitating a confinement system even if grazing land were available. Japan has little cropland and most feedstuffs are imported—and expensive. Transportation cost of milk to the large metropolitan areas is also high.

The dairy industry in Japan has undergone a significant restructuring process and, as part of it, farm numbers have declined significantly, from 82,000 operations in 1985, to 29,000 in 2004, a 65 percent decline (Table 8 and Simpson and Onoochi 2002). Of course, Japan has not been alone in restructuring. Dairy farm numbers in the US declined even more, 70 percent over this same period, from 269,000 units to 81,000 (USDA/NASS, 2005a). Economies of size are a very important reason for it, and the vast differences between the two countries are reflected in increased sizes of operations. In Japan, cows per farm expanded from an average of 16 in 1985, to 38 in 2004. But, by then, only 6 percent of United States' milk cow inventory was on farms in the 30-49 head size category—and 86 percent was on farms with 500 head or more (USDA/NASS 2005b).

Restructuring will continue to take place in Japan. As a result, the number of farms is projected to fall to between 21,000 and 23,000 in 2010 as yield per cow and the number of cows per farm increase (Simpson and Onoochi, 2002). That restructuring, which is highly touted both nationally and internationally as a solution will, unfortunately, provide virtually no assistance in improving Japan's competativeness in terms of lower milk production cost. This is because the base in farm size is so low that Japan cannot catch up with other major milk producing countries that have much larger farm sizes and very low feed costs. Obviously, Japan's milk production cost must be very high, and indeed it is for the nationwide average direct cost was \$0.62 per kg in 2003 (MAFF, 2004a, based on an exchange rate of \$1=¥110).

Ironically, the United States' dairy industry is at a crossroads as globalization is exerting great pressures on both domestic-oriented dairy industries and international market oriented companies to adapt to changing conditions (Blayney and Gehlhar, 2005). Average milk production cost in the US on medium size farms (50-200 cows) is \$0.24 per kg if only operating expenses are taken into account, and \$0.33 if ownership costs are also included (Short, 2004). In comparison, as described earlier, costs in China range between \$0.11 and \$0.19 per kg.

Multinational dairy companies such as Fonterra in New Zealand have long viewed the US as a trade opportunity—and not just because milk production costs in New Zealand are much lower, \$0.12 to \$0.15 per kg (ILRI, 2004). Foreign investment in the US led by the EU companies such as Nestle and Unilever, and now being followed by Fonterra of New Zealand, are pioneering a global dairy industry, largely by partnering with domestic dairy companies. The US is a significant dairy market both as an importer and exporter, and globalization provides it a potential export opportunities for some products such as dry milk powder (appendix 1). If there is further trade liberalization, prices for such products could lead to higher international prices and additional exports by the US.

Dairy policies around the world are changing primarily because of the Uruguay Round, but the change is also gradual and the tariff and tariff rate quota systems continue to constitute the core of many country's policies. For example, the United States has direct producer payments, price support on some dairy products such as butter, cheese and non-fat dry milk, subsidized exports of dairy products and federal milk marketing orders designed to stabilize milk prices. A major effort was supposed to be made in the current round of agricultural trade negotiations to reduce all of the type programs that make up the policies affecting US trade in dairy products. However, the effects of trade policies on the income of dairy farmers in the US are less clear than in the past as large global dairy companies increase tie-ups with dairy companies around the world. In brief, as Blayney and Gehlhar surmise, as global dairy markets evolve domestic policies to limit foreign competition will become less relevant. That may be the case for the middle cost type countries, but certainly is not the case for the very high cost ones like Japan.

Border Measures by China, Japan and the United States on Dairy Products

Dairy products are generally highly protected by nearly all countries, at least those that are importers, or could be importers, of them. One reason is that milk production is greatly affected by season in that yield per cow decreases in hot weather, and increases when it is cool. Another factor is that seasons affect feedstuffs production and availabilities. Drinking milk is perishable and consequently, because most countries will have surpluses at certain times of the year, they use them to make milk products such as cheese or powdered milk. Often those products can be produced at a much lower cost in other countries, leading to a country imposing tariffs or other trade barriers on imports of them.

The objective of this section is to provide an overview of border measures, and tariffs and quotas in particular, carried out by "The Three" to determine if they are "high" or "low" meaning the extent to which they serve to protect their dairy industries. Border measures are very complex as they include quotas, tariffs based on duties paid on imports within the quotas, duties paid on imports over the quotas, individual country determinations of value added taxes (VAT), whether the country has most favored nation (MFN) treatment, etc.

Table 5 reveals that the estimated mean tariff (comparison of actual effective rates for 2005) for all dairy products by China was 32 percent in 2005. China agreed to progressively reduce its tariffs on dairy products as part of its commitments to entering the WTO, and a report by the government (China, government of, CEI, 2004) indicates that the rates on all dairy commodities will fall to 10-15 percent at the end of the agreed period (not stated, but probably by about 2010).

The very high tariffs by Japan is evidenced by its mean for all commodities being 322 percent, and it's having 48 megatariffs, compared with 41 by the EU and 7 by the US. In comparison, the United States had a mean tariff rate on all dairy products of 43 percent at the end of the Uruguay Round in the Agreement on Agriculture (URAA) at which time it was 87 percent by the EU.

Tariffs for individual commodities, also given in Table 5, indicate that the rates for China's individual commodities are quite similar, 25.9 percent to 34.9 percent. Japan is very different by its having a myriad of different tariffs and quotas. Many countries, such as the United States, set their duties on a value basis such as $X per kg rather than on a percentage basis, which makes comparisons very difficult. For this reason the United States data on tariffs is not included in the table. It is apparent that while Japan in particular, and the US to a moderate extent, stand out as targets in agricultural trade negotiations, China is in a relatively good position because of privileges accorded it as a developing country, and its being well on its way to reducing its tariffs.

Conclusions

It can be concluded that China has a comparative advantage in milk production, and *technically* at least, probably will retain it for many years to come. Policy in China related to milk will probably focus heavily on seemingly mundane production aspects and quality assurance issues typical of a country developing very quickly, and relatively little on international problems. Japan is a completely different situation. It has a well developed milk industry, but farm size is small, ecological problems abound, and its extremely high production, transportation and processing costs leave it very vulnerable to outcomes of WTO and bilateral free-trade agreements. Japanese dairy producers feel particularly vulnerable, considering that Japan's direct cost of $0.62 per kg of milk produced is 2.6 times that of $0.24 in the US on medium size operations (derived from Short, 2004), and 3.8 times the $0.16 on the medium size operation described in Jilin province, China. Realistically, the cost of milk produced in Japan cannot be reduced enough to make it competitive no matter how much public funding is injected into restructuring efforts. Consequently, the only option open it for Japan to focus on non-trade concerns aspects as provided for in the URAA (Simpson, James R., 2005b; Simpson, James R., 2005c; Simpson and Schoenbaum, 2003).

Table 5. Tariffs on dairy products by China, EU, Japan and China, 2001 and 2005

Country and item	Units	Mean	Median	Number of Megatariffs	Effective rate	No quota rate	In-quota tariff	Over-quota tariff
China								
Fluid milk	Percent				34.9			
Powdered milk	Percent				29.9			
Yogurt	Percent				29.9			
Whey	Percent				25.9			
Butter & dairy spreads	Percent				29.9			
Cheese	Percent				31.9			
Japan								
Fluid milk	Percent						25	510
Powdered milk	Percent						30	68
Yogurt	Percent						-	-
Whey	Percent						25	134
Butter & dairy spreads	Percent						35	119
Cheese	Percent					29.8		
China (estimated)								
Dairy, all commodities	Percent	32						
Japan								
Dairy, all commodities	Percent	322	227	48				
EU								
Dairy, all commodities	Percent	87	70	41				
United States								
Dairy, all commodities	Percent	43	38	7				

Sources: China by commodity, USDA foreign Agricultural Service GAIN Report Number CH 5075, 10/20/2005. Tariffs are for 2005.

Japan by commodity, Obara, Kakuyo, John Dyck, and Jim Stout, *Dairy Policies in Japan* , USDA/ERS Report LDP-M-134-01, August, 2005. Note: there are variations depending on the commodity. Tariffs are for 2003.

Dairy, all commodities, EU, Japan and the US from Gibson,Paul, John Wainio, Daniel Whitley and Mary Bohman, *Profiles of Tariffs in Global Agricultural Markets* , USDA/ERS, Agricultural Economic Report Number 796, January, 2001. Tariffs are bound rates set in the Uruguay Round Agreement on Agriculture.

China has largely avoided food related conflicts in WTO negotiations by essentially meeting its commitments established when it became a member. It is a low cost producer of agricultural products (Tuan, Francis C., Guoqiang Cheng and Tingjun Peng, 2001) and has no reason to be concerned about either the export or import sides of the issues, preferring to focus its energy on other issues and other conflicts such as its relations with Japan and the United States. Explanation of dairy industry structure in China, and production costs in “The Three,” is in itself very valuable to understand the dynamics taking place in global talks about agriculture, and where they fit in the global scheme of events. The next decade should prove to be a very interesting time concerning Asia's dairy product industries—and particularly evolution of conflicts between "The Three."

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Appendix 1. Dairy product production, consumption and net imports, China, Japan and the US, 1995-2014

Item	Units	1995	2000	2005	2010	2014
				Butter		
China						
Production	1,000 MT	75	82	97	112	122
Total Supply	1,000 MT	75	82	97	112	122
Consumption	1,000 MT	84	94	113	129	142
Net Imports	1,000 MT	9	18	15	16	19
Japan						
Production	1,000 MT	78	88	80	79	77
Total Supply	1,000 MT	120	117	106	107	105
Consumption	1,000 MT	93	84	88	90	91
Net Imports	1,000 MT	1	0	9	11	13
United States						
Production	1,000 MT	573	570	598	632	635
Total Supply	1,000 MT	610	581	626	646	650
Consumption	1,000 MT	538	579	623	653	663
Net Imports	1,000 MT	-63	9	18	22	27
				Cheese		
China						
Production	1,000 MT	185	206	236	262	281
Total Supply	1,000 MT	185	206	236	262	281
Consumption	1,000 MT	192	218	258	294	323
Net Imports	1,000 MT	7	12	22	32	42
Japan						
Production	1,000 MT	31	34	35	30	24
Total Supply	1,000 MT	41	49	50	45	39
Consumption	1,000 MT	183	239	255	275	291
Net Imports	1,000 MT	157	205	220	245	268
United States						
Production	1,000 MT	3,138	3,746	4,130	4,535	4,846
Total Supply	1,000 MT	3,336	4,028	4,471	4,880	5,192
Consumption	1,000 MT	3,254	3,815	4,251	4,664	4,982
Net Imports	1,000 MT	105	38,360	121	129	137
				Nonfat dry milk		
China						
Production	1,000 MT	35	58	76	104	120
Total Supply	1,000 MT	35	58	76	104	120
Consumption	1,000 MT	45	80	144	176	200
Net Imports	1,000 MT	10	22	68	73	80
Japan						
Production	1,000 MT	190	194	179	173	169
Total Supply	1,000 MT	216	228	269	263	259
Consumption	1,000 MT	282	235	213	213	209
Net Imports	1,000 MT	103	52	33	39	40
United States						
Production	1,000 MT	559	659	696	730	711
Total Supply	1,000 MT	619	787	1,048	1,331	1,226
Consumption	1,000 MT	413	340	402	443	472
Net Imports	1,000 MT	-165	-142	-160	-240	-274
				Whole milk powder		
China						
Production	1,000 MT	317	522	775	938	1,088
Total Supply	1,000 MT	317	522	775	938	1,088
Consumption	1,000 MT	328	563	910	1,048	1,165
Net Imports	1,000 MT	11	41	134	110	77
Japan	None reported					
United States	None reported					

Source: http://www.fapri.org/outlook2005/tables/15_Dairy.xls

Appendix 2. Costs and returns, medium size modern dairy farm, Gongzhuling, Jilin, China, 2004

Item	Cost or income	Percent
	US Dollars	
Investment		
Land	0	0.0
Constructions and buildings	180,723	22.5
Fences	0	0.0
Equipment and tools	6,024	0.7
Horses	108,434	13.5
Breeding animals	508,735	63.3
Total	803,916	100.0
Direct costs per year		
Purchased forage	42,220	17.0
Fertilizer	0	0.0
Concentrate	109,210	44.0
Salt	0	0.0
Minerals	1,388	0.6
Molasses	0	0.0
Other feedstuffs	35,566	14.3
Repairs & maintenance	9,639	3.9
Veterinary services	4,337	1.7
Veterinary products	6,506	2.6
Artificial insemination	4,337	1.7
Electricity	3,614	1.5
Gasoline and oil	2,892	1.2
Others, miscellaneous	1,446	0.6
Marketing costs	0	0.0
Labor		
Day & permanent	22,939	9.3
Foreman & administration	3,036	1.2
Land rental	843	0.3
Total direct costs	247,974	100.0
Other costs per year		
Ownership costs		
Depreciation	20,482	10.2
Taxes	0	0.0
Insurance	205	0.1
Subtotal	20,687	10.3
Family labor	4,337	2.2
Capital costs		
Land	0	0.0
Constructions and equipment	59,036	29.4
Breeding stock	101,747	50.7
Operating costs	14,878	7.4
Subtotal	175,662	87.5
Total other costs	200,686	100.0
Total all costs	448,659	

Source, Simpson, et. al., 2005

(continued)

Appendix 2. Income and cost per kg of milk produced, medium size modern dairy farm, Gongzhuling, Jilin, China, 2004 (continued)

ITEM	Cost or income	Percent
	US Dollars	
Annual income		
Milk	210,800	71.1
Cull animals	9,108	3.1
Calves	76,432	25.8
Manure	0	0.0
Total	296,340	100.0
Income per year above:		
Direct production costs	48,367	
Direct production costs and ownership costs	27,680	
Direct production, ownership and family labor costs	23,343	
Direct production, ownership, family labor and capital costs	-152,319	
Annual net income per cow in inventory above:		
Direct production costs	253	
Direct production costs and ownership costs	145	
Direct production, ownership and family labor costs	122	
All costs	-797	
Cost per kg of milk produced		
Direct production costs	0.16	
Direct production costs and ownership costs	0.18	
Direct production, ownership, family labor and capital costs	0.18	
All costs	0.35	
Direct costs as a percent of all costs		55.3

Source, Simpson, et. al., 2005