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Title: A Component Methodology to Assess The Impact of Protein Imports on the U.S. Dairy Industry

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Abstract

This paper provides an assessment of the protein content of U.S. trade in dairy products and their potential impact on U.S. milk prices. The protein in imports of MPC, Casein & Albumins accounted for 5-6 percent of protein in total U.S. consumption during the period 1997-2002.

Introduction

The objective of this paper is to provide an assessment of the protein content of U.S. trade in dairy products and their potential impact on farm-gate milk prices. More specifically, this analysis will focus on:

1. A new method to track protein use throughout the U.S. dairy industry
2. Possible impacts of protein imports on farm-gate milk prices, and
3. The relationship between Milk Protein Concentrate (MPC) imports and removals under the Dairy Price Support Program (DPSP).

There is a great deal of misinformation in the public domain regarding how to quantify dairy imports entering U.S. borders and assessing its impact on farm-gate milk prices. This is the case with imports of Milk Protein Concentrates (MPC). A common mistake is to add up the metric tons of MPC imports during a particular period of time, convert them

to an equivalent volume of raw milk, and compare this volume of milk to overall supply and demand for milk.

There are a number of problems with this methodology. First, one may have poor information regarding the amount of protein, milkfat and other dairy solids contained in these imports. Second, the conversions used to compute an equivalent volume of raw milk (milk equivalent conversions) are notoriously inaccurate. The actual conversions may not properly distinguish the volume of milk between casein, a high protein product, and skim milk powder, a lower protein product. At the very least, milk equivalent conversions from dairy commodity to raw milk are misleading since MPC imports, for example, do not contain the lactose and milkfat that are implied when using these conversions.

USDA has not offered an adequate approach to presenting dairy trade information in a consistent manner so as to allow the industry to quantify its impact on supply and demand. As of this writing, the only sources of information we could find regarding dairy trade was from the Economic Research Service (ERS) and the Foreign Agriculture Service (FAS) of USDA. The ERS report as of October 28, 2003 showed imports of milk on a milk equivalent, milkfat basis, as well as imports of total solids and milkfat. It also showed imports of American Cheese, Other cheese, butter, and skim milk powder (nonfat dry milk). Thus one cannot gleam useful information from this data regarding the impact protein imports of specific dairy products like MPC or casein would have on the overall supply and demand for milk and dairy products. In fact, it appears that ERS does not

explicitly reflect MPC or casein, or butter blends for that matter, in their supply and demand schedules.

The FAS also provides trade information for the dairy industry. However, as of this writing the report, "Dairy: World Markets and Trade" only provided imports for select categories of dairy products during the period January through May, 2003.[1] Not only was the data out of date, but the only consistent aggregate measure of imports and exports available from the FAS were in U.S. dollar figures. Thus one cannot look at these reports and assess the implications of trade on the U.S. market. Thus a lack of adequate market data and analysis by USDA has not helped the industry, particularly dairy farmers, understand the implications of increasing imports on farm-gate milk prices.

Methodology

In this paper we propose an alternative methodology for analyzing trade in dairy products. This method will be published in a forthcoming edition of the ***Journal of Dairy Science***.[2] In short, this method first assesses the percentage of actual dairy content in individual trade items, converts them to metric tons, and then computes the component content of the dairy portion of the trade item in terms of protein, milkfat, and other dairy solids. The protein measure used is for crude protein. This methodology deals with the final traded product and provides a uniform methodology for aggregating imports and exports. It also has the flexibility of adding new Harmonized Tariff Schedule (HTS)

[1] As of this writing, trade data through September 2003 was available.
[2] See http://www.adsa.org/jds/ .

codes as new trade items with significant quantities of dairy components enter U.S. trade channels.

The approach used in this paper accounts for all imports and exports on a component basis. It employs a "mass balance" approach that simply accounts for the major components of milkfat, protein, other dairy solids and moisture in finished dairy products. Such an approach traces the sources and uses of elements, nutrients, or dairy components through an entire system. A mass balance approach has been used in the literature for recycling, environmental pollution, and waste water systems. This approach can be useful for analysis of the dairy industry since it has the potential to trace milk components from imports and domestic milk production throughout the entire U.S. dairy industry. Protein for example can be traced from imports through cheese processing and on to the final consumer. Our first stage in this study is to account for milk components in imports and exports. This is conceptualized as follows:

$$C_{bf} = \sum_i \beta_{bf}^i * X^i , \qquad [1]$$

$$C_{pr} = \sum_i \beta_{pr}^i * X^i , \text{ and} \qquad [2]$$

$$C_{os} = \sum_i \beta_{os}^i * X^i \qquad [3]$$

$$s.t. \sum_k \beta_k^i = 1 \qquad [4]$$

where C_k is the tons of components k (bf=milk fat, pr=protein, and os=other solids) in finished dairy imports and exports, X^i is dairy product i, and β_k^i is the percent of component k in dairy product i. In some cases, imports and exports may not be a 100 percent pure dairy product. That is the case for ice cream and chocolate block. In these cases, one should use the following identity,

$$C_k = \beta_k^i * X^i * \alpha^i \qquad [5]$$

where the tons of dairy component k are computed by first estimating α^i, the percent of dairy solids in product X^i, and then estimating the dairy components of the remaining product on a percentage basis. Note that in this case, β_k^i is the percent of dairy component k not in finished product i, but in the dairy solids contained in dairy product i.

Using this methodology, imports, exports and net trade were grouped into categories for 1997-2002 and are provided in Table 1. Note that the category descriptions encompass all trade that has a significant percentage of dairy components. The actual HTS codes used for each classification (for imports) are presented in Table 2. The categories aggregate a number of similar HTS codes. For example, the category "butter equivalents" is equal to the sum of milkfat contained in 5 different HTS codes divided by 0.82. That presents a U.S. butter equivalent measure of imports.

What's particularly useful about this methodology is that all trade in dairy items can be converted into a common base for analysis. In this case, that base is protein, milkfat and

other dairy solids. This concept is presented in Table 3. This method clearly illustrates that the U.S. is a net importer of protein and milkfat and a net exporter of other dairy solids (mainly lactose and whey). In fact, with regard to protein, we are importing more over time than we are exporting (see Figure 1). In other words, imports that contain protein are increasing over time relative to exports.

Accounting for Components in the U.S. Dairy Industry

Dairy imports enter the U.S. in one of two forms: either as a package product ready for consumption, or as an intermediate dairy product. The latter is used for further processing into other dairy products or food items. Some are also used for processing into industrial products (i.e. casein glue). Thus the supply of dairy components used for domestic processing of dairy products (excluding industrial and other food applications) comes from imports and domestic milk production. Domestically processed dairy products are then packaged into final dairy products, and in other cases are used as intermediary dairy products in still other dairy products or food items.

An example of the complexity of tracing milk component use throughout the U.S. dairy industry is processed cheese. Processed cheese begins with natural American cheese which is made from milk and other dairy ingredients such as skim milk powder and milkfat. The latter two ingredients could have been imported. Processed cheese is then made by combining American cheese and a source of milkfat and other protein dairy ingredients (i.e. whey protein concentrate, whey, skim milk powder, and or MPC) and other non-dairy ingredients. Some of the cheese and ingredients could also have been

imported. The mixture is then melted into a consistent liquid goo that forms the basis for processed cheese. The point is, in order to trace the supply and use of dairy components in products like process cheese, one must make assumptions regarding the dairy ingredients used, the percentage of the ingredients that were imported, and the degree of duplication of dairy components in the ingredients and finished product (i.e. don't double count the dairy components in the dairy ingredients and the processed cheese).

The method developed to account for the sources and uses of dairy components for the entire U.S. dairy industry was presented in pre-hearing brief submitted before the U.S. International Trade Commission (Bailey et al. 2003). This methodology first reconciles dairy component sources and uses in processed dairy products. It then estimates the use of components in government removals (CCC purchases and DEIP sales), ending commercial inventory, and exports. Domestic commercial disappearance is then computed as a residual. Raw data on supply and use for dairy products along with the coefficients were then used to estimate the supply and use for protein in the U.S.

Figure 2 indicates how protein was used in 2002 in the production of domestic dairy products. These figures are net of double counting in the processing of dairy products. It also assumes that protein not used for domestic dairy processing was used in other food processing. In Figure 2 one can see that more protein was used in the production of cheese than in beverage dairy products. The skim milk power use was net of powder used in other dairy products.

Table 4 provides an estimate of the supply and demand for protein in the U.S. During the period 1997-2002, U.S. marketings of protein rose an average 1.4 percent per year. Imports of protein rose an annual average of 5.3 percent. Thus total supply rose an annual average of 1.8 percent per year. Commercial disappearance, however, rose an average of just 0.9 percent, less than the rate of growth in the milk supply. In addition, the protein in government purchases of surplus dairy products (CCC purchases) rose from 6,764 metric tons in 1997 to 110,727 metric tons in 2002; an astonishing annual average growth rate of 256 percent per year. Exports, which reflect both commercial plus DEIP sales, rose an annual average of 3.8 percent per year.

Results

So, did imports of milk protein concentrates (MPC), Casein & Albumins drive farm-gate milk prices to record low levels in 2002? Again, to seriously answer that question, one needs an econometric model. However, a review of the data allows us to draw some conclusions. First, this special class of imports represents a very small fraction of all protein used in the U.S. This study shows that the protein in MPC, Casein & Albumins accounted for just 5-6 percent of protein either in farm milk production or total U.S. consumption. Using more recent data, the protein in this class of imports grew just 1,239 metric tons between 2001 and 2002, whereas the protein in U.S. milk marketings grew 64,054 metric tons. Cleary farm milk production had a much greater impact on the supply and demand balance in 2002 than did imports of MPC, Casein & Albumins.

Next, let's compare the protein in just MPC imports with the amount of protein used in cheese processing and the protein contained in total U.S. commercial disappearance. The protein contained in just MPC imports is very small when compared to either the overall protein produced in the U.S., the amount of protein that consumed in the U.S., or even the amount of protein that is used in the production of cheese. Thus one can draw the preliminary conclusion that the protein in MPC imports represents a significant number with regard to trade. However, the protein in MPC imports alone has had a very limited impact on farm-gate milk prices.

Between 1997 and 2002 the protein in MPC imports rose 8,938 metric tons. Government removals of protein in just skim milk powder under the Dairy Price Support Program (DPSP), however, rose 105,636 metric tons over this same period. This was offset by a decline of 15,744 in protein removals from U.S. markets under the DEIP program. Still, net government removals of protein from U.S. markets rose almost 90,000 metric tons between 1997 and 2002, nearly 10 times the amount of increased imports of protein in MPC.

If one argues that there is 100 percent substitution between MPC imports and skim milk powder in dairy and food processing in the U.S., than one can conclude that the rise in MPC imports had a one-to-one displacement with protein contained in domestically produced skim milk powder. Under that assumption, between 1997 and 2002 the rise in MPC imports resulted in a net gain of just under 9,000 metric tons of protein that went into the DPSP. That means the other 96,700 metric tons in increased protein purchases of

skim milk powder under the DPSP during this period had nothing to do with MPC imports.

If on the other hand one makes the argument that not all of the protein in MPC imports substitutes with domestically produced skim milk powder (i.e. 50 percent or less), than it becomes increasingly difficult to conclude that the growth in protein entering the DPSP during the period 1997-2002 had anything to do with MPC imports. Instead one reaches the conclusion that MPC imports filled a new and growing market niche for high dairy protein applications which could not be met with domestically produced skim milk powder.

Conclusions

The following conclusions are based on the analysis in this report.

1. It is inappropriate to look at imports of MPC alone and draw conclusions about U.S. trade in dairy products. A more appropriate methodology would be to view all trade on a component basis. That more thoughtful analysis will confirm that imports of dairy products have increased over time relative to exports. ***Thus the U.S. has become a net importer of high-value protein and milkfat (cheese, MPC, and dairy spreads/food preparations), and a net exporter of lower-value other dairy solids (i.e. lactose and whey). (see Table 3)***
2. ***USDA has not provided an adequate method of presenting imports and exports of dairy products in a manner that helps the industry understand its impact.*** Trade in dairy products is complex. What is needed is a new methodology that converts all trade into milk components (protein, milkfat and other solids). That methodology is presented here.
3. ***Domestic production of protein in the U.S. market is growing faster over time than domestic consumption.*** For example, over the period 1997-2002, marketings of protein in the U.S. rose an annual average rate of 1.4 percent. Commercial disappearance, however, rose just 0.9 percent over the same period. The difference between what was produced and what was consumed was diverted into the Dairy Price Support Program. The protein in all price support purchases

(mainly skim milk powder) rose 103,963 metric tons, or a whopping 1,537 percent, between 1997 and 2002.

4. ***The protein in imports of MPC, Casein & Albumins accounted for 5-6 percent of protein either in farm milk production or total U.S. consumption during the period 1997-2002.*** This is a significant number. However, to put it in perspective, the protein in this class of imports grew just 1,239 metric tons between 2001 and 2002, whereas the protein in U.S. milk marketings grew 64,054 metric tons.
5. Clearly farm milk production had a much greater impact on the supply and demand balance in 2002 than did imports of MPC, Casein & Albumins. ***Thus one can draw the preliminary conclusion that while significant, the protein in MPC imports alone has had a very limited impact on farm-gate milk prices.***
6. Between 1997 and 2002 net government removals of protein under the Dairy Price Support Program and the Dairy Export Incentive Program rose almost 90,000 metric tons. That is nearly 10 times the growth in protein in MPC imports over the same time period. Thus, assuming there is a 50-100 percent substitution rate between market use of imported MPC and domestically produced skim milk powder, ***we reach the conclusion that the growing volume of skim solids finding their way into the government price support program was only marginally related to growing MPC imports.***

References

Bailey, Ken, Grigorios Emvalomatis, and Zhen Wu. "Pre-hearing Brief Submitted to the U.S. International Trade Commission." Conditions of Competition for Milk Protein Products in the U.S. Market. Washington, DC. December 11, 2003.

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Table 1. Net Trade in U.S. Dairy Products, 1997-2002, Metric Tons

Trade Item	Data	1997	1998	1999	2000	2001	2002
Packaged/Bulk Milk	Imports	9,244	12,978	17,082	8,074	11,838	13,052
	Exports	44,995	33,342	18,820	23,991	26,499	23,634
	Net	-35,751	-20,365	-1,739	-15,917	-14,661	-10,583
Yogurt	Imports	163	910	316	1,739	2,638	2,743
	Exports	2,705	2,433	2,523	2,562	2,403	1,971
	Net	-2,541	-1,523	-2,206	-823	234	772
Ice Cream	Imports	1,365	3,244	16,234	9,151	6,685	7,794
	Exports	40,288	41,447	41,605	41,652	42,356	39,272
	Net	-38,923	-38,203	-25,371	-32,501	-35,672	-31,478
Butter Equivalent[1]	Imports	12,195	38,773	29,342	24,529	66,454	59,609
	Exports	15,785	9,660	3,432	9,499	4,109	4,097
	Net	-3,590	29,113	25,911	15,029	62,345	55,512
Cheese	Imports	141,485	168,430	197,597	188,703	201,771	215,706
	Exports	37,559	36,723	38,341	47,760	52,366	53,909
	Net	103,926	131,707	159,257	140,943	149,405	161,797
Concentrated Unsweetened Milk[2]	Imports	1,284	421	895	1,748	3,226	1,963
	Exports	5,492	2,763	1,003	1,166	3,868	4,166
	Net	-4,208	-2,342	-108	582	-642	-2,203
Sweetened Condensed Milk[3]	Imports	1,772	4,728	7,177	8,613	8,983	10,088
	Exports	3,856	5,258	3,818	4,049	6,805	7,658
	Net	-2,083	-530	3,359	4,564	2,178	2,431
Skim Milk Powder	Imports	3,057	4,957	5,732	4,231	3,889	6,828
	Exports	67,751	80,791	148,536	102,436	118,950	100,710
	Net	-64,694	-75,833	-142,805	-98,205	-115,061	-93,882
Whole Milk Powder	Imports	3,022	3,266	4,826	4,286	4,176	4,587
	Exports	42,990	43,442	10,434	7,195	23,201	11,491
	Net	-39,968	-40,176	-5,609	-2,909	-19,026	-6,905
Lactose	Imports	672	1,287	2,597	4,346	5,253	4,489
	Exports	82,161	75,711	80,236	99,550	126,835	118,224
	Net	-81,489	-74,425	-77,638	-95,205	-121,582	-113,735
MPC/Casein Equivalent[4]	Imports	122,335	140,356	147,997	168,343	137,052	138,428
	Exports	6,854	10,099	9,642	10,528	9,977	8,944
	Net	115,481	130,257	138,355	157,815	127,075	129,484
Whey Equivalent[5]	Imports	4,644	7,593	7,415	10,488	13,779	15,412
	Exports	112,848	113,249	131,520	176,231	159,147	168,798
	Net	-108,205	-105,656	-124,105	-165,743	-145,369	-153,386
Dry Buttermilk	Imports	266	125	141	83	498	129
Infant Formula	Exports	32,783	28,549	29,875	31,960	27,199	26,982
Chocolate Block	Imports	23,772	29,234	39,616	50,935	85,620	95,241

[1]Butter equivalent, 82% butterfat. [2] HTS 0402.91.00. [3] HTS 0402.99.00. [4] Assumes 90% protein. [5] Assumes 82.3% other dairy solids.

Table 2. Harminized Tariff Schedule Numbers for Dairy Trade Analysis

Trade Category	HTS Numbers
Packaged/Bulk Milk	0401.10.00 0401.20.00 0401.30.00
Yogurt	0403.10.00
Ice Cream	2105.00.00
Butter Equivalent	0405.10.00 0405.20.00 0405.90.00 2106.90.64 2106.90.66
Cheese	0406.10.00 0406.20.00 0406.30.00 0406.40.00 0406.90.00
Concentrated Unsweetened Milk	0402.91.00
Sweetened Condensed Milk	0402.99.00
Skim Milk Powder	0402.10.05 0402.10.10 0402.10.50 0402.21.02 0402.21.05 0402.21.25
Whole Milk Powder	0402.21.27 0402.21.30 0402.21.50 0402.21.90 0402.29.05 0402.29.10 0402.29.50
Lactose	1702.11.00 1702.19.00
MPC/Casein Equivalent	3501.10.10 3501.10.50 3501.90.60 3501.90.20 3502.20.00 3502.90.00 0404.90.10 0404.90.70
Whey Equivalent	0404.10.11 0404.10.15 0404.10.20 0404.10.48 0404.90.30 0404.90.50 0404.90.70 0404.10.05
Buttermilk/Sour Cream	0403.90.00
Infant Formula	1901.10.10
Chocolate Block	1806.20.20.90

Table 3. Net Trade in Dairy Components, 1997-2002, Metric Tons

Trade Item	Data	1997	1998	1999	2000	2001	2002
Protein	Imports	148,938	174,208	190,968	209,234	188,829	196,072
	Exports	73,608	82,320	97,804	89,062	99,170	90,333
	Net	75,330	91,888	93,165	120,172	89,659	105,739
Milkfat	Imports	66,512	101,088	107,981	100,108	143,410	143,221
	Exports	40,750	35,049	29,820	39,142	39,819	38,755
	Net	25,762	66,039	78,160	60,966	103,591	104,466
Other Solids	Imports	30,058	43,474	55,377	65,290	72,832	79,684
	Exports	274,210	273,461	309,954	340,194	373,147	354,003
	Net	-244,152	-229,987	-254,577	-274,904	-300,315	-274,319

Figure 1. Protein Content of Monthly U.S. Dairy Trade, Metric Tons

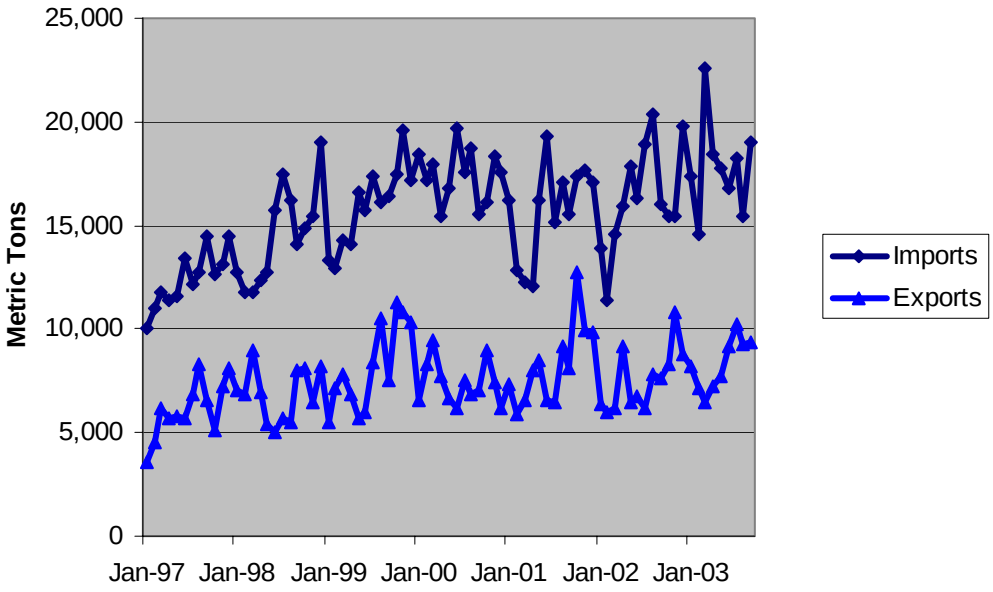

Figure 2. Net Protein Used for Dairy Processing, 2002
2,451,649 metric tons

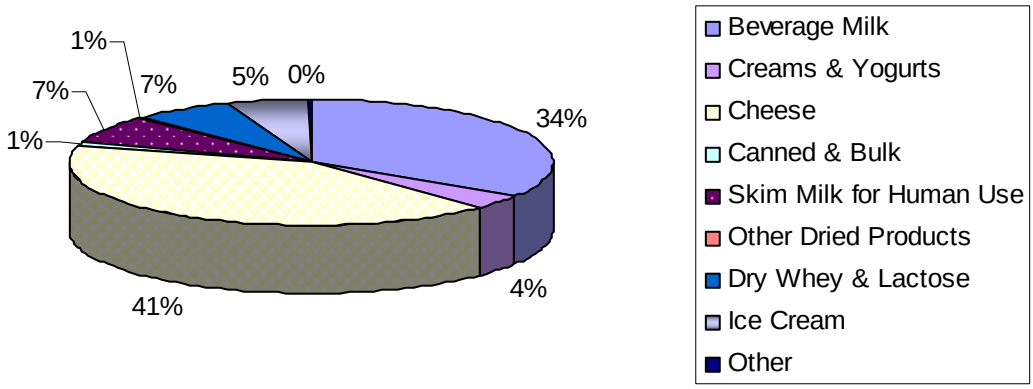

Table 4. U.S. Supply and Demand for Protein, 1997-2002, Metric Tons

	1997	1998	1999	2000	2001	2002
Marketings	2,260,420	2,272,954	2,350,869	2,420,828	2,392,428	2,456,482
% Change in Marketings		0.6%	3.4%	3.0%	-1.2%	2.7%
Beginning Commercial Stocks	69,239	74,222	71,238	98,550	106,146	96,920
Imports	148,938	174,208	190,968	209,234	188,829	196,072
Processing/Transportation Losses	22,921	23,098	23,905	24,653	24,292	24,932
Total Supply	2,455,676	2,498,285	2,589,171	2,703,959	2,663,111	2,724,543
Ending Commercial Stocks	74,222	71,238	98,550	106,146	96,920	102,020
Price Support Purchases	6,764	16,110	38,860	93,411	57,938	110,727
Commercial & DEIP Exports	73,608	82,320	97,804	89,062	99,170	90,333
Commercial Disappearance	2,301,082	2,328,617	2,353,958	2,415,339	2,409,083	2,421,463
% Change Commercial Disappearance	NA	1.2%	1.1%	2.6%	-0.3%	0.5%